COVID19 CONTACT TRACER

A PROJECT REPORT PREPARED BY

K.R.A.L KAHATAPITIYA

S.T.I.C WIMLADHARMA

GAYAN PAMUDITHA LIYANAGE

M.A.S SANDARUWAN

LATHAGINI SIVARAJAH

W. M. R. P. K WEERASEKARA

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DECLARATION

We do hereby declare that the work reported in this project report was exclusively carried out by us under the supervision of Mr. P. M. P. C. Gunathilake, Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya. It describes the implementation and results of our project except where due reference has been made in the text. No part of this project has been submitted earlier or concurrently for the same or any other degree.

Date: .....

Signature of the Candidates

1. K.R.A.L Kahatapitiya (PGIS/CS/2020/21) …….
2. S.T.I.C Wimladharma (PGIS/CS/2020/40) …….
3. Pamuditha Liyanage (PGIS/CS/2020/44) …….
4. M.A.S Sandaruwan (PGIS/CS/2020/33) …….
5. S. Lathagini (PGIS/CS/2020/59) …….
6. W. M. R. P. K Weerasekara (PGIS/CS/2020/54) …….

Certified by:

1. Supervisor (Name): Mr. P. M. P. C. Gunathilake Date: .....

   Signature: .....

2. Supervisor (Name): …..... Date: .....

   Signature: .....

PGIS Stamp:

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LIST OF ABBREVIATIONS

IT – Information Technology

HTML – Hypertext Markup Language

CSS – Cascading Style Sheets

SQL – Structured Query Language

SDLC – System Development Life Cycle

PC – Personal Computer

IS – Information Systems

DBMS – Database Management System

EERD – Enhanced Entity Relationship Diagram

UI – User Interface

GUI – Graphical User Interface

AOP - Aspect Orient Programing

ORM - Object Relational Mapping

WHO - World Health Organization

CDC - Center for Disease Control

DCT - Digital Contact Tracing

PEPP-PT - Pan-European Privacy-Preserving Proximity Tracing protocol

CHAPTER 1

INTRODUCTION

Covid 19 has become a global pandemic since late 2019. Matter of fact Sri Lanka became a severe victim of the pandemic due to aggressively spreading different variants. Prevention is the only option remaining for Sri Lankans as the country exceeds all the healthcare thresholds by now. Currently the main challenge faced by both the healthcare officials and the citizens is to trace the positive patients and convey the locations they visited in the last two weeks with other potential contacts.

According to the World Health Organization (WHO), contact tracing is the process of identifying all people that a COVID-19 patient has come in contact with in the last two weeks [1]. It has been an impossible task for an infected person to remember all the locations he/she visited in the last two weeks, which leads to a complex contact tracing process. As a result of that, an infected patient may spread the virus in the community

Furthermore, accessing or tracing the personal records of a citizen is prevented and covered under the legislation of each county and protected by privacy policies of the same. Therefore, no authority can force a person to reveal his/her travelling history without a proper legal procedure. It has completely become the accountability of every citizen of a community to be self-aware about individuals' health and safety while taking the responsibility to prevent spreading the deadly virus in the society.

The main intention behind the proposed “Covid19 Contact Tracer” is to assist people to keep track of their own routing history and help healthcare officials to manage the positive cases and notify their close-contacts more effectively, efficiently and reliably.

The high-level view of the system is depicted in Figure 1, in which the main components and the users are mentioned.

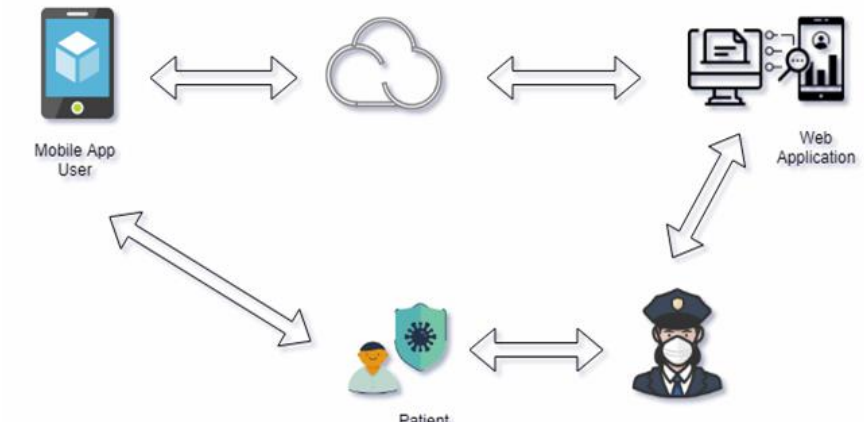

Figure 1: Proposed system in abstract view

CHAPTER 2

LITERATURE REVIEW

Covid 19 classified as pandemic on December 2019 and the first case reported on November 17th in the Wuhan, Hubei Province and novel coronavirus was eventually identified. (Organisation, 2020). World Health Organization issued a comprehensive package of technical guidance online with advice to all countries on how to detect, test and manage potential cases, based on what was known about the virus at the time and shared with WHO's regional emergency directors to share with WHO representatives in countries. Prevention should be based on proper patient identify mechanism and contract tracing is considered as more effective mechanism than any other (Organisation, 2020). Pandemic cause nearly billions of exposures for the date this article is written but fewer contact tracing in the Covid 19 system to be found. Center for Disease Control and Prevention United States (CDC) guidance for contact tracing use clear protocols to notify, interview, and advise close contacts to patients with confirmed or probable COVID-19. Further proceedings on Jurisdictions able to following guidance framework considerations while an establishment of protocol on tracing the close contacts (Prevention, 2021). Quarantine refers to the separation of individuals who may have been exposed to the virus but are currently pre-symptomatic or asymptomatic, and is distinct from isolation of symptomatic or confirmed cases.

Digital contact tracing introduced with hope of new technology will help of digital help of technology alongside contain spread of virus. Digital contact tracing systems mostly lunches using smartphone apps. This is the common technology used Bluetooth data exchange standards or else GPS. Which uses the proximity of installation of the application in the device. Proximity data can be used to infer the risk that two users might have been close enough and for a sufficient amount of time to infect each other with the SARS-Cov-2 virus. (Health Ethics and Policy Lab, 2021). The identification of contract tracing is the main mechanism to prevent spread of the pandemic which is identified with it.The key factor in Sri Lanka while rapid patient detection for appropriate quarantine mechanism with contact tracing for the prevention and control of COVID-19. Gathering timely and consolidate information is essential for efficiently implement these activities. A team of expertise in WHO, and technical experts in Epidemiology unit, western province, Ministry of Health in Sri Lanka worked to present a digital solution. A real-time web-based information dashboard and mobile application called Suwapetha. (Organisation, 2020). The main focus of the Suwapetha was in to the quarantine the identified patients. They haven't picked a proper mechanism of identing the contact tracing data other than the close contact of the patient. It was a downside of the system. Considering the DCT in other hand the patient may elect to notify some or all of their close contacts before the contact tracer. The identity of the patient or other identifying information will not be revealed, alluded to, or confirmed by the contact tracer, even if explicitly asked by a contact. Contacts can be notified through different channels such as phone, text, email, or in-person (if appropriate) in the primary language of the individual. Special consideration should be given to

ensure culturally and linguistically appropriate communications, if possible. The protocol should clearly outline the primary and secondary means of notifying a contact. Protocols should be in place to provide services to people who are deaf or who have hearing loss. Every effort should be made to interview the close contact by telephone, text, or video conference instead of in-person. The interview should be conducted in the individual's primary language (through interpretation services, if necessary). For in-person interviews, guidance on recommended infection prevention and control practices at a home or non-home residential setting can be found on CDC's Evaluating PUIs Residential page. Appendix C includes critical data elements that can be incorporated into a jurisdiction's form used to interview contacts to assess symptoms, better characterize their underlying risk for infection, and assess home and social factors that could impact compliance with self-quarantine. Notification of Exposure – A Contact Tracer's Guide for COVID-19 focuses on communication strategies for contact interviews and provides suggested language for each topic area covered in an interview (A James, 2021)

Purpose of the application is to supports healthcare professionals in the country to provide effective case management while acknowledge the general public by providing updated information on the COVID-19 situation. The major mechanism of collecting data is based on geo locations using data from the laboratory system and national and provincial health authorities. (Organisation, 2020). When it comes to contact tracing the World Health Organization is clearly indicating guidelines to trace out proper and effective mechanism. Initial identification through a patient by himself which probable COVID-19 should be notified of their exposure to the relevant authority as soon as possible (within 24 hours of contact elicitation). In the Europe the DCP application send al when alerts to the close contacts with considering the proximity data which recorded in the system. This alerted user is then isolated to prevent circulating of the virus further. Asian counties among the top of adaptation of the system which majorly hit with the pandemic. The public health potential of the system DCT is identified by the many European countries followed suit during the spring, developing national DCT systems in an attempt to expand their contact tracing capability. (Health Ethics and Policy Lab, 2021). Despite the promising potential of DCT, its introduction gave rise to intense debate over ethical, legal, and societal implications (ELSI). In particular, some characteristics of the Asian approach (mandatory use, centralized protocols, GPS- or cell tower-based geolocation) are seen by many as incompatible with European legal provisions and ethical views about the value of individual privacy.

CHAPTER 3

REQUIREMENT ENGINEERING

Although "Covid 19 Contact Tracer" is yet another web-based application, it comes with a significant number of prominent features and functions which can be distinguished from existing systems. There are plenty of studies conducted to assess the adoption of such contact-tracing apps among the general public because lower usage of the apps prevents them from functioning at the maximal potential. The major concern of the users is the security/privacy risks over the health benefits they get from the app1.

The proposed system development follows a combination of incremental and iterative software development models due to considerable feasibility factors such as time constraints and limitations of human resources. Therefore, the development process was broken down into manageable portions.

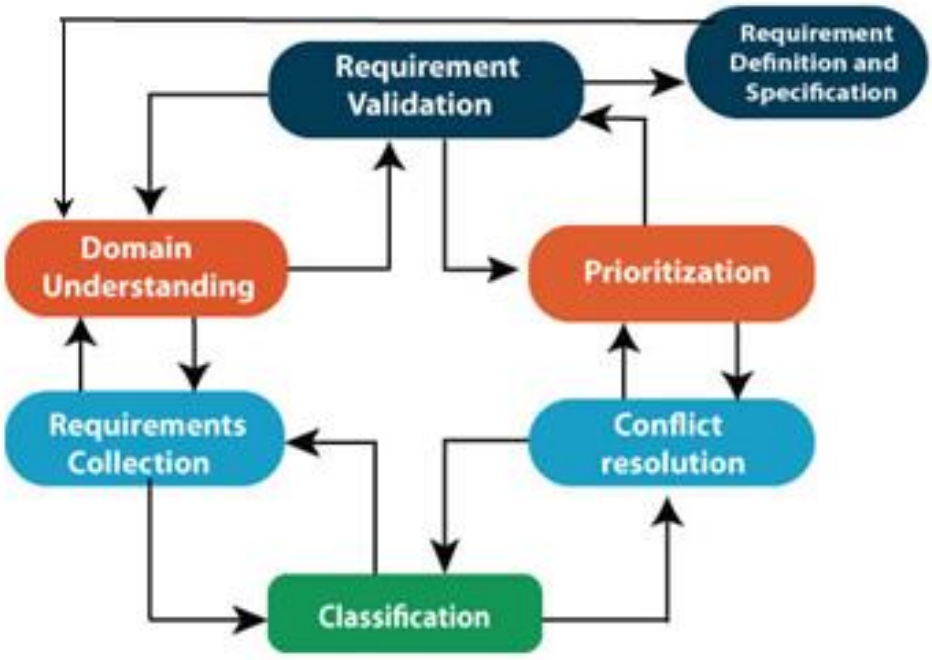

Figure 2: Requirement Engineering Process

1 Li, T., Cobb, C., Yang, J. (Junrui), Baviskar, S., Agarwal, Y., Li, B., … Hong, J. I. (2021). What makes people install a COVID-19 contact-tracing app? Understanding the influence of app design and individual difference on contact-tracing app adoption intention. Pervasive and Mobile Computing, 75, 101439. doi:10.1016/j.pmcj.2021.101439

3.1. Feasibility Study

The main concern of the proposed application was to ensure user acceptance, since such systems are directly influencing an individual's privacy. According to the usability statistics and analysis reports from the countries which are using contact-tracing apps, most of the users are reluctant or refuse to use apps because they believe that those apps are threatening their privacy and data. "Covid 19 Contact Tracer" highly values the privacy and data protection of a user therefore, sensitive data such as location history and date, time and duration of a stay at a place of a user is recorded anonymously. That is, the user identity is completely discarded.

When considering the technical feasibility, the available technologies confirm that the application development process can be initiated with state-of-the-art techniques and tools. Github (github.com) was selected as the project/task management tool whereas Slack (slck.com) is the business communication platform throughout the application development lifecycle.

"Covid 19 Contact Tracer" application development team is a voluntary non-profit group of developers and designers affiliated with the Postgraduate Institute of Science, University of Peradeniya, Sri Lanka. The primary intention of the team is to contribute to the community to suppress the deadly virus and its drastic spread. Therefore, the economic feasibility of the initial stages of the lifecycle has not been a constraint, i.e. the economic feasibility of the application is confirmed.

3.2. Product Perspective

"Covid19+ve Contact Aware App" is a web-based application to help authorities to manage positive covid19 cases up to the level of Grama Niladhari (GN) division, with an optional mobile application for general users to look back their steps in past days and to be notified about the potentially risk places they visited in the last week with respect to their present locations (GN divisions).

System maintains a database where the necessary details of a patient (covid19 positive patient) are recorded and updated for two weeks from the day reported until he/she gets a negative test result. Just after an authorized officer (e.g. Public Health Inspector) registers and updates a record of a patient, a summary of the places, where the patient visited within the last 5 days, is generated.

A recognized user-level hierarchy is employed in the system to filter records and generate the reports when requested. For instance, descriptive details to the overview cases in each GN to MOH or District to Provincial level can be produced to assist the decision makers to make rational decisions.

The system is capable of producing textural and/or graphical outputs that can be used to make decisions in GN or district level isolation or lockdown (area fusing), imposing inter-provincial

travel restrictions, and other important criteria defined and implemented by the director general of health, Sri Lanka2.

3.3. Requirement Gathering

Requirements are mainly identified based on the existing applications, client's specifications and monitoring the operations in real world business processes. There were regular one-on-one interviews with the client to collect necessary information to define the requirements while a pre-arranged stakeholder meeting was held to define the business process in the context of contact tracing, treatment and isolation or quarantine. In the business analysis process, public health inspectors (PHI) and doctors of MOH participated.

Basically, the underlying business logic was defined based on the existing contact tracing applications introduced by most of the developed countries such as New Zealand3, Australia4 and Norway5. Moreover, COVID-19 related information sources from the ministry of health, Sri Lanka6, Epidemiology Unit, Ministry of Health, Sri Lanka, and National COVID19 Surveillance System of Sri Lanka, Ministry of Health, Sri Lanka were regularly referred to and strictly followed when defining requirements and procedures.

Additionally, brainstorming techniques were also used to identify possible solutions to problems, and clarify details of opportunities. User stories were created based on the requirements gathered from different means.

3.4. Requirement Specification

Once the requirements are gathered based on the aforementioned techniques and various sources including the client's definitions in natural language, a list of primary and mandatory requirements for a Covid-19 contact tracing application are technically specified as below.

3.5. Functional Requirements

The initial version of the application supports three user levels with different privileges, administrator, PHI and general user. Each has a different set of unique functionalities as well as common functions. In addition to the main roles in the current version, there is a provision for additional user types as well.

The administrator should be able to do the following functions:

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2 The epidemiology unit, Sri Lanka: https://www.epid.gov.lk/web/ [Accessed on 07-09-2021]

3 NZ COVID Tracer app: https://www.health.govt.nz/our-work/diseases-and-conditions/covid-19-novel-coronavirus/covid-19-resources-and-tools/nz-covid-tracer-app

4 COVIDSafe app: https://www.health.gov.au/resources/apps-and-tools/covidsafe-app

5 Smittestopp: https://www.loc.gov/item/global-legal-monitor/2020-05-06/norway-government-launches-mobile-app-to-track-and-stem-spread-of-covid-19/

6 http://www.health.gov.lk/

- Add user
- Add role
- Assign user role
- Add GN
- Add DS
- Add district
- Add location
- View places
- Manage GN
- Manage DS
- Manage district
- Generate reports
- Login
- Change password
- Edit profile
- Logout

The PHI should be able to perform the following tasks:

- Add person
- Add location
- Manage GN
- Generate reports
- Login
- Change password
- Edit profile
- Logout
- Manage location
- Edit infected turn
- Infected turn management

The general user is the one who visits the application without authentication. He has the access to the following function:

- View recent places

In addition to the primary user levels, some of the above functional requirements are dependent on external systems/services namely Mobile app, Map API and Google location. They are associated with the following functions:

- Add location
- View recent places
- Login

Following use case diagram depicts the dynamic aspect of the application with respect to internal and external user roles and interaction. Mobile app is an extended module of the system. Google location service is one of the main external services included in the system. Though the actor Map API is also an external service the system is depending on, the geographical information services are not employed in the current version of “Covid19 contact tracer” application.

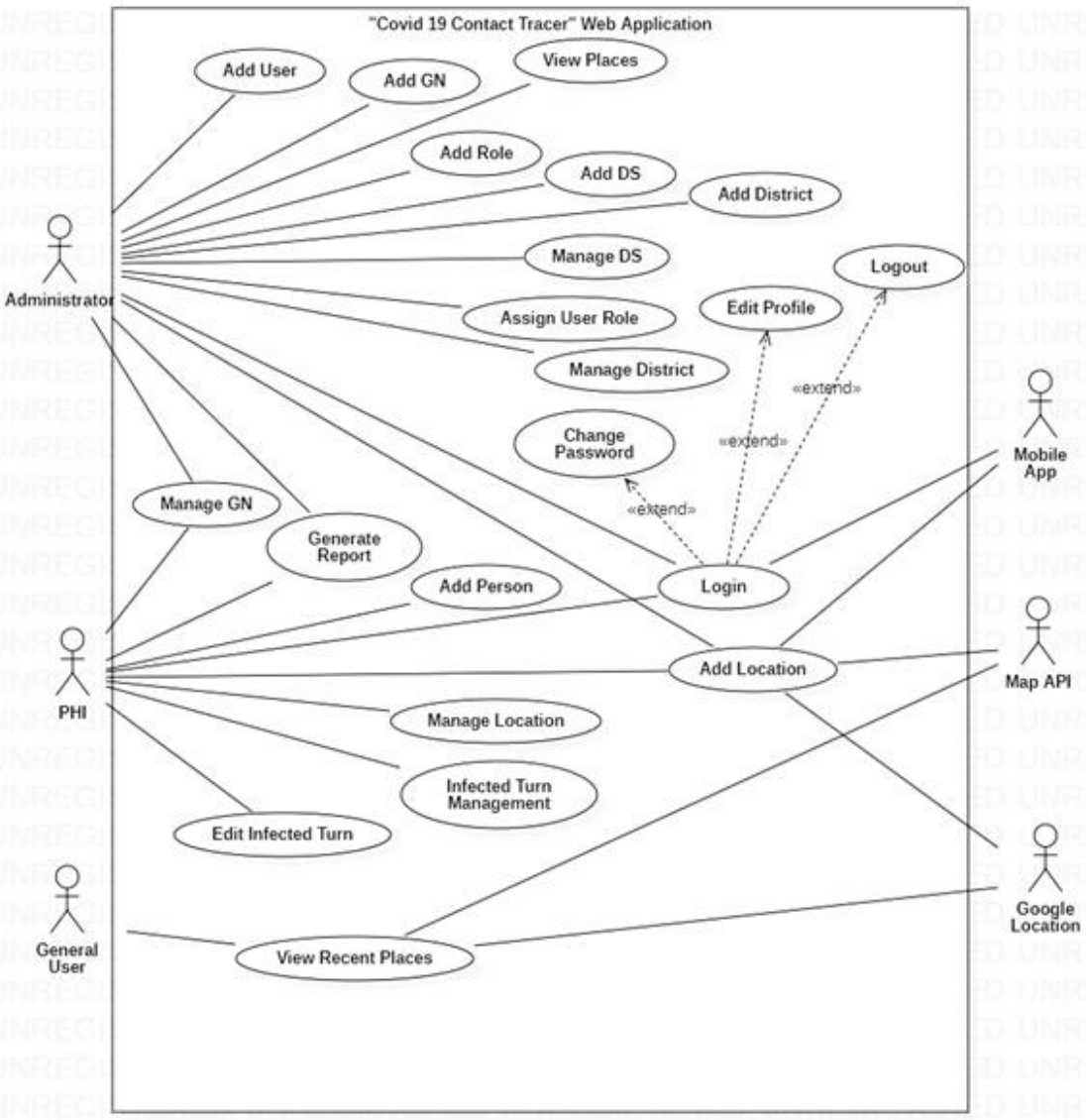

Figure 3: Use Case diagram for functional requirements

3.5.1. Use Case Description for Administrator and PHI

Table 1: Use case description for the login process

Use Case Name	**Login**	
Use case description	User login into the system to access the functions	
Actor(s)	Administrator, PHI	
Pre-Condition	System must be online and user must be pre-registered	
Post-Condition	Upon a successful login user is directed to the system functions	
Main Scenarios	**Serial No**	**Steps**
Actors	1	Enter username Enter password
	2	Validate username & password
	3	Allow access to system
Extensions	1a	Invalid username System shows an error message
	1b	Invalid password System shows an error message

Table 2: Use case description for report generation

Use Case Name	**Generate Reports**	
Use case description	System generates reports based on the user selection	
Actor(s)	Administrator, PHI	
Pre-Condition	User must be logged in to system, user must select the duration ("from" date to "to" date)	
Post-Condition	Upon success a report is generated by system	
Main Scenarios	**Serial No**	**Steps**
Actors	1	Select 'from' date by date picker Select 'to' date by date picker
	2	Upon success a report is generated by system
Extensions	1a	Without a correct date range or no date range is selected, error popups appear.

Table 3: Use case description for add location process

Use Case Name	**Add Location**	
Use case description	Add a location where a covid positive patient visited	
Actor(s)	Administrator, PHI	
Pre-Condition	User must log in to system	
Post-Condition	Redirect to the list of locations already recorded	
Main Scenarios	**Serial No**	**Steps**
Actors	1	Enter GN division Enter location name
	2	Validate data
	3	Upon success new location is inserted to system
	4	Loads the list of locations in the system
Extensions	1a	Upon invalid data formats system pops up warning message preventing update

Table 4: Use case description to manage GN division

Use Case Name	**Manage GN Division**	
Use case description	Edit/Update Grama Niladhari Division details to system	
Actor(s)	Administrator, PHI	
Pre-Condition	User must log in to system	
Post-Condition	List the available GN division data with the updates made	
Main Scenarios	**Serial No**	**Steps**
Actors	1	Edit (select) Province name Edit (select) District name Edit (select) Divisional Secretariat name Edit GND number Edit GND name
	2	Validate entries
	3	Upon successful edition GND details are updated
	4	Load the list of GND
Extensions	1a	Upon invalid data formats system pops up warning message preventing update

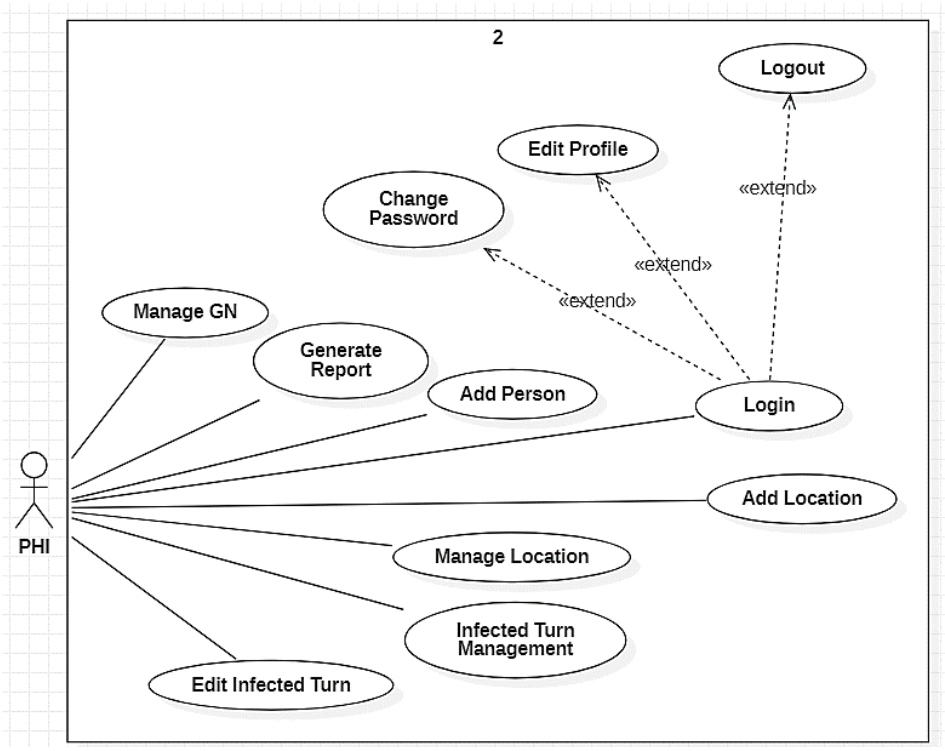

Figure 4: Use case diagram for PHI

3.5.2. Use Case Description for PHI

Table 5: Use case description for Add details of a new person

Use Case Name	**Add person**	
Use case description	Add details of a new person	
Actor(s)	PHI	
Pre-Condition	User must be logged in to system	
Post-Condition	Upon success, acknowledgement is shown by system	
Main Scenarios	**Serial No**	**Steps**
Actors	1	Enter NIC no. Enter Name Select gender Select date of birth Enter work place address Enter GN division Enter home address Enter mobile phone number
	2	Validate data
	3	Insert person data to system
	4	Upon success redirect user to person management
Extensions	1a	Upon invalid data formats system pops up warning message

Table 6: Use case description for Managing Location - View Process

Use Case Name	**Manage Location: View**	
Use case description	View selected ‘location interacted’ record	
Actor(s)	PHI	
Pre-Condition	User must log into system	
Post-Condition	List out the list of current ‘location of interact’	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Click on view
	2	Upon success display record of selected locations interacted

Table 7:Use case description for Managing Location - Edit Process

Use Case Name	**Manage Location: Edit**	
Use case description	Edit ‘location interacted’	
Actor(s)	PHI	
Pre-Condition	User must log into system	
Post-Condition	Update the selected ‘location of interact’	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Enter GND name Enter location name
	2	Update existing ‘location interact’ data

Table 8: Use case description for Managing Infected Turn - View Process

Use Case Name	**Manage Infected Turn: View**	
Use case description	View previous status of selected person	
Actor(s)	PHI	
Pre-Condition	User must log in to system Person data must be available in the system	
Post-Condition	Display status history of selected person	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Click on view
	2	Upon success display previous status and/or diagnosis record of selected person

Table 9: Use case description for Managing Infected Turn - Edit Process

Use Case Name	**Manage Infected Turn: Edit**	
Use case description	Edit infected turn related data Edit interact location related data	
Actor(s)	PHI	
Pre-Condition	User must log in to system Person data must be available in the system	
Post-Condition	Update details of selected person	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Enter identified date Enter remarks if any
	2	Enter visited location Select arrival time Select departure time

Table 10: Use case description for Managing Infected Turn - New Turn Process

Use Case Name	**Manage Infected Turn: New Turn**	
Use case description	Add new turn of infection to a selected person	
Actor(s)	PHI	
Pre-Condition	User must log in to system Person data must be available in the system	
Post-Condition	Status of a person is changed to infected Add visited locations to selected infected person	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Add identify date Add visited locations related to selected person
	2	Validate entry
	3	Update the status to infected and locations are added to system
Extension	1	Upon incorrect entry error messages are shown

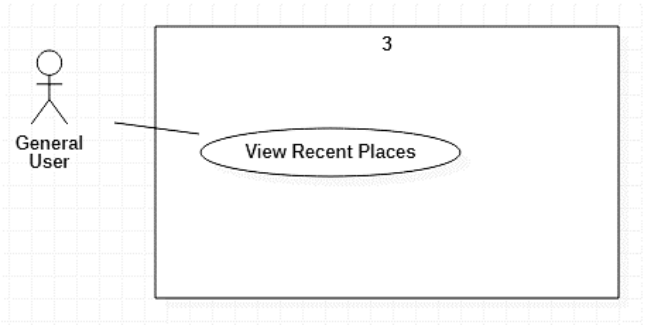

Figure 5: Use case diagram for General User

3.5.3. Use Case Description for General User

Table 11: Use case descriptions for View Recent Places

Use Case Name	**View Recent Places**	
Use case description	System displays a list of recent locations where infected person visited in selected GND Subscribe for SMS notification	
Actor(s)	General user	
Pre-Condition	Internet must be available System should be available	
Post-Condition	List of locations relevant to selected time duration and GND Successful subscription for notification	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Pick date/time range Enter GND name
	2	Validate entry
	3	Search records
	4	Enter GND for subscription Enter valid phone number
Extension	1	Upon invalid inputs, system shows error message

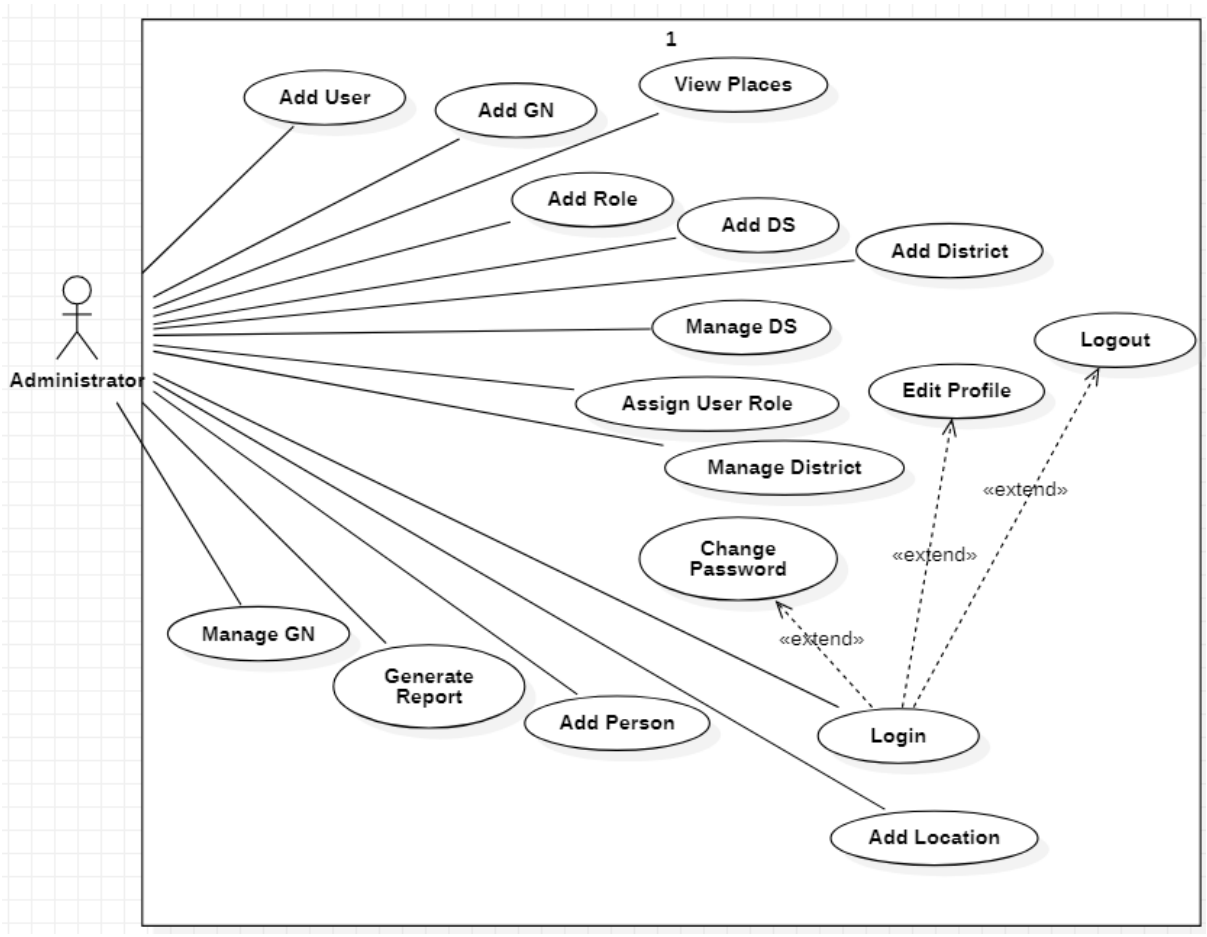

Figure 6: Use case diagram for Administrator

3.5.4. Use Case Description for Administrator

Table 12: Use case description for Manage Role - Add Process

Use Case Name	**Manage Role: Add**	
Use case description	User levels can be added to system	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	New user level (role) is added to system	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Enter role name
	2	Validate entry
	3	New role is added
Extension	1	Upon invalid entry system shows an error message

Table 13: Use case description for Manage Role - Edit Process

Use Case Name	**Manage Role: Edit**	
Use case description	User levels and access privileges can be edited	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Existing user level/role name is changed	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Enter new name
	2	Validate entry
	3	Update role name
Extension	1	Upon invalid entry system shows error message

Table 14: Use case description for Manage Role - Delete Process

Use Case Name	**Manage Role: Delete**	
Use case description	Existing user role is deleted from system	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Remove user role from system	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Select user role to remove/delete
	2	Remove role from system

Table 15: Use case description for Manager User - View Process

Use Case Name	**Manage User: View**	
Use case description	System user details are listed	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Existing system user details are listed for selected user	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Click on view button of selected system user

Table 16: Use case description to Add User

Use Case Name	**Add User**	
Use case description	Add user details to system	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Add new user details to system	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Select title Enter name Enter preferred name Enter NIC number Select gender Pick date of birth Select a photograph Enter Address Enter mobile phone number Enter secondary mobile phone Enter fixed line phone number Enter email Enter official email
	2	Validate all entry with standard formats
	3	Upon valid entry new user details are added to system
Extension	1	Upon invalid data entry system shows error message

Table 17: Use case description for Manager User - Edit Process

Use Case Name	**Manage User: Edit**	
Use case description	Existing system user details are edited	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Existing system user details are edited/updated	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Select enable/disable Enter password Select user role/roles
	2	Upon valid entry system user is updated
Extension	1	Upon invalid password/empty password system shows error message

Table 18: Use case description for Manage User - Disable

Use Case Name	**Manage User: Disable**	
Use case description	Selected system user is disabled	
Actor(s)	Administrator	
Pre-Condition	User must login to system	
Post-Condition	Disabled system user is no longer valid for use	
Main Scenarios	**Serial No**	**Steps**
Actor	1	Click on disabl button of selected system user

3.6. Non-Functional Requirements

There is an important and increased interest in non-functional requirements of applications used for contact tracing of infected patients in the context of COVID-19 epidemic. Those non-functional requirements mainly include the security of application users (or public safety), privacy impacts, and data protection. Primarily, the concept of "Contact Tracing" application possibly involves a number of risks due to the contact and health data collected and stored in a database.

With privacy as one of the main concerns, the proposed system ensures user privacy by anonymization of an individual's details. Especially the location history of a person (possibly a patient) is recorded without disclosing the identity. Therefore, no identification is visible to the other users.

Information integrity plays a significant role in the success of the "contact tracing" concept. Though the accuracy, reliability, and consistency of information are vital, only minimal data or metadata required for the application is stored upon the user's consent.

As a non-functional requirement, the evolution quality of the application is achieved by introducing the extensibility, scalability and maintainability. That is by the completion of the first phase of development, a provision to scale and extend the application scope is adopted.

CHAPTER 4

APPLICATION MODELLING

4.1. Spring Boot Architecture

Spring Boot is an advanced version or project of the Spring framework. Along with the Spring framework, it also consists of third-party libraries and Embedded HTTP servers. It easily creates a production-grade, less time-consuming, and stand-alone applications based on the Spring framework.

The aim of Spring Boot is to completely remove the use of XML-based and annotation-based configuration in the applications. Using Spring Boot, we can also create an application with minimal fuss (less time and effort). By default, it offers most of the things, such as functions, procedures, etc.

In this tutorial, we are going to learn about the architecture of the Spring Boot framework. It follows the layered architecture and consists of four layers, as shown below.

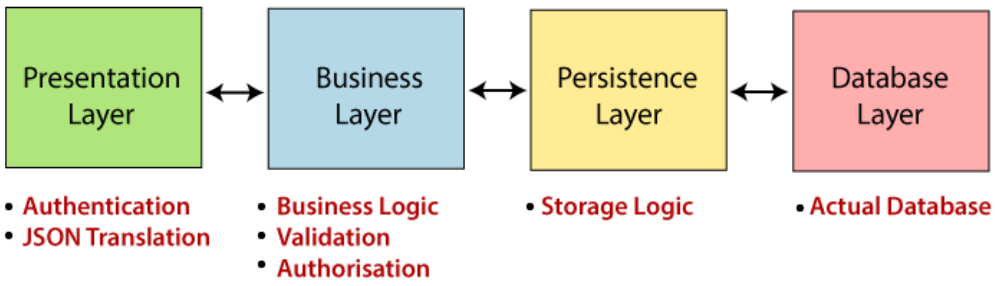

Figure 7: Spring boot framework

3Presentation Layer

It is the front layer or top layer of the architecture, as it consists of *views*. It is used to translate the JSON fields to objects and vice-versa, and also handles authentication and HTTP requests. After completing the authentication, it passes it to the business layer for further processes.

1. Business Layer

   It handles all the business logic and also performs validation and authorization as it is a part of business logic. For example, only admins are allowed to modify the user's account.

2. Persistence Layer

   It contains all the storage logic, such as database queries of the application. It also translates the business objects from and to database rows.

3. Database Layer

   The database layer consists of the database such as MySQL, Postgre, MongoDB, etc. It may contain multiple databases. All the database related operations like CRUD (Create, Read/Retrieve, Update, and Delete) are performed in this layer.

4.2. Spring Boot MVC

Spring is widely used for creating scalable applications. For web applications Spring provides Spring MVC framework which is a widely used module of spring which is used to create scalable web applications. Spring MVC framework enables the separation of modules namely Model View, Controller, and seamlessly handles the application integration. This enables the developer to create complex applications also using plain java classes. The model object can be passed between view and controller using maps. In this article, we will see how to set up a Spring MVC application in the Eclipse IDE and understand how to make applications.

The Spring MVC framework consists of the following components:

- **Model –** A model can be an object or collection of objects which basically contains the data of the application.
- **View –** A view is used for displaying the information to the user in a specific format. Spring supports various technologies like **freemarker**, **velocity**, and **thymeleaf**.
- **Controller –** It contains the logical part of the application. *@Controller* annotation is used to mark that class as a controller.
- **Front Controller –** It remains responsible for managing the flow of the web application. Dispatcher Servlet acts as a front controller in Spring MVC

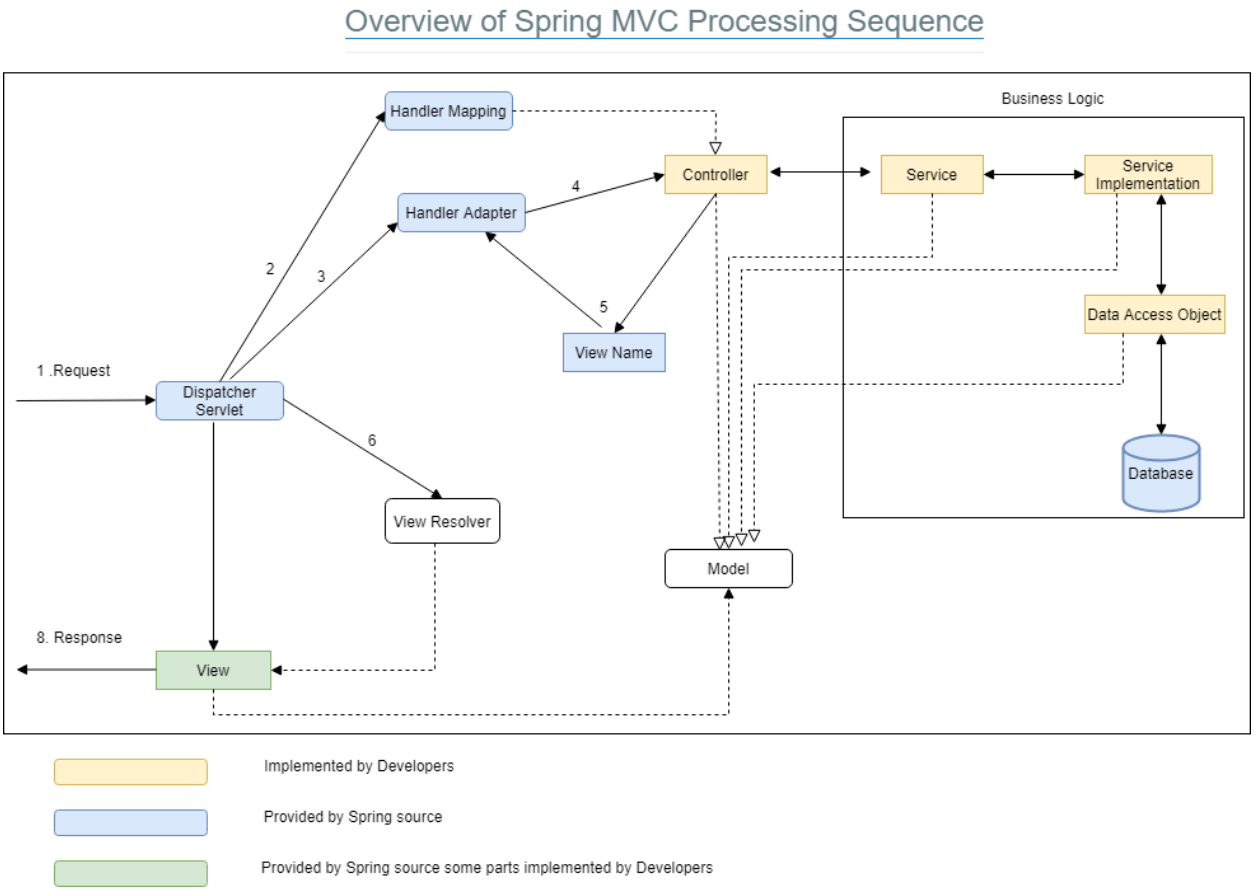

Figure 8: Processing sequence of Spring MVC

1. *DispatcherServlet* receives the request.
2. *DispatcherServlet* dispatches the task of selecting an appropriate *controller* to *HandlerMapping*. HandlerMapping selects the controller which is mapped to the incoming request URL and returns the (selected Handler) and Controller to *DispatcherServlet*.
3. *DispatcherServlet* dispatches the task of executing of business logic of Controller to *HandlerAdapter*.
4. *HandlerAdapter* calls the business logic process of Controller.
5. *Controller* executes the business logic, sets the processing result in Model and returns the logical name of view to *HandlerAdapter*.
6. *DispatcherServlet* dispatches the task of resolving the *View* corresponding to the View name to *ViewResolver*. *ViewResolver* returns the *View* mapped to View name.
7. *DispatcherServlet* dispatches the rendering process to returned *View*.
8. *View* renders *Model* data and returns the response.

4.2.1. Why Use Spring Boot MVC

1. **Lightweight:** Spring is a lightweight framework, there is no performance issues in Spring based web application.
2. **High productive:** Spring MVC is a productive framework which can boost your development.
3. **Secure:** Fully secure, that's why most of the online baking web applications are developed using Spring MVC. Spring Security is a great API for enterprise grade security implementation.
4. **MVC Supported:** As it's based on MVC. It's a great way to develop modular web applications.
5. **TDD Supported:** Fully support for Test Driven Development (TDD) technique.
6. **Fit for Agile Development:** Best fit for Agile based web application development.
7. **Role Separation:** Separate class for specific roles like Model, Command, Validator etc.
8. **RESTful Service Support:** In-build RESTful web services supported.
9. **Even More:** Internationalization(i18n), theme support, multiple views supported and seamless integration with database framework like Hibernate, JPA, TopLink and more…

4.3. Modelling Diagrams of the System

4.3.1. Class Diagram

The class diagram is the main building block of object-oriented modelling. It is used both for general conceptual modelling of the systematics of the application, and for detailed modelling translating the models into programming code. Class diagrams can also be used for data modeling. The classes in a class diagram represent both the main objects, interactions in the application and the classes to be programmed.

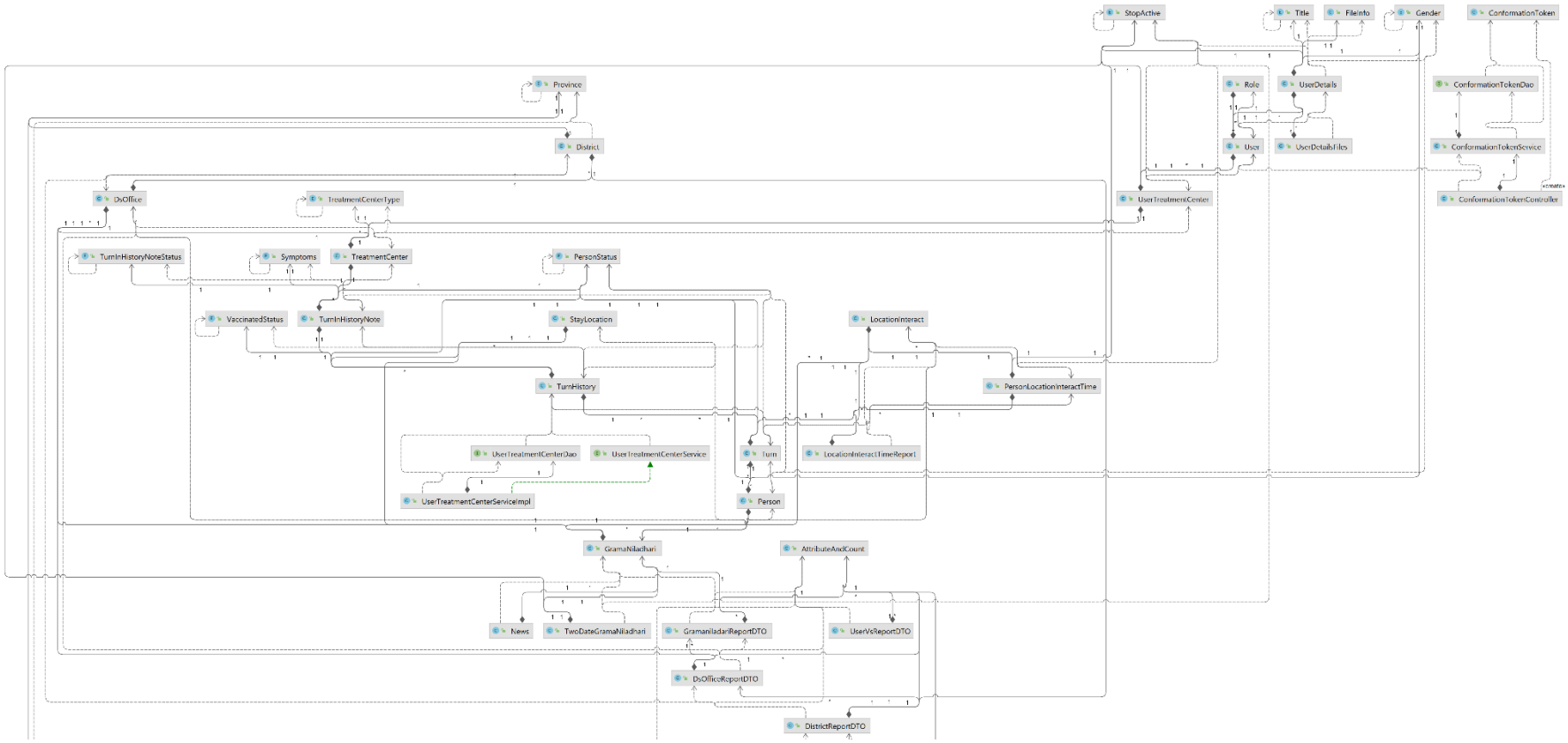

Figure 9: Class diagram of the system

4.3.2. Sequence Diagram for Add Person

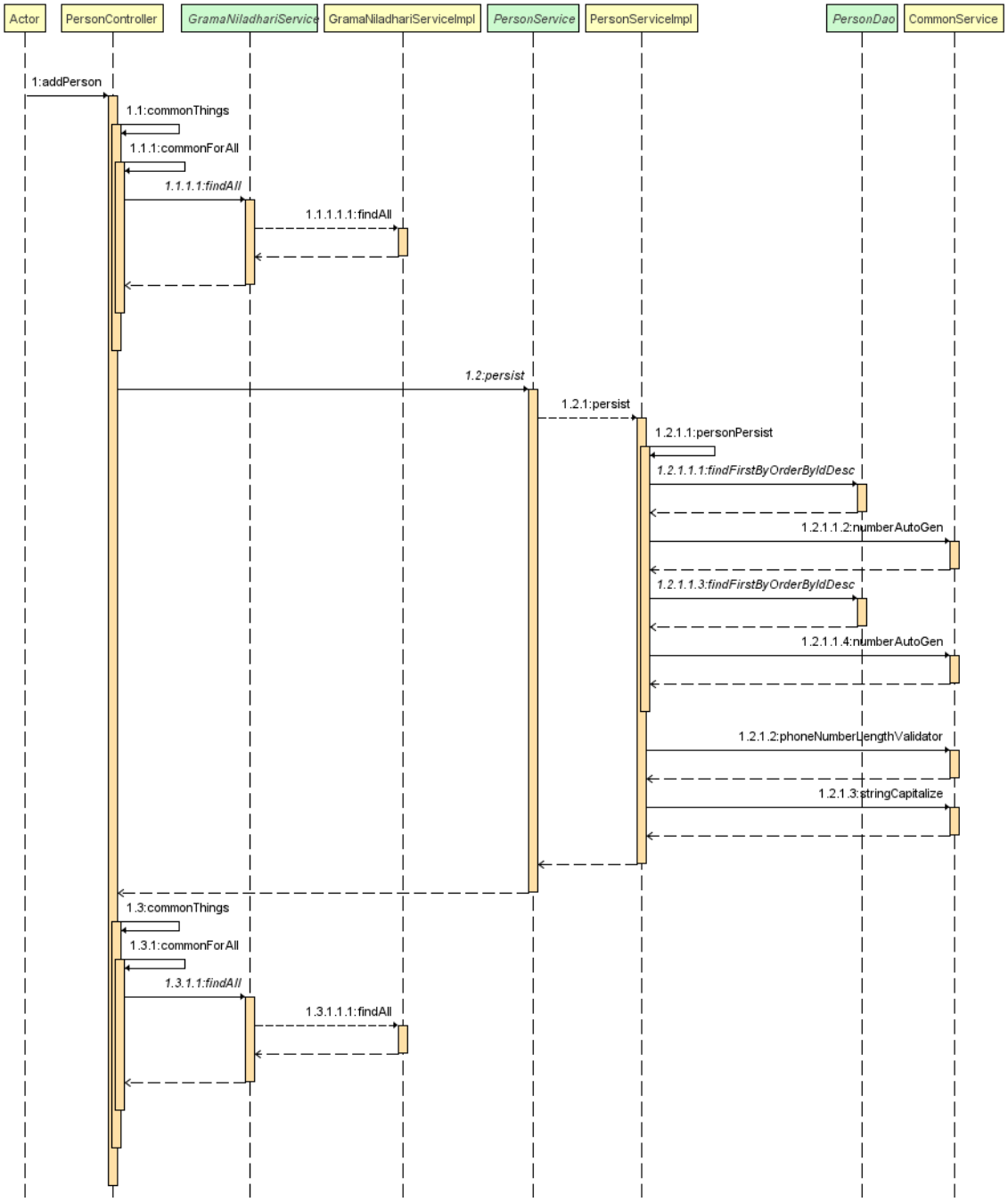

Figure 10: Sequence diagram for Add Person Process

4.3.3. Sequence diagram for News Subscription

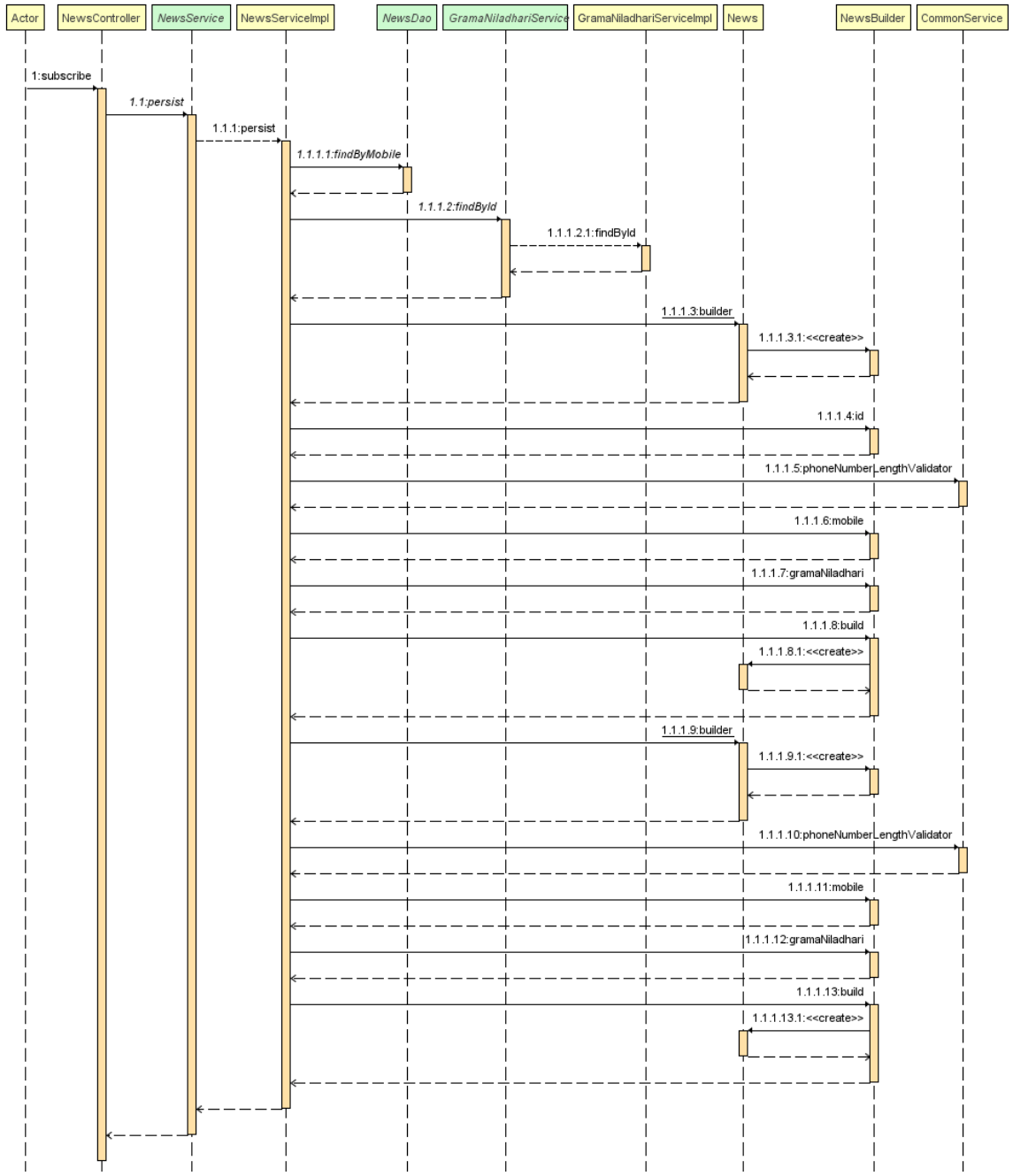

Figure 11: Sequence diagram for news subscription

4.3.4. Sequence diagram for Save New Turn of a Person

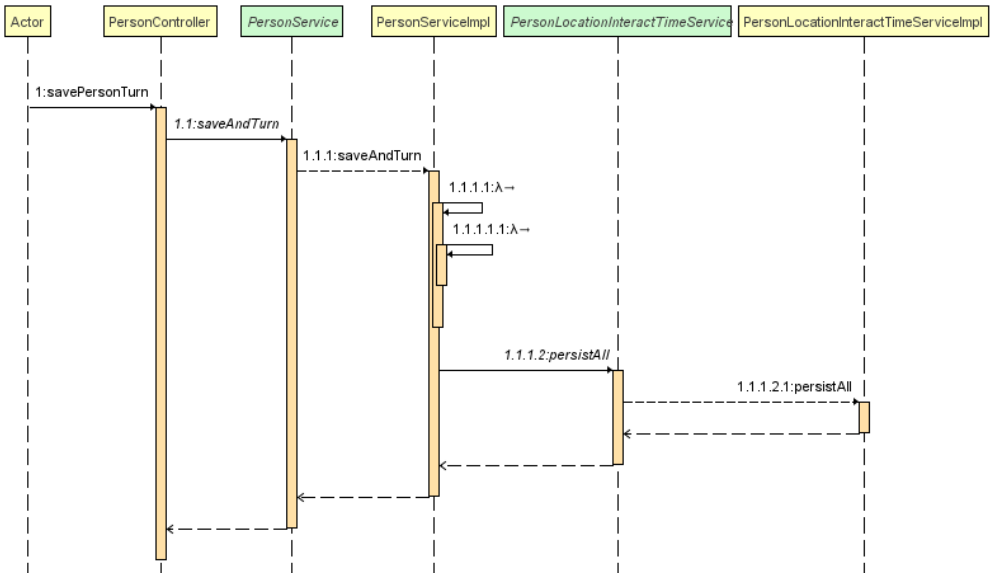

Figure 12: Sequence diagram for new turn of a person - Save Process

4.3.5. Activity diagram for Contact Tracer Login

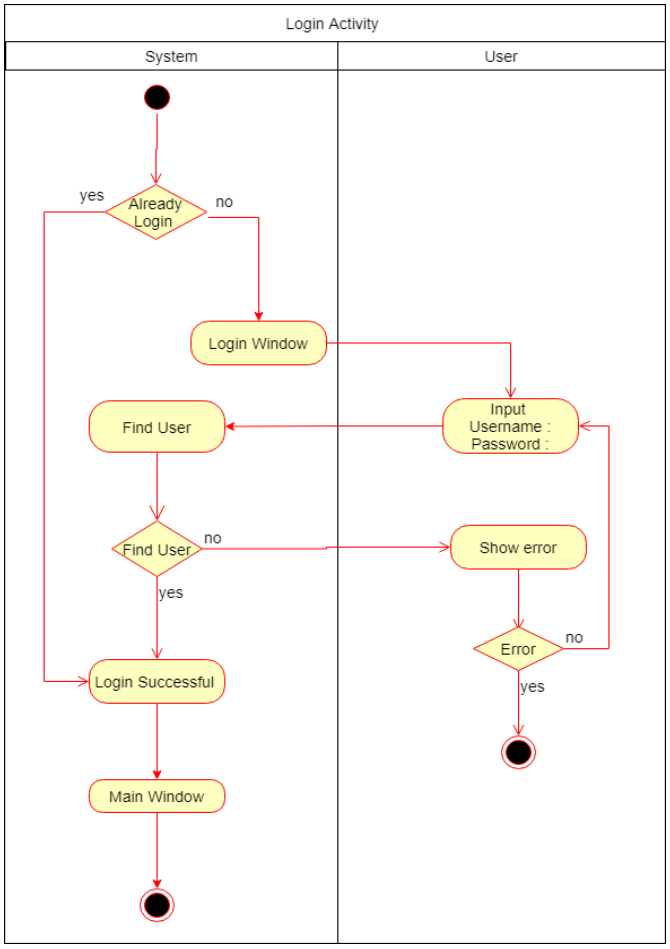

Figure 13: Activity diagram for Contact Tracer Login

4.3.6. Activity diagram for New Turn Add Process

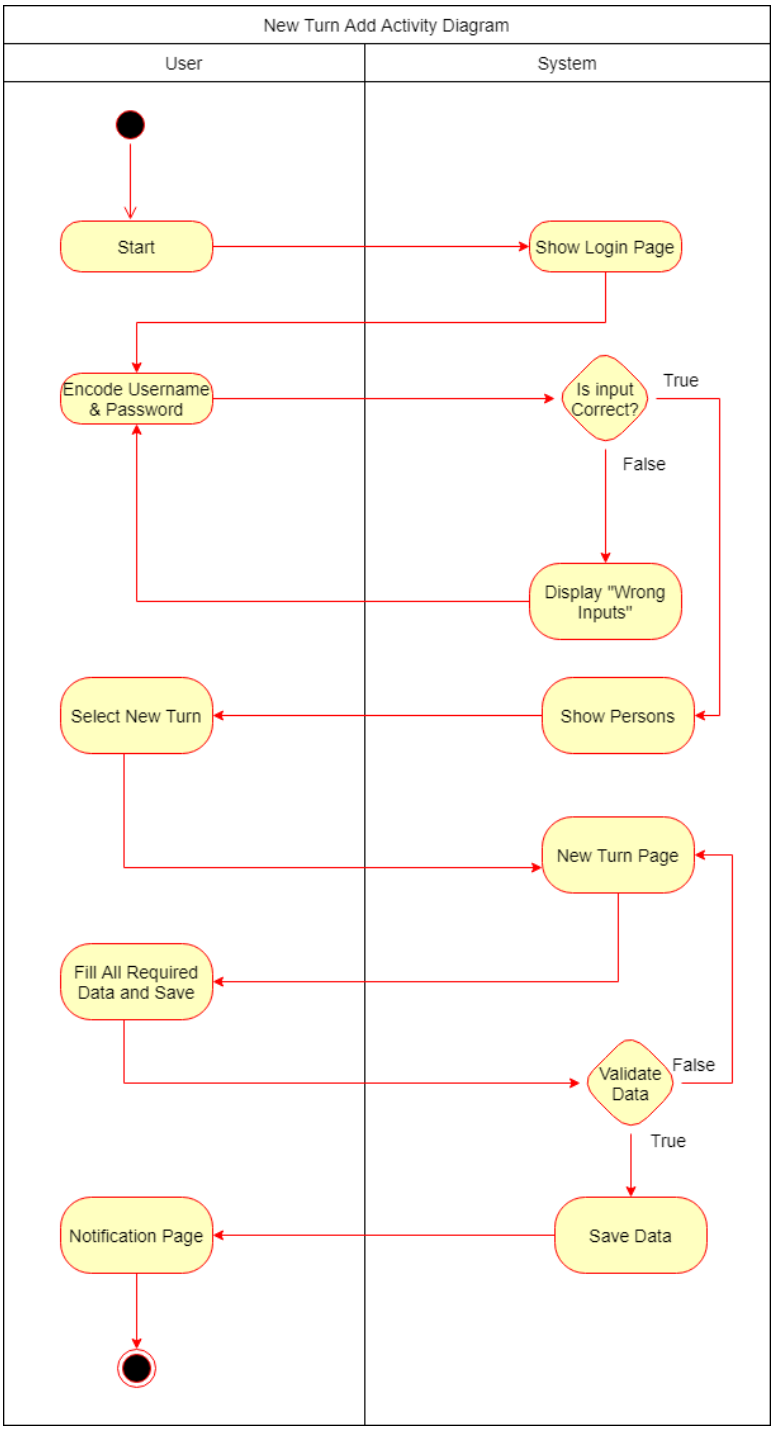

Figure 14: New Turn Add Activity Diagram

4.3.7. Activity diagram for Contact Tracer – Person Registration

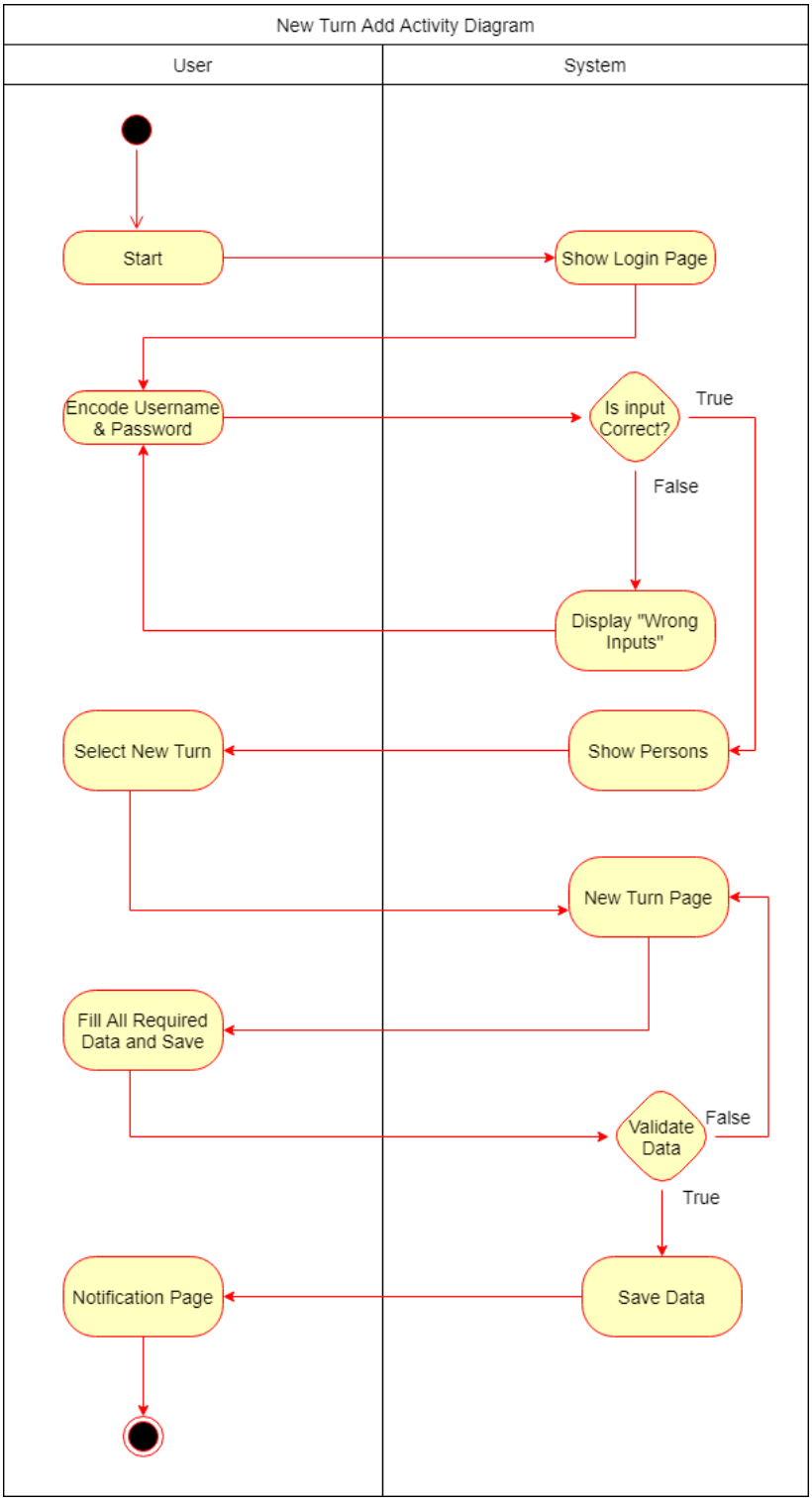

Figure 15: Activity diagram for Contact Tracer – Person Registration

CHAPTER 5

IMPLEMENTATION

Designed technical solutions in the design phase are transformed to an executable system which satisfy the client requirements collected in analysis phase.

Implementation process required hardware and software, Development process required tools, languages and frameworks used in the system are briefly described in this chapter.

5.1. Implementation Environments

The environment of the business organization and the functional & non-functional requirements of the intended system were taken into consideration when the selection of the set of software tools & other resources. Ensure of the high performance, technology feasibility, maintainability & the user friendliness was the important aspects of the selection process.

5.1.1. Hardware requirements

- Processor – 3.06GHz or above
- RAM – 4GB or above
- Hard Disk – 250GB or above

5.1.2. Software requirements

- MySQL – 8
- Java EE - 11
- Linux or Windows Virtual Private Server

5.2. Development Environment

5.2.1. Hardware requirements

- Processor – 3.06 GHz or above
- RAM – 8GB or above
- Hard Disk – 250GB or above

5.2.2. Software requirements

- Windows 10
- MySQL Work Bench – 6.3
- MySQL 8
- Intelli J Idea
- Microsoft Project 2019
- Gradle 7
- Java EE 11
- Google Chrome

5.2.3. Framework Use

- Spring framework
- Bootstrap 4
- jQuery 3.1
- Font awesome -5

5.3. Justification for the choice of implementation platform

5.3.1. IntelliJ Idea

IntelliJ IDEA is a Java integrated development environment (IDE) for developing computer software. It is developed by JetBrains (formerly known as IntelliJ), and is available as an Apache 2 Licensed community edition, and in a proprietary commercial edition. Both can be used for commercial development.

System requirements

Following shows, the minimum system requirements for intellij idea.

	Windows	macOS	Linux
OS Version	Windows 10/8/7 x64	macOS 10.8 or later	GNOME or KDE desktop
RAM	1 GB minimum; 4 GB or more recommended for Android development And commercial production.		
Disk space	300 MB hard disk space + at least 1 GB for caches		
JDK Version	JDK 1.8 since 2016.[11]		
Screen resolution	1024×768 minimum screen resolution		

Figure 16: System requirements for intellij idea

Features

Version 2021 includes support for the upcoming Java 16, a UI designer for Android development, Play 2.0 and Scala.

- Coding assistance
- Built in tools and integration
- Plugin ecosystem 7

5.3.2. JAVA PRGAMMING LANGUAGE

Java is a general-purpose computer-programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture. As of 2016, Java is one of the most popular programming languages in use, particularly for client-server web applications, with a reported 9 million developers. Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle Corporation) and released in 1995 as a core component of Sun Microsystems' Java platform. The language derives much of its syntax from C and C++, but it has fewer low-level facilities than either of them.

The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun relicensed most of its Java technologies under the GNU General Public License. Others have also developed alternative implementations of these Sun technologies, such as the GNU Compiler for Java (bytecode compiler), GNU Class path (standard libraries), and Iced Tea-Web (browser plugin for applets).

The latest version is Java 11, released on September 25, 2018, which follows Java 10 after only six months in line with the new release schedule. Java 8 is still supported but there will be no more security updates for Java 9. Versions earlier than Java 8 are supported by companies on a commercial basis; e.g. by Oracle back to Java 6 as of October 2017 (while they still "highly recommend that you uninstall" pre-Java 8 from at least Windows computers) **8**

5.3.3. MYSQL 8

MySQL is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. The MySQL development project has made its

7 https://en.wikipedia.org/wiki/IntelliJ_IDEA

8 https://en.wikipedia.org/wiki/Java_(programming_language).

source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation. For proprietary use, several paid editions are available, and offer additional functionality.

MySQL is a central component of the LAMP open-source web application software stack (and other "AMP" stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python". Applications that use the MySQL database include: TYPO3, MODx, Joomla, WordPress, Simple Machines Forum, phpBB, MyBB, and Drupal. MySQL is also used in many high-profile, large-scale websites, including Google (though not for searches), Facebook, Twitter, Flickr, and YouTube.9

5.3.4. MySQL Work Bench 6.3 CE

MySQL Workbench is a visual database design tool that integrates SQL development, administration, database design, creation and maintenance into a single integrated development environment for the MySQL database system. It is the successor to DB Designer 4 from fabFORCE.net, and replaces the previous package of software, MySQL GUI Tools Bundle10.

5.3.5. Spring framework

The Spring Framework is an application framework and inversion of control container for the Java platform. The framework's core features can be used by any Java application, but there are extensions for building web applications on top of the Java EE (Enterprise Edition) platform. Although the framework does not impose any specific programming model, it has become popular in the Java community as an addition to, or even replacement for the Enterprise JavaBeans (EJB) model. The Spring Framework is open source11.

5.3.6. Bootstrap 4

Bootstrap is a free and open-source front-end framework for designing websites and web applications. It contains HTML- and CSS-based design templates for typography, forms, buttons, navigation and other interface components, as well as optional JavaScript extensions. Unlike many earlier web frameworks, it concerns itself with front-end development only.

Bootstrap is the second most-starred project on GitHub, with more than 126,000 stars12.

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9 https://en.wikipedia.org/wiki/MySQL.

10 https://en.wikipedia.org/wiki/MySQL_Workbench.

11 https://en.wikipedia.org/wiki/Spring_Framework

12 https://en.wikipedia.org/wiki/Bootstrap_(front-end_framework)

5.3.7. jQuery

jQuery is a cross-platform JavaScript library designed to simplify the client-side scripting of HTML. It is free, open-source software using the permissive MIT License. Web analysis indicates that it is the most widely deployed JavaScript library by a large margin.

jQuery's syntax is designed to make it easier to navigate a document, select DOM elements, create animations, handle events, and develop Ajax applications. jQuery also provides capabilities for developers to create plug-ins on top of the JavaScript library. This enables developers to create abstractions for low-level interaction and animation, advanced effects and high-level, theme able widgets. The modular approach to the jQuery library allows the creation of powerful dynamic web pages and Web applications.

The set of jQuery core features—DOM element selections, traversal and manipulation—enabled by its selector engine (named "Sizzle" from v1.3), created a new "programming style", fusing algorithms and DOM data structures. This style influenced the architecture of other JavaScript frameworks like YUI v3 and Dojo, later stimulating the creation of the standard Selectors API.

Microsoft and Nokia bundle jQuery on their platforms. Microsoft includes it with Visual Studio for use within Microsoft's ASP.NET AJAX and ASP.NET MVC frameworks while Nokia has integrated it into the Web Run-Time widget development platform13

5.3.8. Google Chrome

Google Chrome (commonly known simply as Chrome) is a freeware web browser developed by Google LLC. It was first released on September 2, 2008 for Microsoft Windows, and was later ported to Linux, macOS, iOS and Android. Google Chrome is also the main component of Chrome OS, where it serves as a platform for running web apps.

Google releases the majority of Chrome's source code as the Chromium open-source project; however, Chrome itself is proprietary software. One component that is not open-source is the built-in Adobe Flash Player (that Chrome has disabled by default since September 2016. Chrome used the Web Kit layout engine until version 27. As of version 28, all Chrome ports except the iOS port use Blink, a fork of the Web Kit engine.

As of 2018, Stat Counter estimates that Google Chrome has a 66% worldwide usage share of web browsers as a desktop browser. It also has 56% market share across all platforms combined, because it has over 50% share on smartphones; and thus, Chrome is the most used browser in virtually all countries (most exceptions in Africa). Its success has led to Google expanding the "Chrome" brand name on various other products such as Chrome OS, Chromecast, Chromebook, Chromebit, Chromebox and Chromebase14

13 https://en.wikipedia.org/wiki/JQuery.

14 https://en.wikipedia.org/wiki/Google_Chrome

5.3.9. Windows 10 Operating System

Windows 10 is a series of personal computer operating systems produced by Microsoft as part of its Windows NT family of operating systems. It is the successor to Windows 8.1, and was released to manufacturing on July 15, 2015, and to retail on July 29, 2015. Windows 10 receives new builds on an ongoing basis, which are available at no additional cost to users. Mainstream builds of Windows 10 are labelled version YYMM with YY representing the year and MM representing the month of release. For example, the latest mainstream build of Windows 10 is Version 1809. There are additional test builds of Windows 10 available to Windows Insiders. Devices in enterprise environments can receive these updates at a slower pace, or use long-term support milestones that only receive critical updates, such as security patches, over their ten-year lifespan of extended support.

One of Windows 10's most notable features is support for universal apps, an expansion of the Metro-style apps first introduced in Windows 8. Universal apps can be designed to run across multiple Microsoft product families with nearly identical code—including PCs, tablets, smartphones, embedded systems, Xbox One, Surface Hub and Mixed Reality. The Windows user interface was revised to handle transitions between a mouse-oriented interface and a touchscreen-optimized interface based on available input devices—particularly on 2-in-1 PCs, both interfaces include an updated Start menu which incorporates elements of Windows 7's traditional Start menu with the tiles of Windows 8. Windows 10 also introduced the Microsoft Edge web browser, a virtual desktop system, a window and desktop management feature called Task View, support for fingerprint and face recognition login, new security features for enterprise environments, and DirectX 12.

Windows 10 received mostly positive reviews upon its original release in July 2015. Critics praised Microsoft's decision to provide a desktop-oriented interface in line with previous versions of Windows, contrasting the tablet-oriented approach of 8, although Windows 10's touch-oriented user interface mode was criticized for containing regressions upon the touch-oriented interface of Windows 8. Critics also praised the improvements to Windows 10's bundled software over Windows 8.1, Xbox Live integration, as well as the functionality and capabilities of the Cortana personal assistant and the replacement of Internet Explorer with Microsoft Edge. However, media outlets have been critical of changes to operating system behaviors, including mandatory update installation, privacy concerns over data collection performed by the OS for Microsoft and its partners and the adware-like tactics used to promote the operating system on its release.

Microsoft aimed to have Windows 10 installed on at least one billion devices in the two to three years following its release. Up to August 2016, Windows 10 usage was increasing, with it then plateauing, while eventually in 2018, it became more popular than Windows 7 (though that is still more used in most countries in Asia and Africa and thus the single most used Windows version overall (at 48.18%, thus the other more used overall), though not on some continents as measured by web traffic. As of September 2018, the operating system is running on more than 700 million

devices and has an estimated usage share of 32% on traditional PCs and 15% across all platforms (PC, mobile, tablet, and console)15.

5.3.10. Gradle

Gradle is an open-source build automation system that builds upon the concepts of Apache Ant and Apache Maven and introduces a Groovy-based domain-specific language (DSL) instead of the XML form used by Apache Maven for declaring the project configuration. Gradle uses a directed acyclic graph ("DAG") to determine the order in which tasks can be run.

Gradle was designed for multi-project builds, which can grow to be quite large. It supports incremental builds by intelligently determining which parts of the build tree are up to date; any task dependent only on those parts does not need to be re-executed.

The initial plugins are primarily focused on Java, Groovy and Scala development and deployment, but more languages and project workflows are on the roadmap16.

15 https://en.wikipedia.org/wiki/Windows_10

16 https://en.wikipedia.org/wiki/Gradle.

CHAPTER 6

TESTING

Testing is the process of assessing a system with the goal of determining whether it meets the specified requirements. In contrast to the actual, testing is the process of testing a system in order to find any gaps, mistakes, or missing requirements. System is verified for correctness, quality, and performance. Verification and validation are the process of ensuring that a software system satisfies requirements and serves its intended function in software testing. Verification is a software evaluation procedure that determines if the products of a certain development phase meet the requirements set out at the beginning of that phase. Validation ensures that the product design meets or exceeds the intended purpose, and that the software fulfills the user's needs. Software testing may either be a manual or an automated process. Here we have evaluated this system using manual testing process. We have performed Smoke testing to verify this system.

a. Smoke Testing

Smoke Testing is a software testing method that checks whether developed system is stable or not. It is called as "Build Verification Testing" or "Confidence Testing". we check the system to see whether the main features are working. It's a straightforward test that verifies that the product is ready for testing. This aids in determining if the construction is defective in order to make an informed decision. The smoke tests indicate that the structure is ready for further formal testing. The primary goal of smoke testing is to discover major problems early on. Smoke tests are used to show that a system is functioning properly and fits the requirements.

b. Benefits of Smoke Testing

Smoke testing is useful in software development since it assures the system's accuracy in the early stages. We can save time and money by doing so. As a consequence, smoke tests ensure that the system is in proper working order.

- After the build has been released to evaluation, smoke testing is performed. Smoke testing identifies the majority of errors during the early phases of software development.
- Smoke testing makes detecting and correcting major flaws much easier.
- The smoke testing is used to uncover faults in the application's functioning that may have been introduced by the new code.
- Easy to perform testing
- Defects will be identified in early stages.
- Improves the quality of the system
- Reduces the risk

- Progress is easier to access.
- Saves test effort and time
- It runs quickly
- Minimizes integration risks

c. Smoke testing life cycle

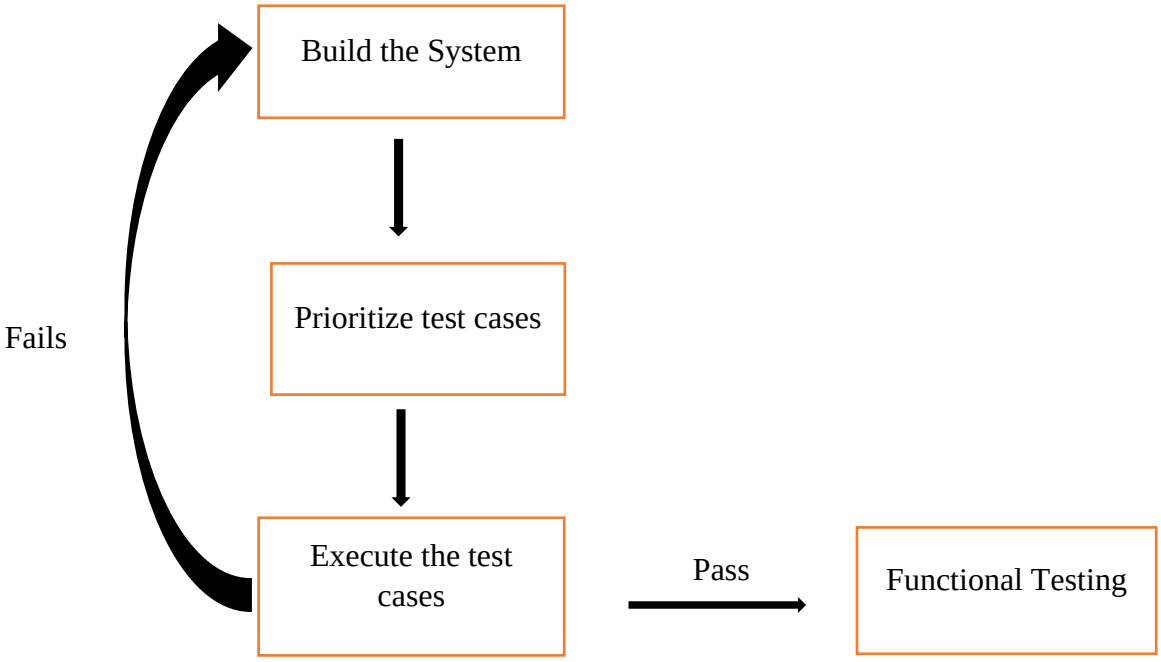

Figure 17: Flow chart of Smoke testing Life Cycle

The Smoke testing life cycle is given above. After system is built, it identifies the test cases based on priorities then executes test cases. If system pass its test cases, System will be evaluated by functional testing. Otherwise, System should be rebuilt to correct the defects and meet its requirements.

d. Smoke Test Cases

Table 19: Smoke test cases of the system

Test id	Test scenari	Description	Test step	Expected result status	Actual result	Status	Date
1	Valid login credentials	Test the login functionality of the web application to ensure that a registered user is allowed to login with username and password	1. Launch the application 2. Navigate the login page 3. Enter valid username 4. Enter valid password 5. Click on login button	Login should be success	As expected	Pass	2021.10.01
2	Prohibit unauthorized access and Show Error Message	Test the accessibility of unauthorized persons	1. Launch the application 2. Navigate the login page 3. Enter Invalid username 4. Enter Invalid password 5. Click on login button	Login should be denied	As expected Pass	Pass	2021.10.01
3	Add new User Details Functionality	Test the adding new User details functionality into the System	1. Launch the application 2. Navigate the login page as Admin 3. Fill up the details shown in registration page 4.*Click Save Button*	1. Save the User details into that System. 2. Give ACK /Message for saving successfully	Not add that user into the System	Fail	2021.10.01
4	Add new User Details Functionality	Test to check whether system Able to add new User details into the System	1. Launch the application 2. Navigate the login page as Admin 3. Fill up the details shown in registration page 4.*Click Save Button*	1. Save the User details into that System. 2. Give ACK /Message for saving successfully	add given user into the System	Pass	2021.10.06

6	Add New User	Testing for checking system to Able to add user type	1. Launch the application 2. Navigate the login page as Admin 3. Select Add user Button then select parameter (NIC/RegNo). 4. Select the person then add him into a category.	Able to add a person into particular user type (PHI/MOH etc..)	If a user is not registered with details, not able to add him into user type. Otherwise Add User according to the user type	Pass	2021.10.06
7	District management	Testing to add District, view all district with related province, update details related to the district.	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then district management	Able to Add district, view all districts, update details	As expected	pass	2021.10.06
8	Divisional Secretary Office management	Able to Add Ds Office, view all Ds Office, update details	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then ds office management	1. Able to Add Ds Office. 2. Able to view All Ds Office with related district. 3. Update details related to the Ds office.	As expected,	pass	2021.10.09
9	Grama niladhari division management	Able to Add Gramaniladhari division, view all Gramaniladahri division with related Ds Office, update details	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then Gramaniladhari division management	1. Able to Add Gramaniladhari division. 2. Able to view All Gramaniladahri division with related Ds Office. 3. Update details related to the Gramaniladahri division.	As expected	pass	2021.10.09

10	Location Interact management	. Able to add interact location , view all interact locations, update interact location details	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then location interact management	1. Able to Add location interact. 2. Able to view all location interact with related gramaniladhari. 3.Update details related to the location interact	As expected	pass	2021.10.13
11	Role Management	Able to Add role, view all roles, update and delete roles.	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then role management	1. Able to Add New Role. 2. Able to view All roles. 3. Update details related to the Role. 4. Able to delete roles.	As expected	pass	2021.10.13
12	User management	Testing to add New User, view All Users, view Single user's details, update details related to the user and disable users.	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then User management	Able to Add new user, view all users, detail view of a user, update and disable users.	As expected	pass	2021.10.15
13	User Details management	Add New User, view All Users' Details, view Single user's details, Update details related to the user.	1. Launch the application 2. Navigate the login page as Admin 3.Go to general then User Details Management	Able to Add new user, view all users, detail view of a user, update users.	As expected	pass	2021.10.15
14	Summary Report generation	Get the summary and graphical representation between 2 dates.	1. Launch the application 2. Navigate the login page as Admin 3.Go to Report then All Summary	Able to get the summary and graphical representation	As expected	pass	2021.10.15

15	Recent Locations where patient was found	Able to get the case details of GN Division by selecting date range and GN Division.	1. Launch the application 2.Go to Recent identified place	Able to get the case details of GN Division between 2 dates	As expected	pass	2021.10.17
16	Recent Update Covid Result at Home Page	Get the case details from HEALTH PROMOTION BUREAU and represent them in a graphical way.	1. Launch the application	Able to view the active, new, recover, dead cases details daily list and graph representation.	As expected	pass	2021.10.17
17	Forgotten Password Management	Able to manage login into the system if fail to remember user name or password	1. Launch the application 2.Click Login button 3.Click forgot password 4.Give email address for recover	Able to reset the password by provide reset password link through mail	As expected	pass	2021.10.17
18	News subscription management	Able to get the case details of GN Division by selecting GN Division and give the mobile number.	1. Launch the application 2. Navigate the login page as Admin 3.Go to Recent identified place in home page then SMS Subscribe	Able to get the case details of GN Division to mobile.	As expected	pass	2021.10.17
19	Report Generation	Get Report according to District, Gramaniladhari, DS office, Province wise and all	1. Launch the application 2. Navigate the login page as Phi 3.Go to report	Able to get report according to District, Gramaniladhari, DS office, Province wise.	As expected	pass	2021.10.19

20	Grama niladhari division management	Able to view all Gramaniladahri division with related Ds Office and view Summary report and graphical representation of covid 19 spread	1. Launch the application 2. Navigate the login page as Phi 3.Go to general then Gramaniladhari division management 4.Click View	Able to view all Gramaniladhari division, with related Ds Office and view Summary report and graphical representation of covid 19 spread of particular GS Division	As expected	pass	2021.10.19
21	Location Interact management	Testing to view all location interact with related gramaniladhari or DS division,Update details related to the location interact.	1. Launch the application 2. Navigate the login page as Phi 3.Go to general then location interact management	1. Able to view All location interact with related gramaniladhari or DS division. 2. Update details related to the location interact.	As expected	pass	2021.10.19
22	Person Management	View /add person details with status. Add interact locations with time if he is affected	1. Launch the application 2. Navigate the login page as Phi 3.Go to general then person management	1. Able to view /add person details with status. 2.Able to add interact locations with time if he is affected	As expected	pass	2021.10.19
23	Turn Management	View or edit person interact location with time. Allow to change person's status.	1. Launch the application 2. Navigate the login page as Phi 3.Go to general then turn management	1. Able to view or edit person interact location with time. 2. Able to change person's status.	As expected	pass	2021.10.21

CHAPTER 7

CONCLUSION

Our results show that a high-quality, rapid contact tracing system, combined with strong support for people in quarantine or isolation, can be highly effective in reducing the spread of COVID-19. If case isolation or contact quarantine are imperfect, or some contacts are not traced or traced more slowly, then the reduction in Reff is only around 40%, meaning that stronger social distancing would be required. Further people should maintain their social responsibilities and it will be effective to proper management of the pandemic and contact tracing as well.

CHAPTER 8

RECOMMENDATIONS

Improving the speed and capacity of contact tracing systems is likely to be more cost-effective than prolonged population-wide social distancing measures, although some level of social distancing may be also be needed to contain a resurgence. The crucial importance of effective quarantine and isolation makes it essential that there is universal provision of social security such as paid leave entitlements for pre-symptomatic or asymptomatic individuals in quarantine, and adequate job security and unemployment benefits. Likewise, the need to rapidly trace the majority of contacts mean that investment in skilled professionals and workers trained in public health work is essential. Overreliance on automated contact tracing solutions or the use of contact tracing staff who are not trained in public health work may lead to less favorable outcomes. This does not diminish the importance of developing scalable contact tracing systems, including digitally supported and automated systems. These are an increasingly essential part of the public health response during a major outbreak where public health agencies do not have capacity to manually trace all contacts of new cases. However, it highlights the need to design digital systems that are well integrated with public health agencies, so that the effectiveness of quarantine and isolation is not compromise. We recommend using the time from quarantine or isolation of the index case to quarantine or isolation of secondary cases as a performance indicator for the contact tracing system. If at least 80% of cases are quarantined or isolated within 4 days of quarantining or isolating the index case, this indicates a reduction.

CHAPTER 9

FUTURE WORK

The Contact Tracer provides support to control the spread of COVID-19 and a substance for many research activities. In order to succeed in handling accurate and reliable information, there will be improvements in the future terms of development efforts.

Automation using geolocation tracking which will be helpful to trace not only the contacts but also the setting in which contact occurred up to 14 days before symptom diagnosis. This will be implemented by synchronizing the system with google location tracking service.

At present, this system has designed as a web application. But whilst a web app offers many advantages, there are situations where a mobile app may have more valuable benefits. Particularly in supporting older mobile devices or using offline use.

Implementation of a location tracking using mobile device as a solution in the fight against the spread of COVID-19. This feature will enable to identify and notify contacts immediately after a person is tested positive.

Thus, implementing a user self-service will allow the system to send an email or SMS to a contact, which includes a link that prompts the user to complete a self-service questionnaire. Many users will be mobile only, so this must be fully tested with all mobiles. Some users will be unwilling or indeed not have a Google account – so it will add a manual login option. As some users may be low-tech, it must make this very easy to use, whilst still being secure. This will mean that the user interface is simplified to the version used by professionals.

A well-defined electronic patient history management will assist to effectively and efficiently manage cases and their respective contacts. In addition, being able to register information about infected cases and contacts, this will allow authorized people to produce daily patient reports, export data for analysis, geographically map contacts and visually represent the chains of transmission of the disease in a particular area. Using this patient history management, it will facilitate the quick reporting of data and trends and thus will enable to take quick decisions about the contact tracing process.

A report generation process in which will be facilitated with vaccine efficiency report and recovery ratio based on the location. This feature will assist to make prediction on the spread of the disease and also to make prediction about the recovery ratio as per with the vaccination efficiency based on locations traced within the system.

Building automated services are keen to stress that they are not trying to replace manual tracing; they are trying to aid it. They see digital tools as a way to complement and scale up the work done by human teams. For example, smartphone alerts can help filter out those at low or no risk

so that manual tracers can spend their time investigating genuine cases, people at higher risk, or those who are harder to contact. Therefore, this API will ensure that tracing covers as many people as possible.

Use technology to notify contacts and to generate anonymized mapping to notify the public of high-risk areas. This will enable reach without access to the mobile access. In Sri Lanka, not all the locations are mapped properly and there are areas that has not been detected automatically. The contact notification will directly be built into the identification system, so those who are identified are automatically notified.

This system develops to obtain data covering GN areas to trace COVID-19 infected patients to assist PHI to make public awareness about the spread of the disease in a particular area. Furthermore, this data can be synchronized with the laboratory services, hospitals and also with COVID-19 Control Center for further investigations and also to direct infected patients for treatments and follow-ups.

Development of a data-sharing guidelines will help to minimize data collection and to support privacy rights by encrypting the data. The identification and enrollment process will be handled effectively by obtaining consent from the necessary authorities. The data hold within the system itself are highly confidential and sensitive and in case of pertaining for further research purpose or analysis, consenting will be an integral part.

REFERENCES

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APPENDIX 1

"Covid19 Patient Contact Tracing Application" Software Development Agreement - Version 1.0

This Software Development Agreement (the "Agreement" or "Software Development Agreement") states the terms and conditions that govern the contractual agreement between **LaSCP (Pvt.) Ltd.** having its principal place of business **at 123 Circular Rd, Mapanawathura, Kandy,** and **Prabath Gunathilake.** (additionally referred to as "Client") having its principal place of business at **No. 25, Postgraduate Institute of Science, University of Peradeniya** who agrees to be bound by this Agreement.

WHEREAS, the Client has conceptualized features required for **"Covid19 patient Contact Tracking Application 1.0"** (the "Software"), which is described in further detail on Exhibit A, the Client has come to an agreement to use the web application developed for "Facilitating the contact tracking of Covid19 patients which is supported by portable devices such as mobile devices" as a service platform.The payment terms and fees for which services will be on a **pro rata basis (one developer US$ 25 per hour)**, rates of which will be on mutual terms with the Parties.

NOW, THEREFORE, in consideration of the mutual covenants and promises made by the parties to this Agreement, the Provider and the Client (individually, each a "Party" and collectively, the "Parties") covenant and agree as follows:

DEVELOPER'S DUTIES

1. The Client hereby engages the Developer and the Developer hereby agrees to be engaged by the Client to develop the Software in accordance with the specifications attached hereto as Exhibit A (the "Specifications")

2. The Developer shall complete the development of the features requested by the client according to the milestones described on the form attached hereto as Exhibit B. In accordance with such milestones, the final product shall be delivered to the Client by **Final Delivery Date** (the "Delivery Date") mentioned in Exhibit B.

3. The Client may terminate this Agreement at any time upon material breach of the terms herein and failure to cure such a breach within **10 business days** of notification of such a breach.

4. The license grants access to source code. However, within the development period, the Client should not change the source code without taking consent in writing from the maintenance team.

DELIVERY

1. The Software shall function in accordance with the Specifications on or before the Delivery Date
2. If the Software as delivered does not conform with the Specifications, the Client shall within **30 days** of the Delivery Date notify the Developer in writing of the ways in which it does not conform with the Specifications. The Developer agrees that upon receiving such notice, it shall correct any non-conformity.
3. The Client shall provide to the Developer written notice of its finding that the Software conforms to the Specifications within **30 days** of the Delivery Date (the "Acceptance Date") unless it finds that the Software does not conform to the Specifications.

PAYMENT

1. In consideration for the Service, the Client shall pay the Provider the following fees. No advance payments will be given to the Developer. ***(Payments by Company will be made, within Company's discretion, according to Company's then-current payment policies or as agreed upon in the applicable Sprint. Company will be entitled to offset any amounts that Developer owes to Company against any amounts Company owes to Developer.)***
2. All the payments must be paid in USD.

Item	**Unit / Period**	**Amount USD**
Milestone I (Environment setup and 20% of work)	**2 Weeks**	**1600**
Milestone II (30% of work)	**2 Weeks**	**2400**
Milestone III (40% of work)	**2 Weeks**	**3200**
Final Delivery (10% of work and bug fixing)	**2 Weeks**	**800**

Figure 18: Payment Quotation

SERVICE & SUPPORT

1. The Provider shall attend to any support requests within **24 Hours**, during regular business days

POINT OF CONTACT

2. A designated project manager shall be appointed on behalf of the Developer for the project implementation process and all instructions and requests shall be directed from the client to the Developer through the assigned project manager and vice-versa.
3. The Client shall assign a dedicated project manager for the implementation process and all instructions,
4. Information and feedback needs to be directed through the appointed project manager.
5. A designated technical person should be appointed on behalf of the client. Developer's support team shall be the point of contact for on-going support requests.
6. Requests for additional features or modifications for the existing system shall be directed to the project manager of the Developer.

CLIENT RESPONSIBILITIES

The client shall be responsible for the following tasks and cooperating with the Developer to fulfil the mentioned tasks will be vital to deliver the project on time and budget.

a. A demonstration of the existing application must be given by the Client.
b. Source code management, deployment and delivery mechanisms must be provided by the Client.
c. Providing Software feature requirements in detail addressing all exceptional and complication scenarios.
d. Providing a copy of existing database structure and data for migration.
e. Providing feedback within **48 hours** during regular business days for questions that the Developer shall come across during the implementation or development stage.

COPYRIGHTS IN THE SOFTWARE

The Parties acknowledge and agree that the Client shall hold all copyrights in the Software. The Developer agrees not to claim any such ownership in the Software's copyrights at any time prior to or after the completion and delivery of the Software to the Client.

MODIFICATIONS IN 'THE SPECIFICATION'

1. The Client may request that changes (Change Requests) be made to the Specifications and tasks associated with the implementation of the Specifications. If the Client requests such a change, The Developer will use its best efforts to implement the requested change at nominal additional expense to the Client.

2. In the event that the proposed change will, in the sole discretion of the Developer, require a delay in the delivery of the Software or would result in additional expense to the Client, then the Client and the Developer shall confer and the Client may either withdraw the proposed change or require the Developer to deliver the Software with the proposed change

3. and subject to the delay and/or additional expense. The Client agrees and acknowledges that the judgment as to if there will be any delay or additional expense shall be made solely by the Developer.

EXPANDING THE SCOPE OF WORK WITH NEW FEATURES

The Client shall request any new features during and/or after the scope of this agreement. Such requests shall also be covered by the terms and conditions provided in this agreement provided such features will have their own Client Specifications which will then be processed as per this agreement, the payment terms for which will be on a pro rata basis mutually agreed by the parties. However, the request(s) has to be made in writing within five (05) days immediately after the agreement meeting.

CONFIDENTIALITY

1. The Developer shall not disclose to any third party the business of the Client, details regarding the Software, including, without limitation any information regarding the Software's code, the Specifications, or the Client's business (the "Confidential Information"), (ii) make copies of any Confidential Information or any content based on the concepts contained within the Confidential Information for personal use or for distribution unless requested to do so by the Client, or (iii) use Confidential Information other than solely for the benefit of the Client.
2. The Developer shall use the name, logo and other information of the client in developer marketing and advertising material subjected to terms and conditions of the said logo use set by the Client.

WARRANTIES

The Developer represents and warrants to the Client the following:

- Development and delivery of the Software under this Agreement are not in violation of any other agreement that the Developer has with another party.
- After the Delivery Date, the Software shall operate according to the Specifications. If the Software malfunctions or in any way does not operate according to the Specifications within that time, then the Developer shall take any reasonably necessary steps to fix the issue and ensure the Software operates according to the Specifications.
- The client must inform the developer all the issues in one business week after a delivery.

NON-COMPETE

The Developer agrees not to sell or market the Software to any businesses in **Sri Lanka** or any **other parts of the world**.

NO MODIFICATIONS UNLESS IN WRITING

No modification of this Agreement shall be valid unless in writing and agreed upon by both Parties.

APPLICABLE LAW

1. This Agreement and the interpretation of its terms shall be governed by and construed in accordance with the laws of the Democratic Socialist Republic of Sri Lanka and subject to the exclusive jurisdiction of the federal and state courts located in Democratic Socialist Republic of Sri Lanka.
2. IN WITNESS WHEREOF, each of the Parties has executed this Agreement, both Parties by its duly authorized officer, as of the day and year set forth below.

EXHIBIT A

1. Software Specification

Table 20: Software Specification

Inspection Type	Screens	Weight	Total (Weight, in man hours)
Module 1: District Module	3	1	40
Module 2: Gramaniladhari Module	3	1	40
Module 3: Province Module	3	1	40
Module 4: User Module	3	2	80
Module 5: Patient Module	5	1	40
Module 6: Report Application	5	2	80

- Development Technology: **Springboot with Thymeleaf**
- Database Management System: **Mysql**
- No Server-side development tasks are involved with the Software

EXHIBIT B

Provider Project Manager for implementation phase	Pamuditha Leo
Client Project Manager for implementation phase	Nominated by Prabhath Gunathilake
Provider Support Desk	Charitha Wimaladharma
Client Technical Manager for on-going support	Prabhath Gunathilake
Post-implementation requests	Lathagini Sivarasa

Project Agreement Signing Date	
Project Start Date	**Five business days from project signing date**
Final Delivery Date	**Eighty business days (4 Calendar Months) from project start date**

EXHIBIT C - System in Abstract

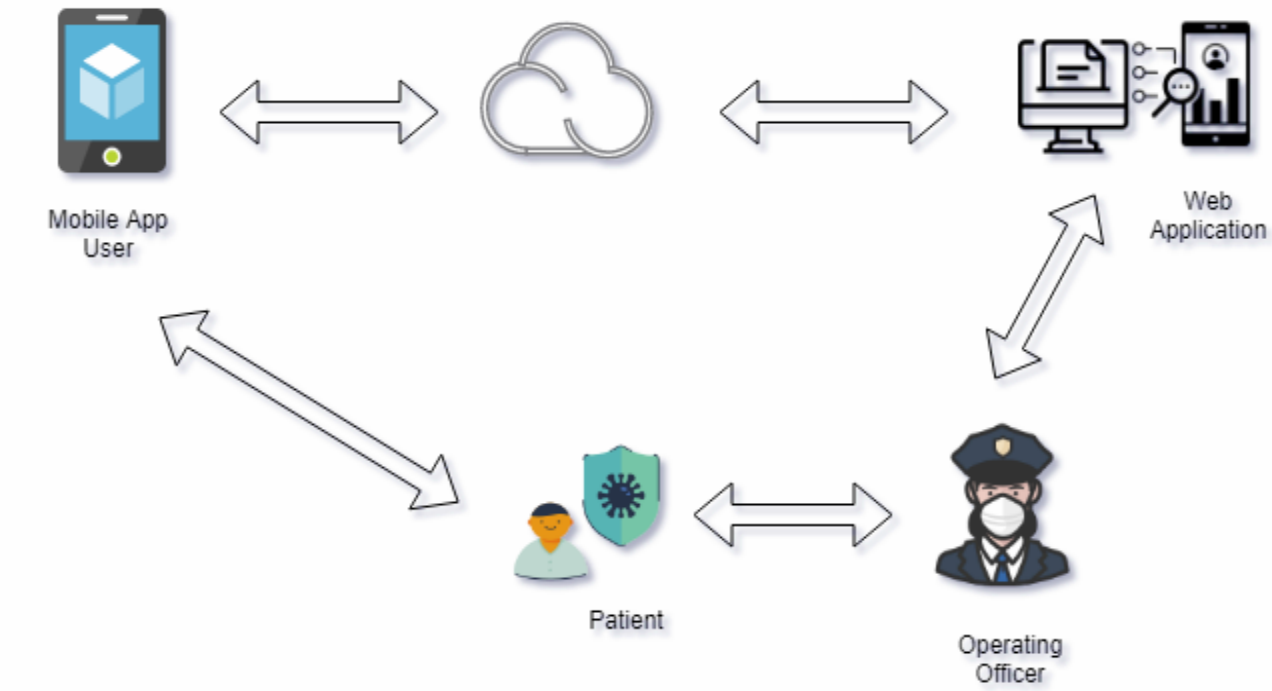


EXHIBIT D - Glossary

1. Regular business days - Monday through Friday 8:00 to 17:00 except public and mercantile holidays in Sri Lanka

Team leader	Prabhath Gunathilake
…….	…….
For LaSCP (Pvt.) Ltd	**For PGIS**
Name: Lalith Kahatapitiya @ **LaSCP (Pvt.) Ltd. PGIS**	Name: Prabhath Gunathilaka @
Designation: **Software Development Manager**	Designation: Project Manager
Date: …….	Date: ……

WITNESSES

Signature: ……

Sasika Moragoda

Name: …….

N. I. C. No: …….

Address: …….

WITNESSES

Signature: ……

Prarthana Weerasekara

Name: ……

N.I.C. No. : ……

Address: …….

APPENDIX 2

Software Requirement Specification

Introduction

Covid 19 has become a global pandemic since late 2019. Matter of fact Sri Lanka became a severe victim of the pandemic due to aggressively spreading different variants. Prevention is the only option remaining for Sri Lankans as the country exceeds all the healthcare thresholds by now. Currently the main challenge faced by both the healthcare officials and the citizens is to trace the positive patients and convey the locations they visited in the last two weeks with other potential contacts.

According to the World Health Organization (WHO), contact tracing is the process of identifying all people that a COVID-19 patient has come in contact with in the last two weeks [1]. It has been an impossible task for an infected person to remember all the locations he/she visited in the last two weeks, which leads to a complex contact tracing process. As a result of that, an infected patient may spread the virus in the community

Furthermore, accessing or tracing personal records of a citizen is prevented and covered under the legislation of each county and protected by privacy policies of the same. Therefore, no authority can force a person to reveal his/her travelling history without a proper legal procedure. It has completely become the accountability of every citizen of a community to be self-aware about individuals' health and safety while taking the responsibility to prevent spreading the deadly virus in the society.

The main intention behind the proposed “Covid19 Contact Tracer” is to assist people to keep track of their own routing history and help healthcare officials to manage the positive cases and notify their close-contacts more effectively, efficiently and reliably.

The high-level view of the system is depicted in Figure 1, in which the main components and the users are mentioned.

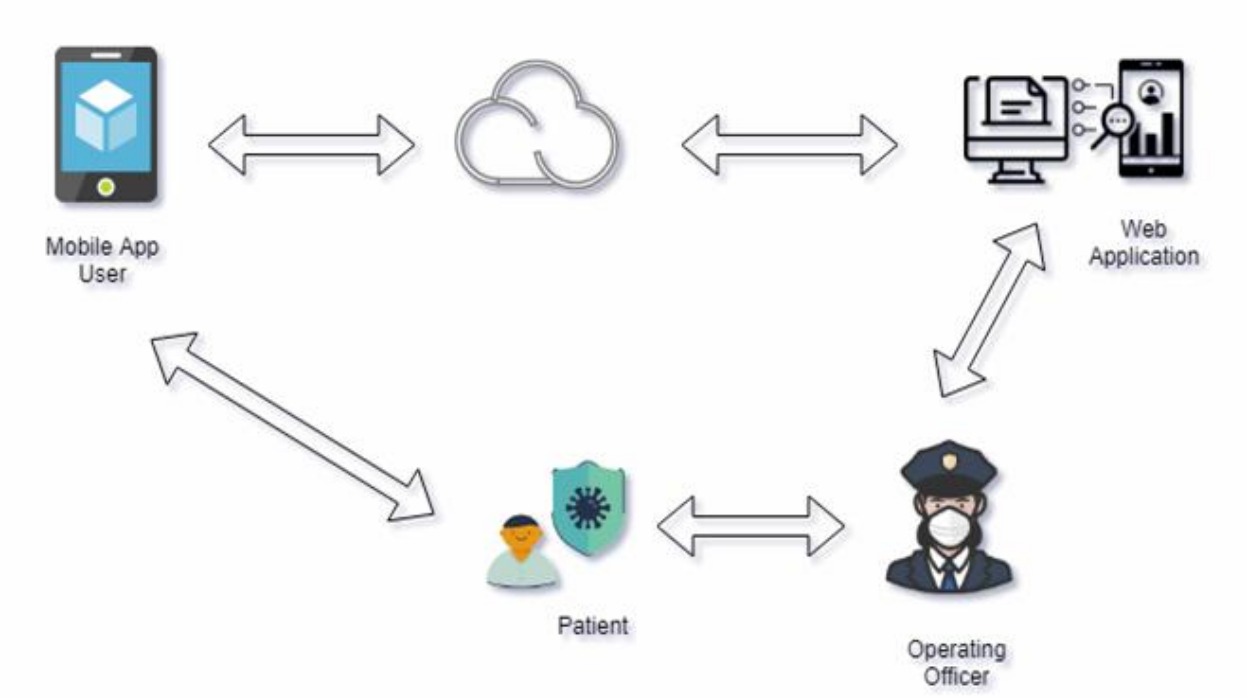


Figure 1: Proposed system in abstract view

Product Perspective

"Covid19+ve Contact Aware App" is a web-based application to help authorities to manage positive covid19 cases up to the level of Grama Niladhari (GN) division, with an optional mobile application for general users to look back their steps in past days and to be notified about the potentially risk places they visited in the last week with respect to their present locations (GN divisions).

System maintains a database where the necessary details of a patient (covid19 positive patient) are recorded and updated for two weeks from the day reported until he/she gets a negative test result. Just after an authorized officer (e.g. Public Health Inspector) registers and updates a record of a patient, a summary of the places, where the patient visited within the last 5 days, is generated.

A recognized user-level hierarchy is employed in the system to filter records and generate the reports when requested. For instance, descriptive details to the overview cases in each GN to MOH or District to Provincial level can be produced to assist the decision makers to make rational decisions.

The system is capable of producing textural and/or graphical outputs that can be used to make decisions in GN or district level isolation or lockdown (area fusing), imposing inter-provincial travel restrictions, and other important criteria defined and implemented by the director general of health, Sri Lanka [2]. The system architecture consists of two main components namely web

application and mobile application. Each component is equipped with several modules and associated services.

Feasibility Study

The main concern of the proposed application was to make sure the user acceptance, since such systems, are directly influencing an individual's privacy. According to the usability statistics and analysis reports from the countries which are using contact-tracing apps, most of the users are reluctant or refuse to use apps because they believe that those apps are threatening their privacy and data. "Covid 19 Contact Tracer" highly values the privacy and data protection of a user therefore, sensitive data such as location history and date, time and duration of a stay at a place of a user is recorded anonymously. That is, the user identity is completely discarded.

When considering the technical feasibility, the available technologies confirm that the application development process can be initiated with state-of-the-art techniques and tools. Github (github.com) was selected as the project/task management tool whereas Slack (slck.com) is the business communication platform throughout the application development lifecycle.

"Covid 19 Contact Tracer" application development team is a voluntary non-profit group of developers and designers affiliated with the Postgraduate Institute of Science, University of Peradeniya, Sri Lanka. The primary intention of the team is to contribute to the community to suppress the deadly virus and its drastic spread. Therefore, the economic feasibility of the initial stages of the life cycle has not been a constraint, i.e. the economic feasibility of the application is confirmed.

Requirement Gathering

Requirements are mainly identified based on the existing applications, client's specifications and monitoring the operations in real world business processes. There were regular one-on-one interviews with the client to collect necessary information to define the requirements while a pre-arranged stakeholder meeting was held to define the business process in the context of contact tracing, treatment and isolation or quarantine. In the business analysis process, public health inspectors (PHI) and doctors of MOH participated.

Basically, the underlying business logic was defined based on the existing contact tracing applications introduced by most of the developed countries such as New Zealand , Australia and Norway . Moreover, COVID-19 related information sources from the ministry of health, Sri Lanka , Epidemiology Unit, Ministry of Health, Sri Lanka, and National COVID19 Surveillance System of Sri Lanka, Ministry of Health, Sri Lanka were regularly referred and strictly followed when defining requirements and procedures.

Additionally, brainstorming and reverse-engineering techniques were also used to identify possible solutions to problems, and clarify details of opportunities. User stories were created based on the requirements gathered from different means (see appendix 01 for sample user stories).

Requirement Specification

Once the requirements are gathered based on the aforementioned techniques and various sources including the client's definitions in natural language, a list of primary and mandatory requirements for a Covid-19 contact tracing application are technically specified as below.

Functional Requirements

The initial version of the application supports three user levels with different privileges, administrator, PHI and general user. Each has a different set of unique functionalities as well as common functions. In addition to the main roles in the current version, there is a provision for additional user types as well.

The administrator should be able to do the following functions:

- Add user
- Add role
- Assign user role
- Add GN
- Add DS
- Add district
- Add location
- View places
- Manage GN
- Manage DS
- Manage district
- Generate reports
- Login
- Change password
- Edit profile
- Logou

The PHI should be able to perform the following tasks:

- Add person
- Add location
- Manage GN
- Generate reports
- Login
- Change password
- Edit profile
- Logout
- Manage location
- Edit infected turn
- Infected turn management

The general user is the one who visits the application without authentication. He has the access to the following function:

- View recent places

In addition to the primary user levels, some of the above functional requirements are dependent on external systems/services namely Mobile app, Map API and Google location. They are associated with the following functions:

- Add location
- View recent places
- Login

Following use case diagram depicts the dynamic aspect of the application with respect to internal and external user role and interaction. Mobile app is an extended module of the system. Google location service is one of the main external services included in the system. Though the actor Map API is also an external services the system is depending on, the geographical information services are not employed in the current version of “Covid19 contact tracer” application.

Use case diagram

Non-Functional Requirements

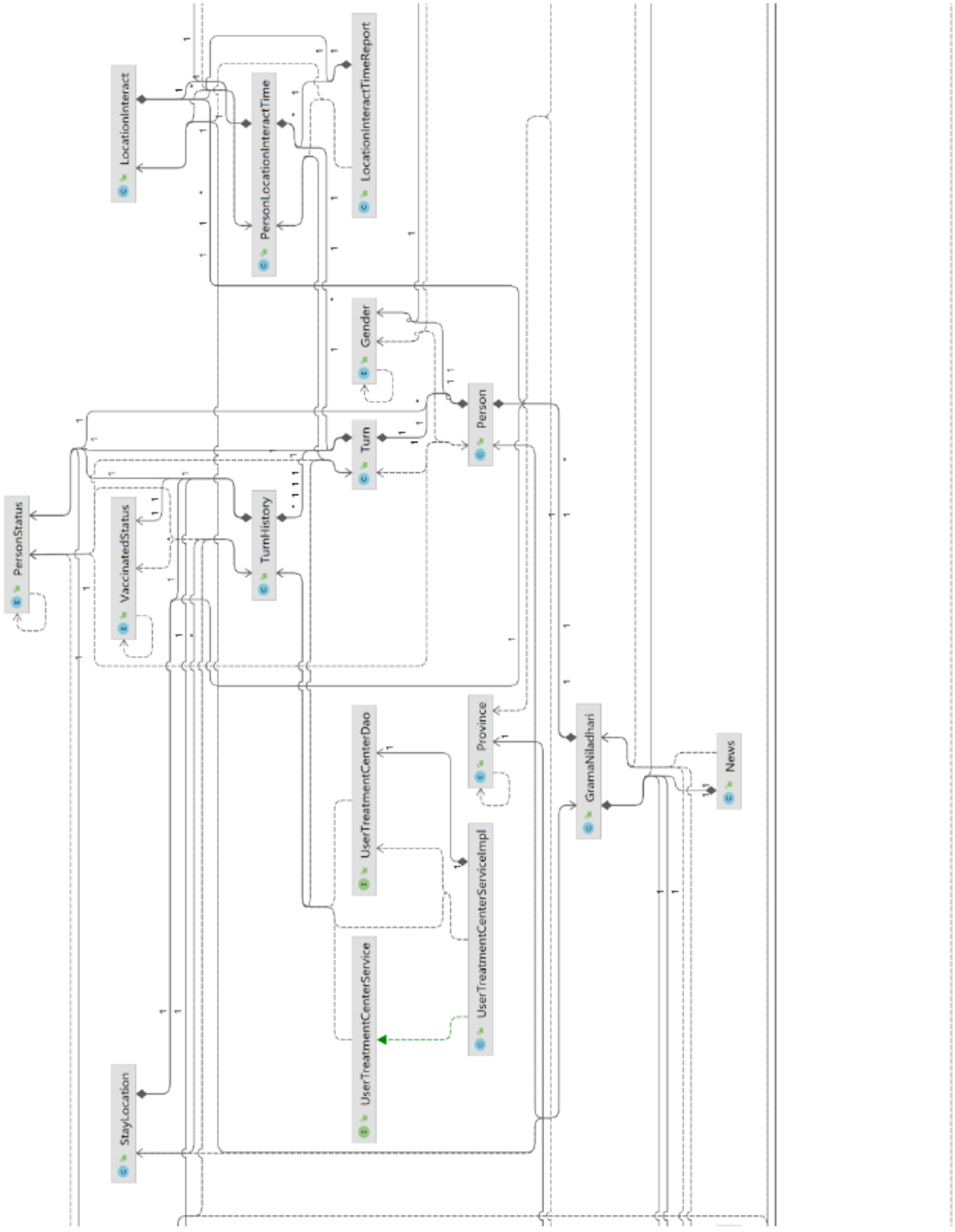
There is an important and increased interest in non-functional requirements of applications used for contact tracing of infected patients in the context of COVID-19 epidemic. Those non-functional requirements mainly include the security of application users (or public safety), privacy impacts, and data protection. Primarily, the concept of "Contact Tracing" application possibly involves a number of risks due to the contact and health data collected and stored in a database.

With privacy as one of the main concerns, the proposed system ensures user privacy by anonymization of an individual's details. Especially the location history of a person (possibly a patient) is recorded without disclosing the identity. Therefore, no identification is visible to the other users.

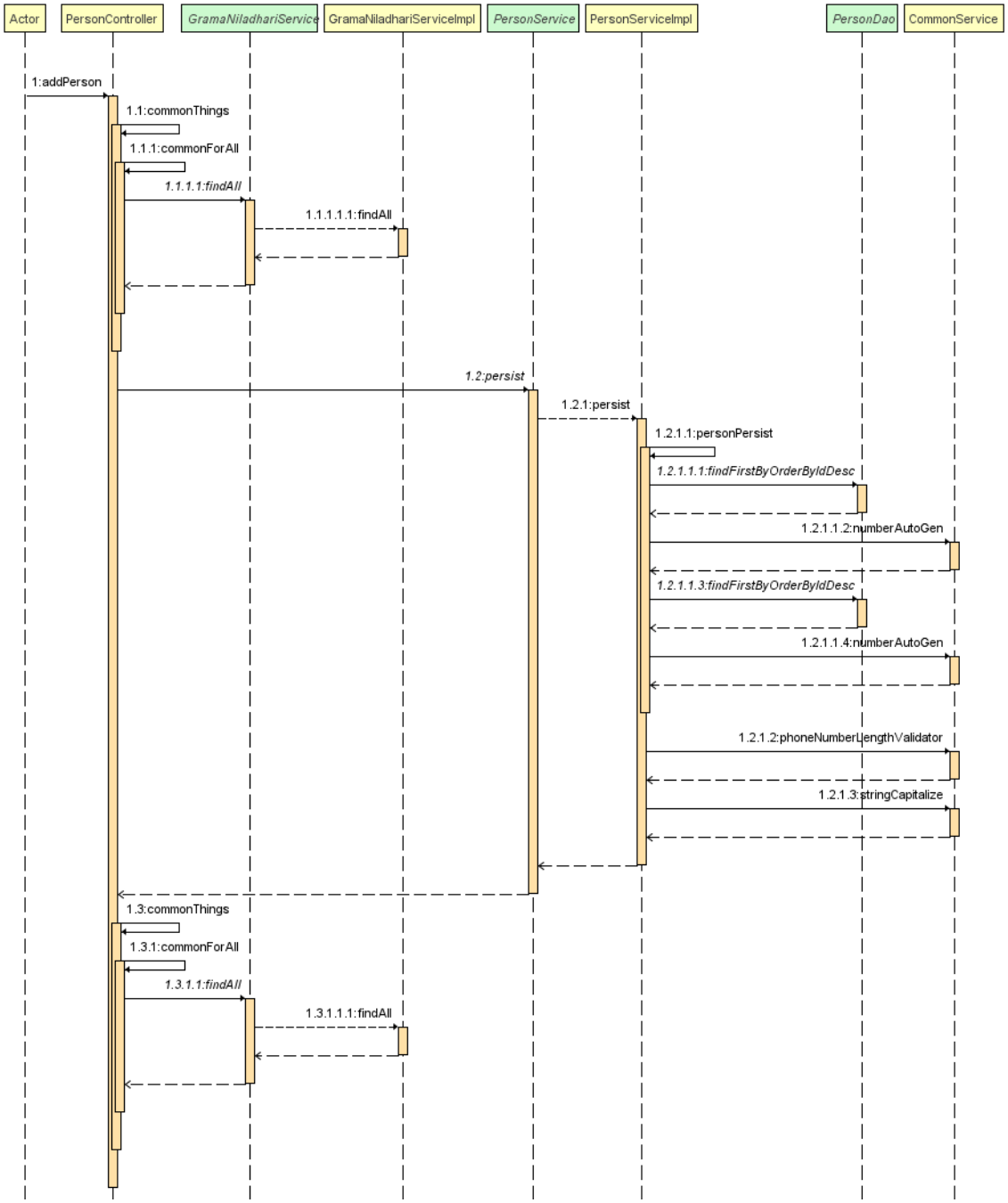
Information integrity plays a significant role in the success of the "contact tracing" concept. Though the accuracy, reliability, and consistency of information are vital, only minimal data or metadata required for the application is stored upon the user's consent.

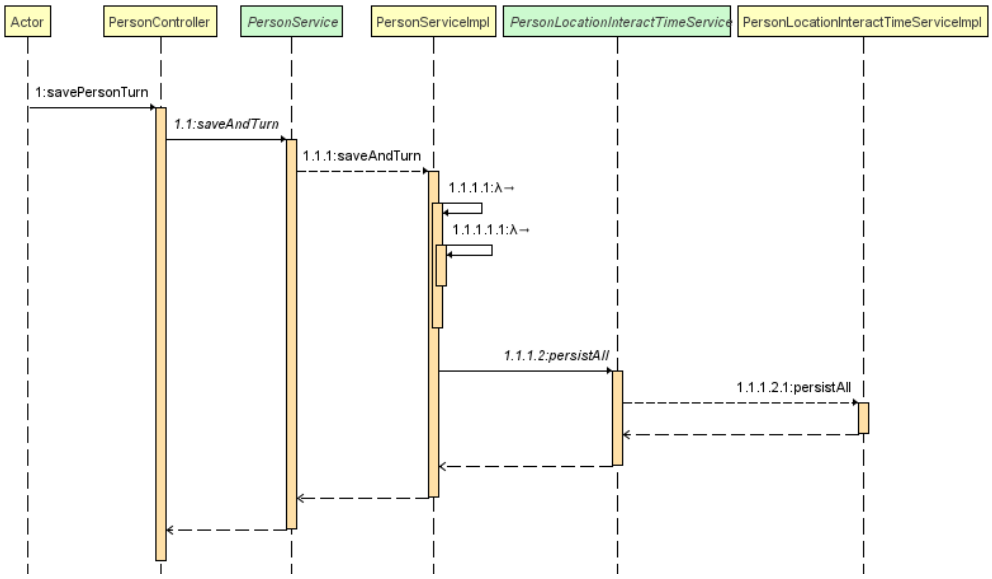
As a non-functional requirement, the evolution quality of the application is achieved by introducing the extensibility, scalability and maintainability. That is by the completion of the first phase of development, a provision to scale and extend the application scope is adopted.

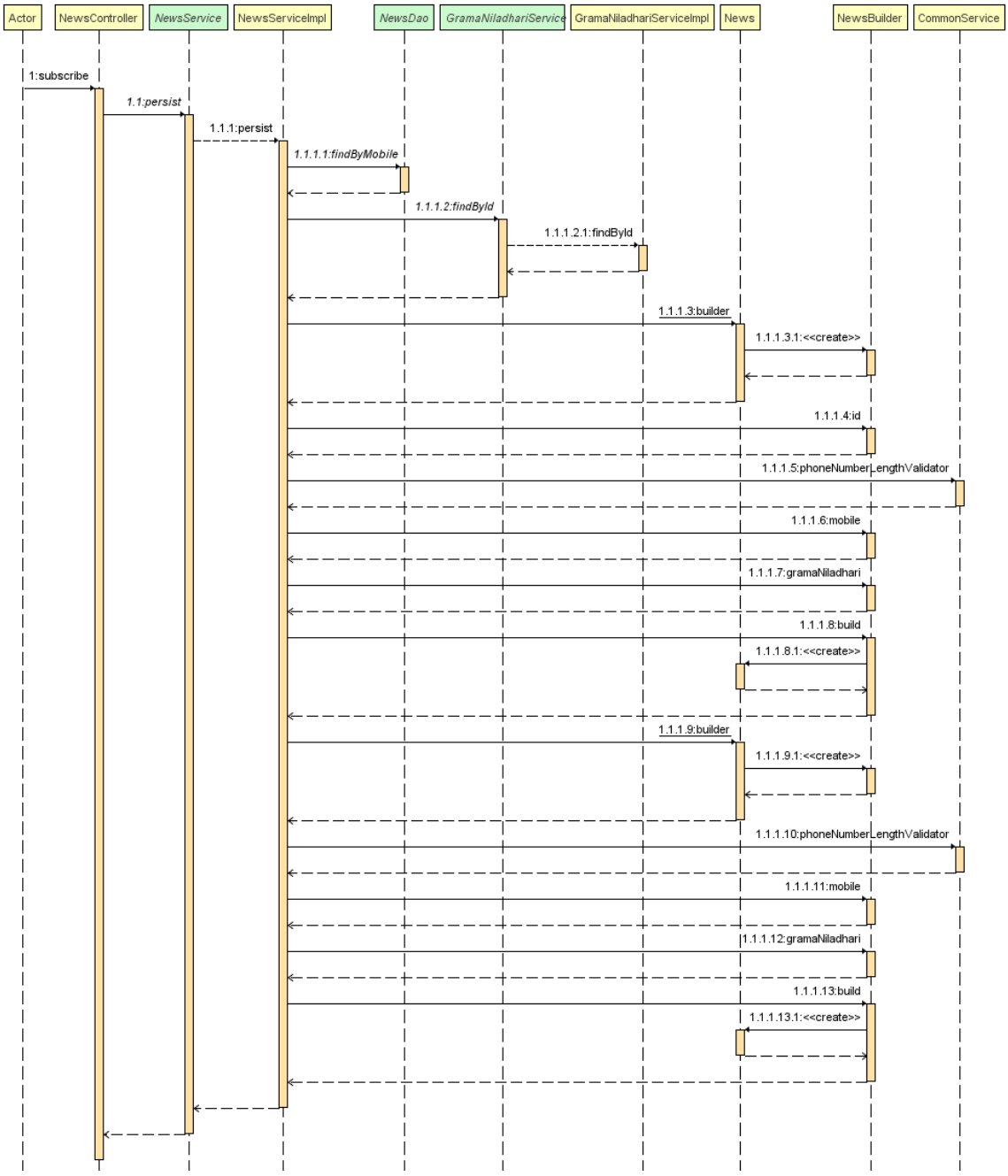
Class Diagram



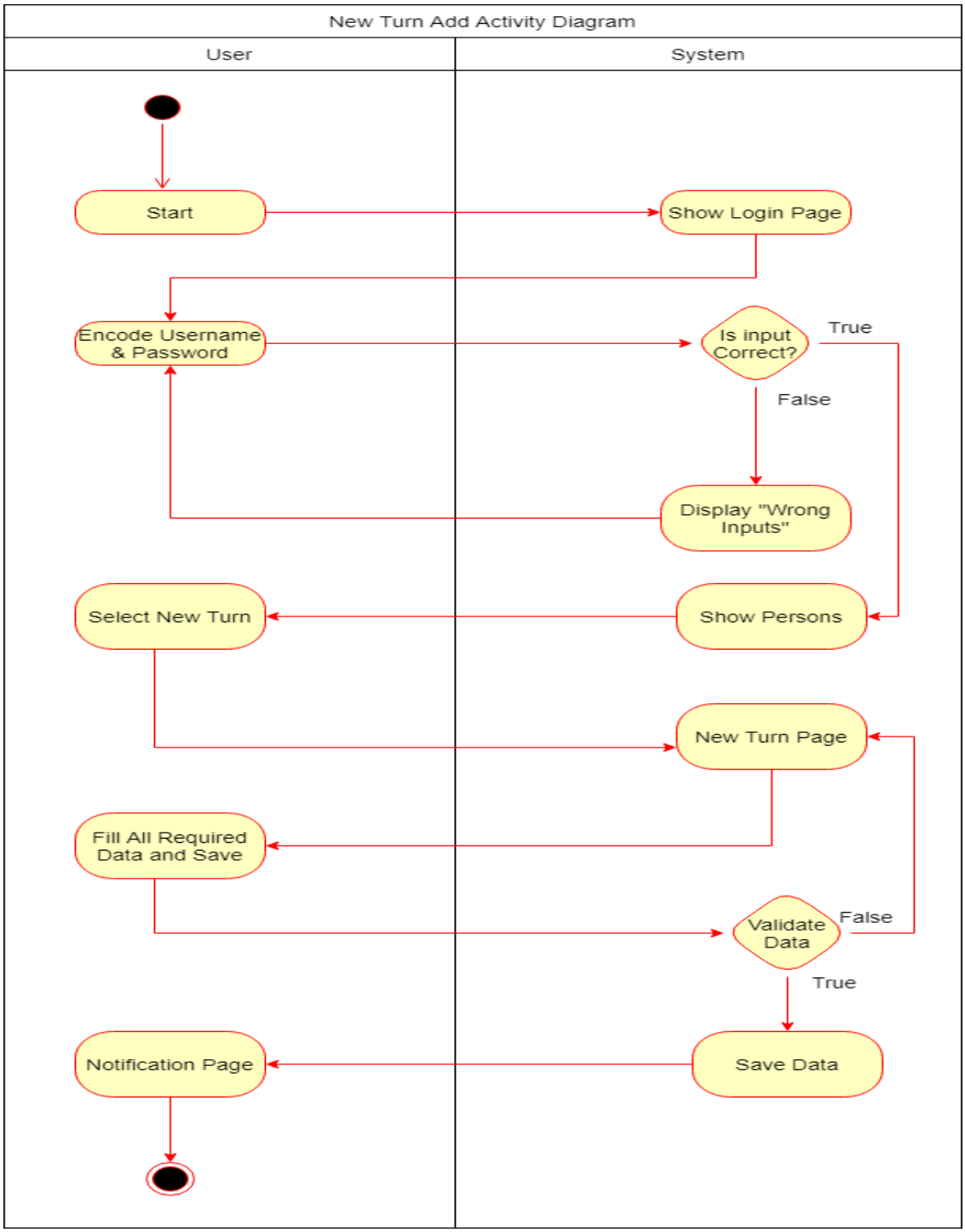
Sequence Diagram

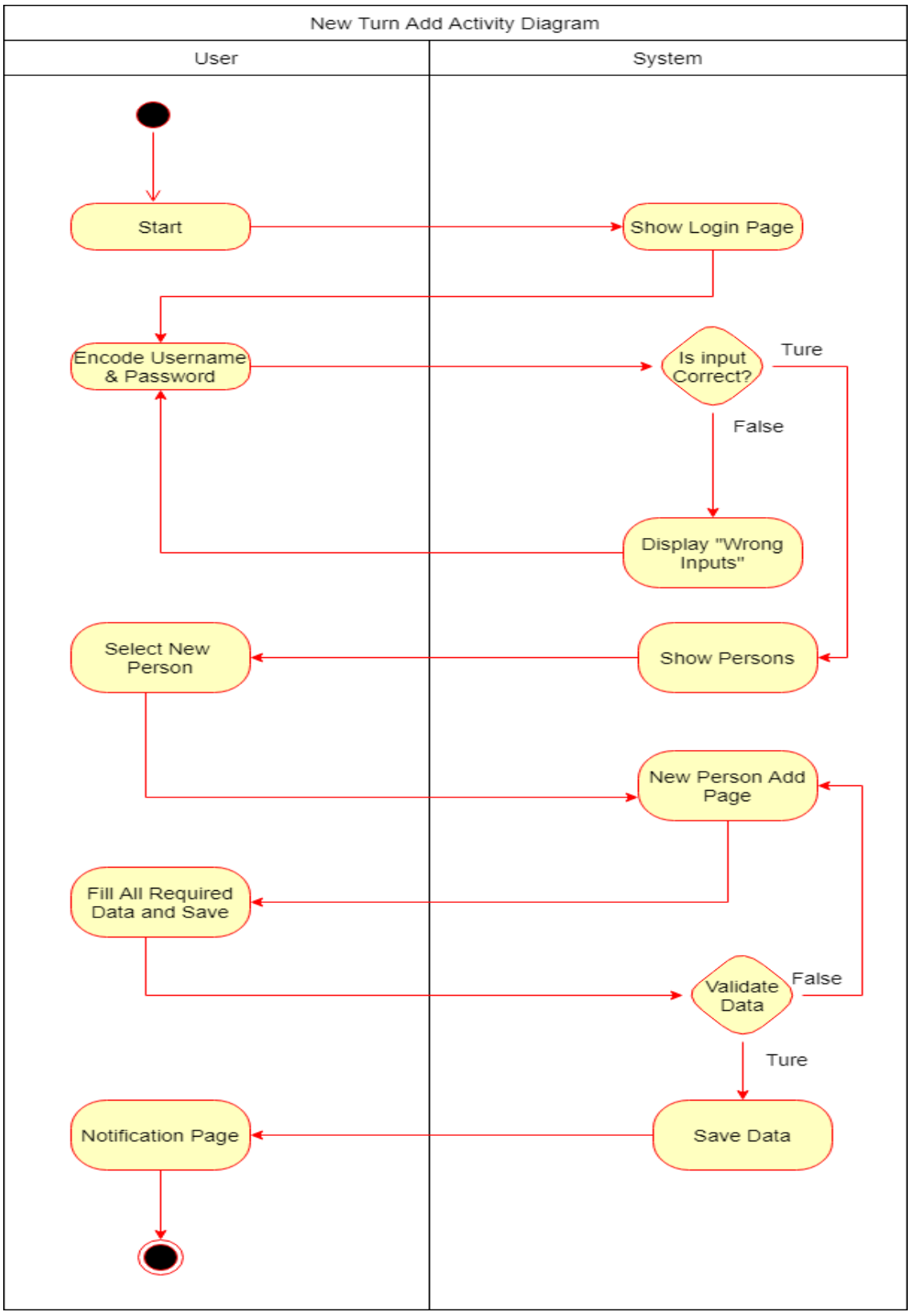


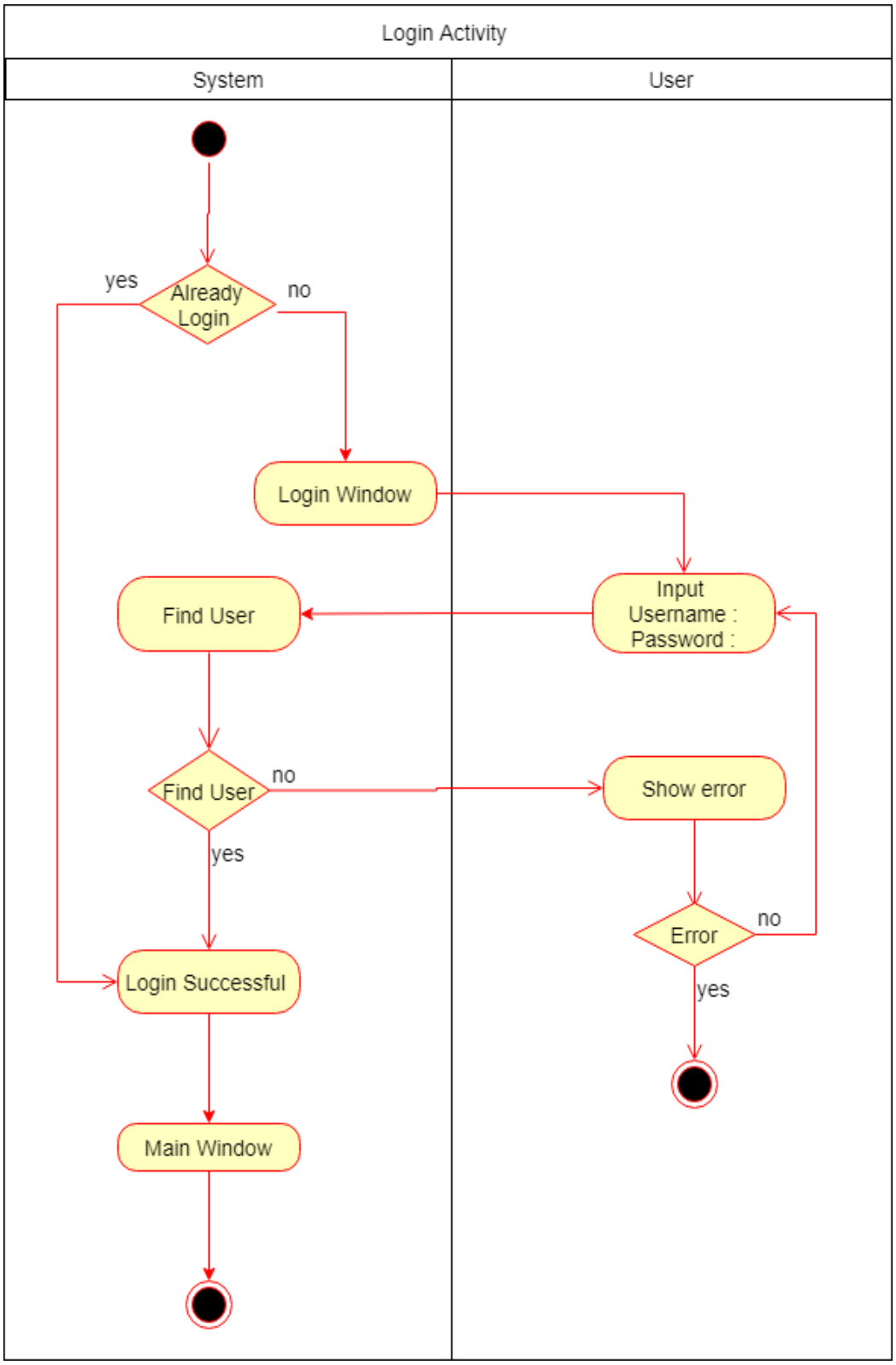

Actor
PersonController
PersonService
PersonServiceImpl
PersonLocationInteractTimeService
PersonLocationInteractTimeServiceImpl
1:savePersonTurn
1.1:saveAndTurn
1.1.1:saveAndTurn
1.1.1.1:λ→
1.1.1.1.1:λ→
1.1.1.2:persistAll
1.1.1.2.1:persistAll


Actor
NewsController
NewsService
NewsServiceImpl
NewsDao
GramaNiladhariService
GramaNiladhariServiceImpl
News
NewsBuilder
CommonService
1:subscribe
1.1:persist
1.1.1:persist
1.1.1.1:findByMobile
1.1.1.2:findById
1.1.1.2.1:findById
1.1.1.3:builder
1.1.1.3.1:<<create>>
1.1.1.4:id
1.1.1.5:phoneNumberLengthValidator
1.1.1.6:mobile
1.1.1.7:gramaNiladhari
1.1.1.8:build
1.1.1.8.1:<<create>>
1.1.1.9:builder
1.1.1.9.1:<<create>>
1.1.1.10:phoneNumberLengthValidator
1.1.1.11:mobile
1.1.1.12:gramaNiladhari
1.1.1.13:build
1.1.1.13.1:<<create>>

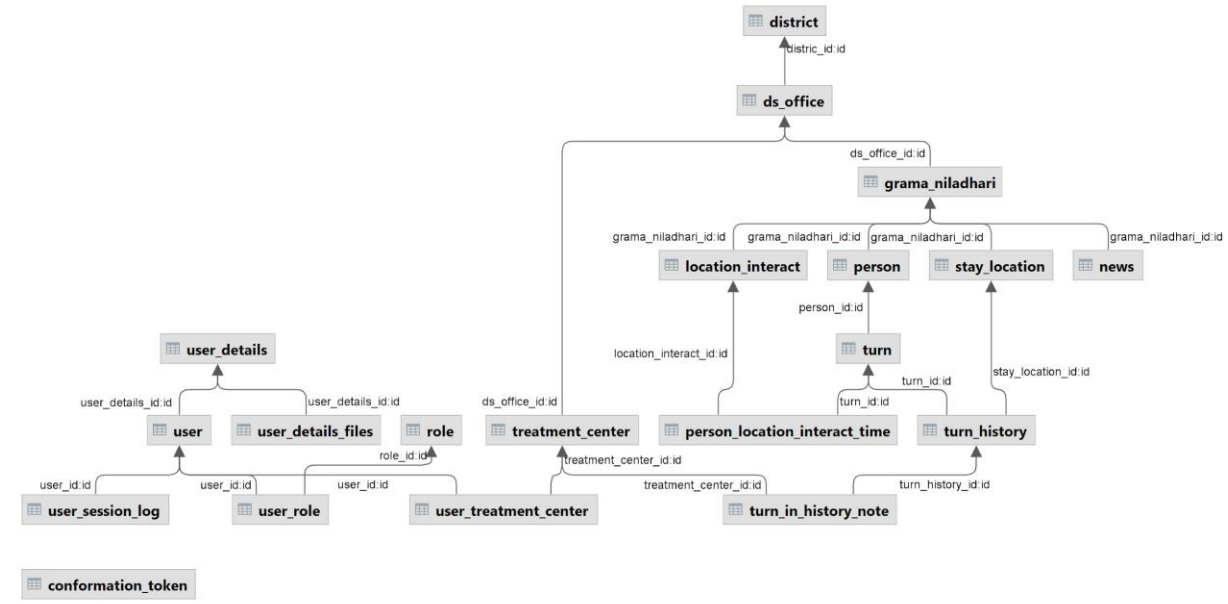
Activity Diagram




New Turn Add Activity Diagram
User
System
Start
Show Login Page
Encode Username & Password
Is input Correct?
Ture
False
Display "Wrong Inputs"
Select New Person
Show Persons
New Person Add Page
Fill All Required Data and Save
Validate Data
False
Ture
Notification Page
Save Data


Login Activity
System
User
yes
Already Login
no
Login Window
Find User
Input Username : Password :
Find User
no
Show error
yes
Error
no
yes
Login Successful
Main Window

Entity Relationship Diagram



Reference

1. https://www.who.int/news-room/feature-stories/detail/tracking-covid-19-contact-tracing-in-the-digital-age [Accessed 0n 14-08-2021]
2. The epidemiology unit, Sri Lanka: https://www.epid.gov.lk/web/ [Accessed on 07-09-2021].

APPENDIX 3

User Manual

HOME SCREEN

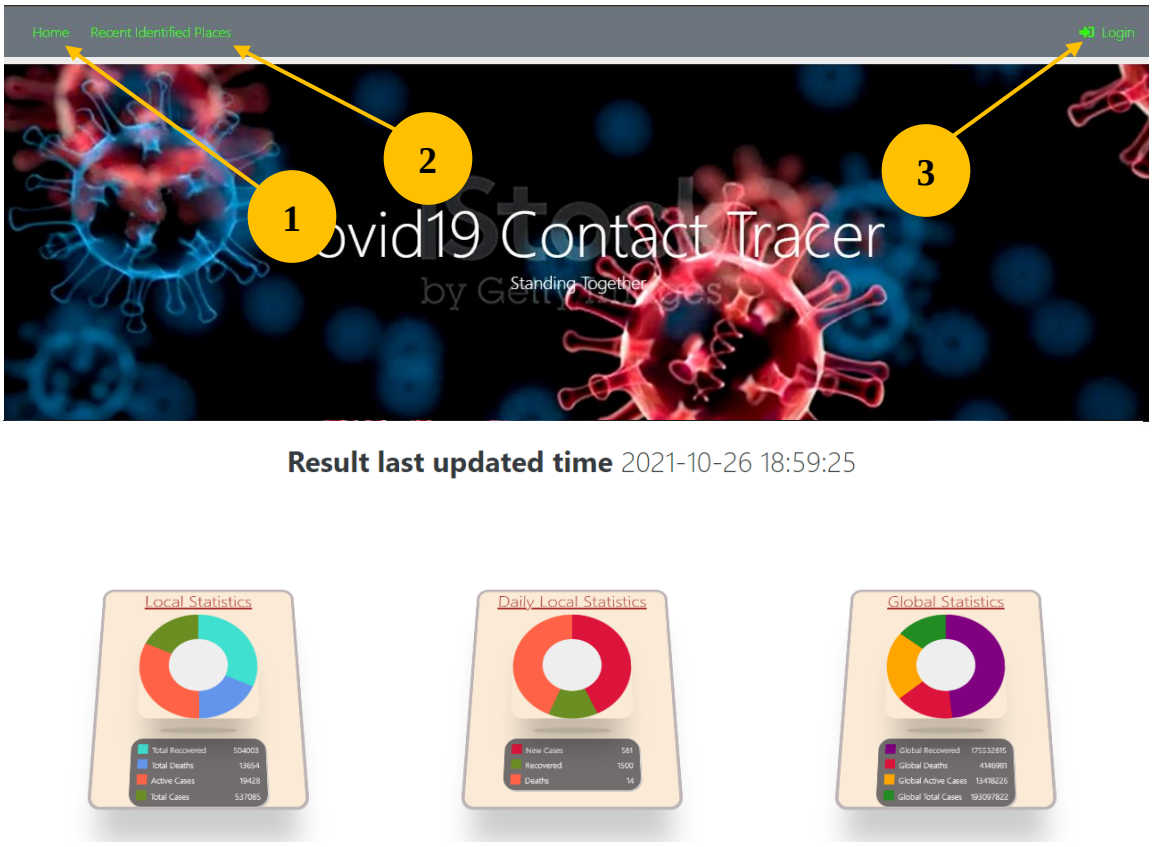


Figure 19: System Home Screen

This window shows identified covid 19 cases locally daily and globally.

1. Home button refresh the home window
2. Recent Identified Places

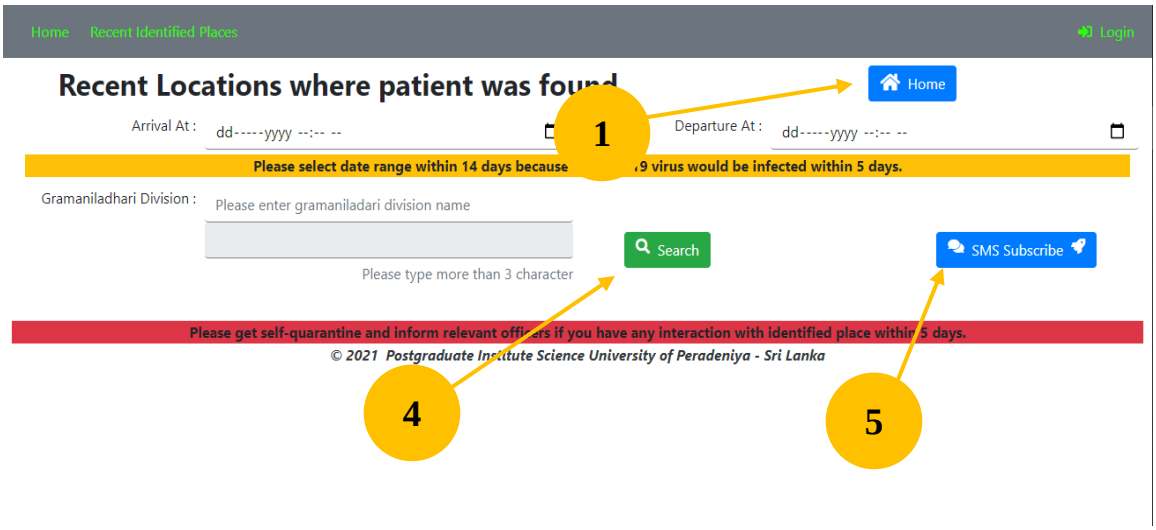


Figure 20: Recently Identified Places

LOGIN SCREEN

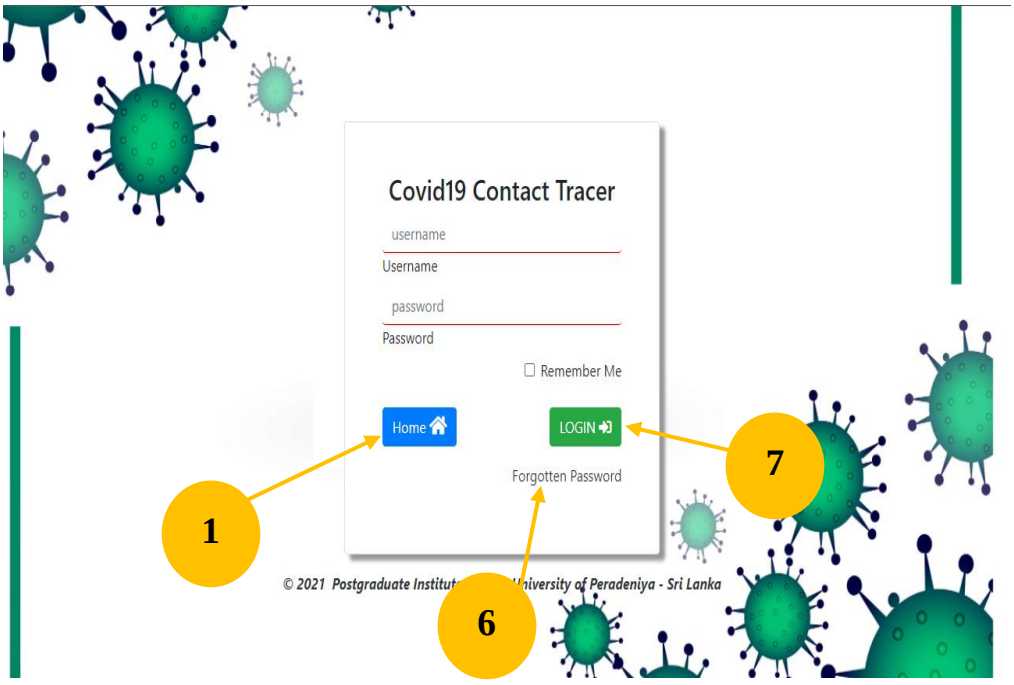


Figure 21: Login Screen of the system

After filling Arrival time, departed time and Grammaniladhari Division, locations where patients have been found lists.

SMS Subscribe

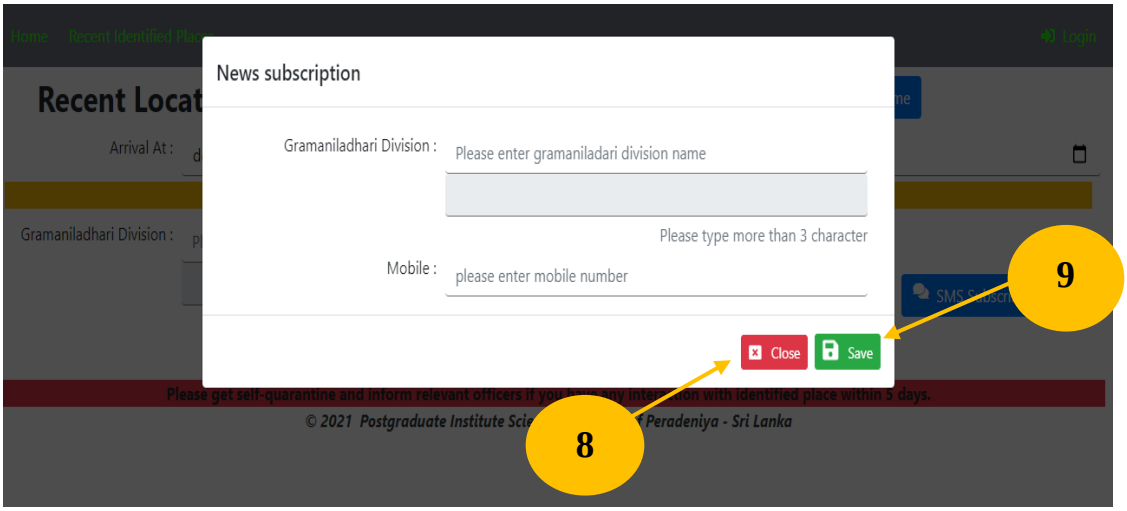


Figure 22: SMS News Subscription

Reset the password

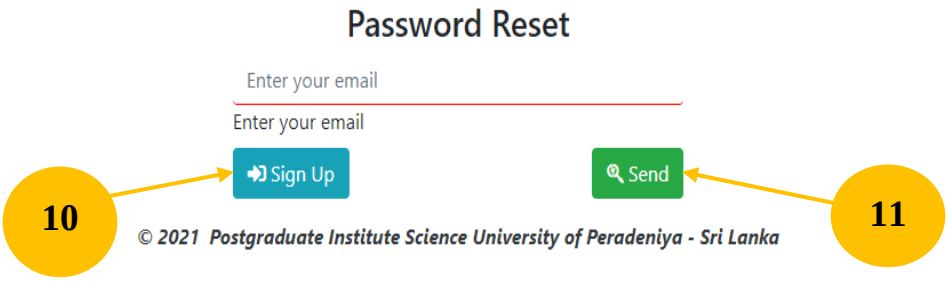


Figure 23: Password Reset

1. Entering the correct Username and Password will be a successful login attempt

2. Close the SMS Subscribe window.

3. Enter mobile number and Gramaniladhari Division and save; News related to selected gramaniladhai division will be sent via SMS.

4. Reload back to login menu.

5. After entering registered email and clicking send bellow window will appear

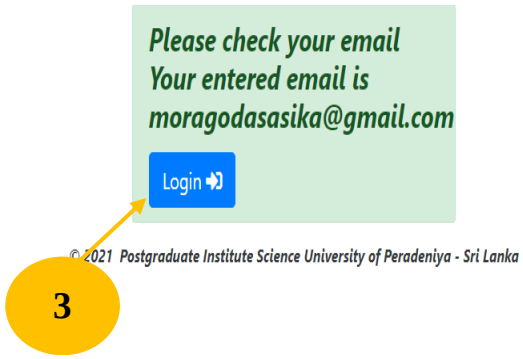


Figure 24: Validating the email entered

You will be sent an email with instructions to reset password.

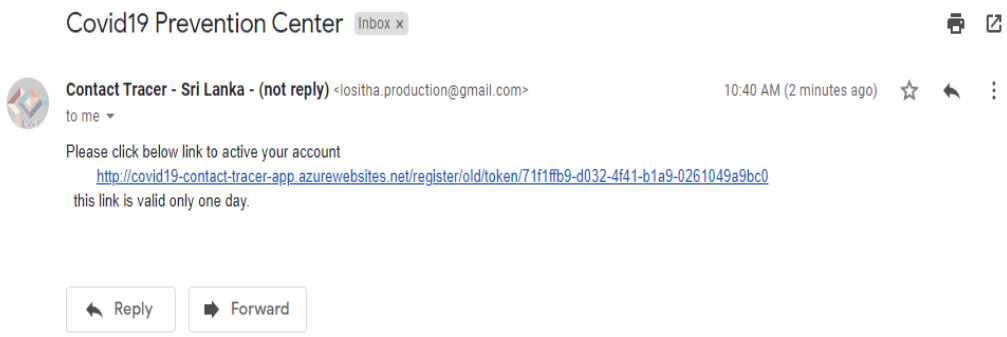


Figure 25: Instructions link to reset the password

6. Enter new password and click send to change password.

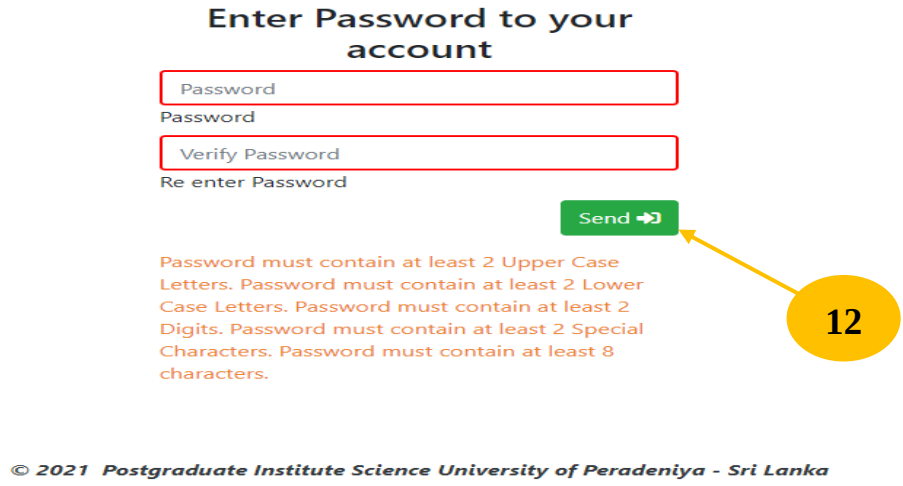


Figure 26: Screen to enter new password

User Login - ADMIN

Successful login will direct admin account to the following window.

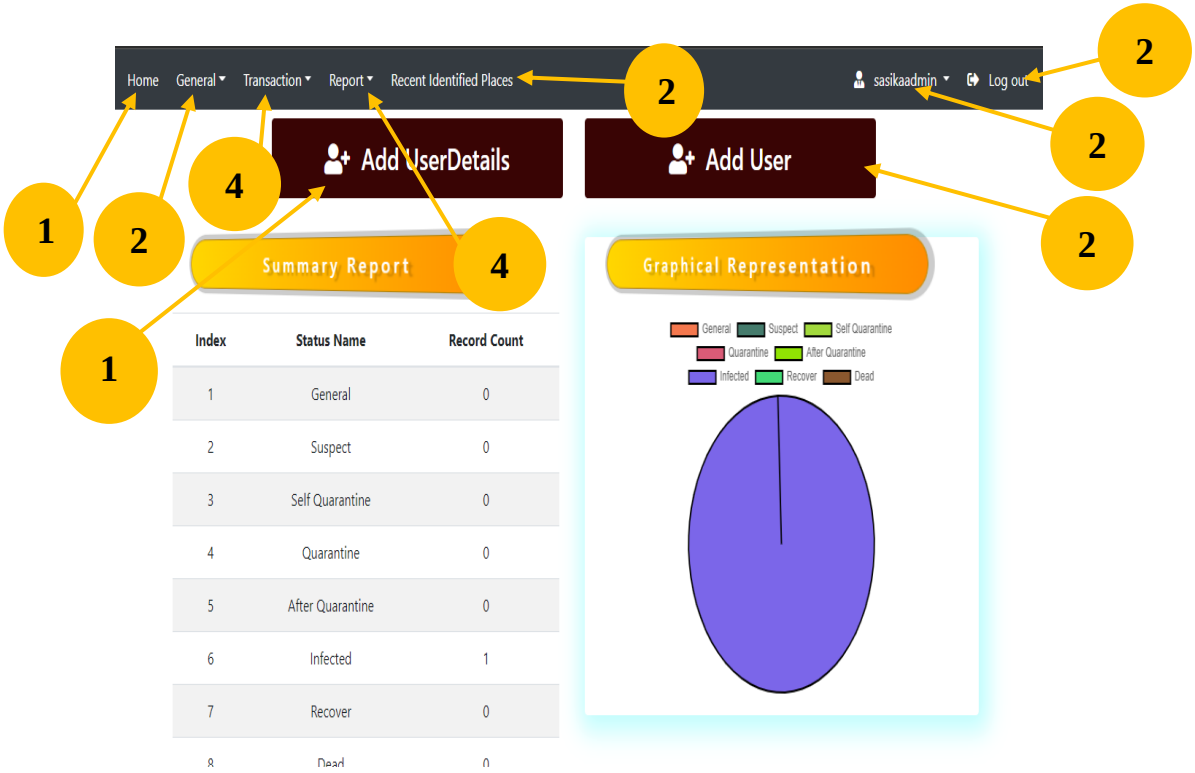


Figure 27: Admin login window

1. Above window shows summery report of entered data to the application.
2. Logout from the account.
3. Add User Details.

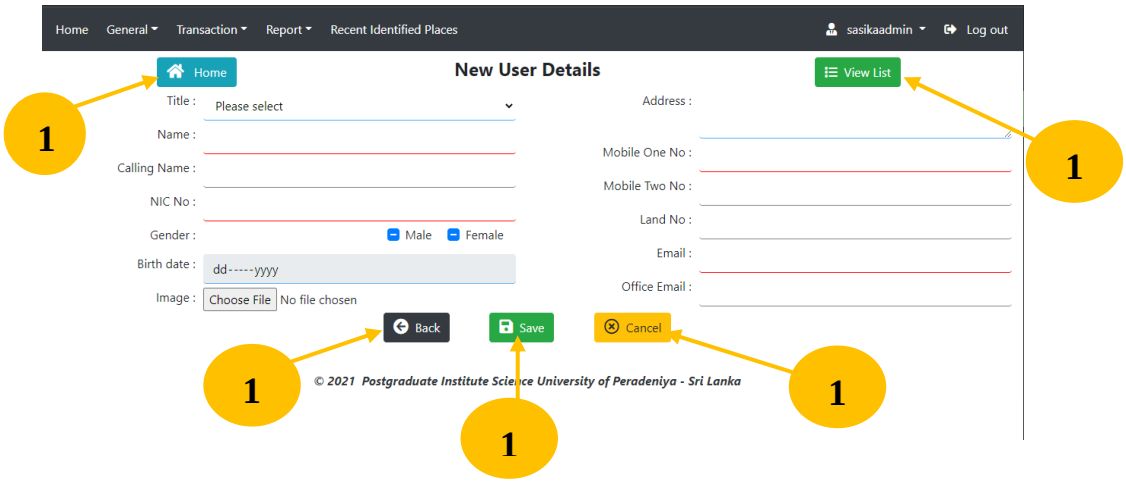


Figure 28: Screen to add user details

4. Direct to list view of registered users.

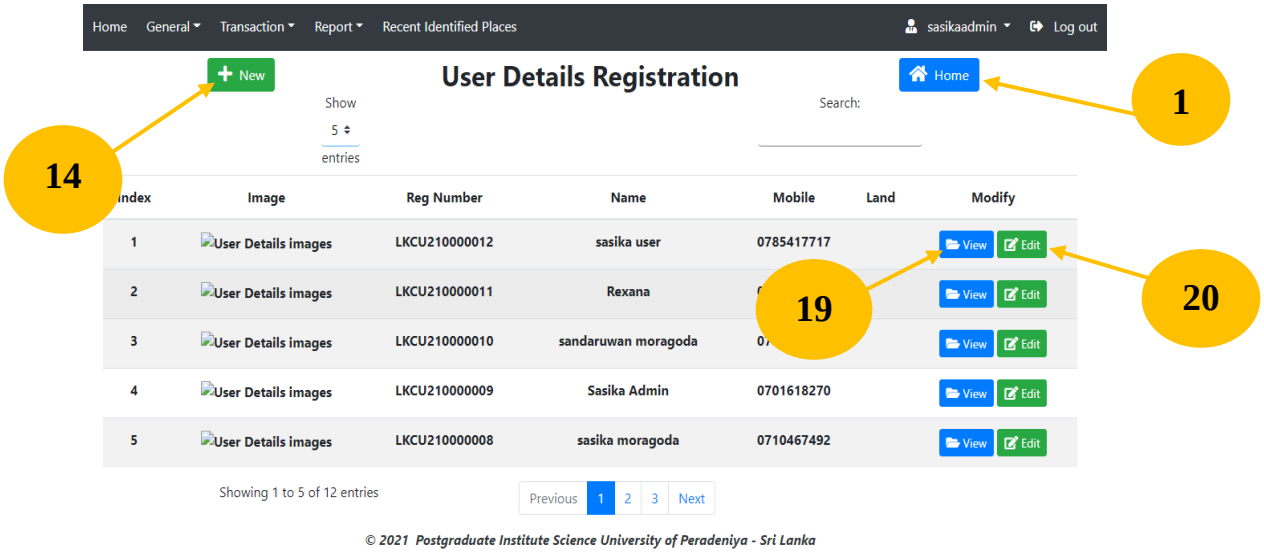


Figure 29: Screen to user details registration

5. Direct to list view of registered users.
6. After filling necessary information admin can register a new user.
7. Close the add user details menu.
8. View

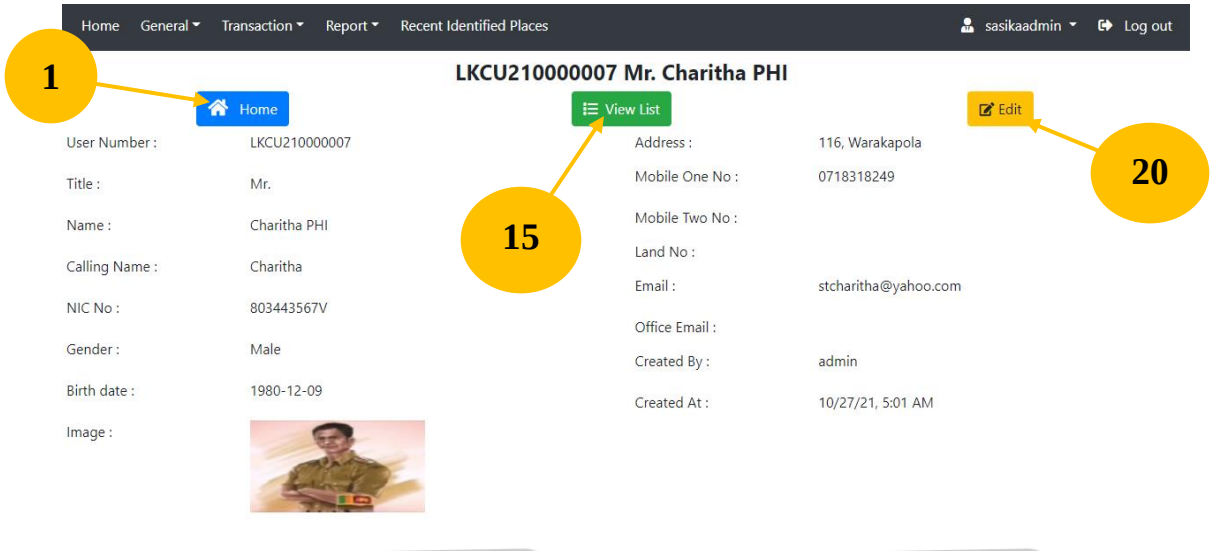


Figure 30 : Screen to view registered users

7. Edit

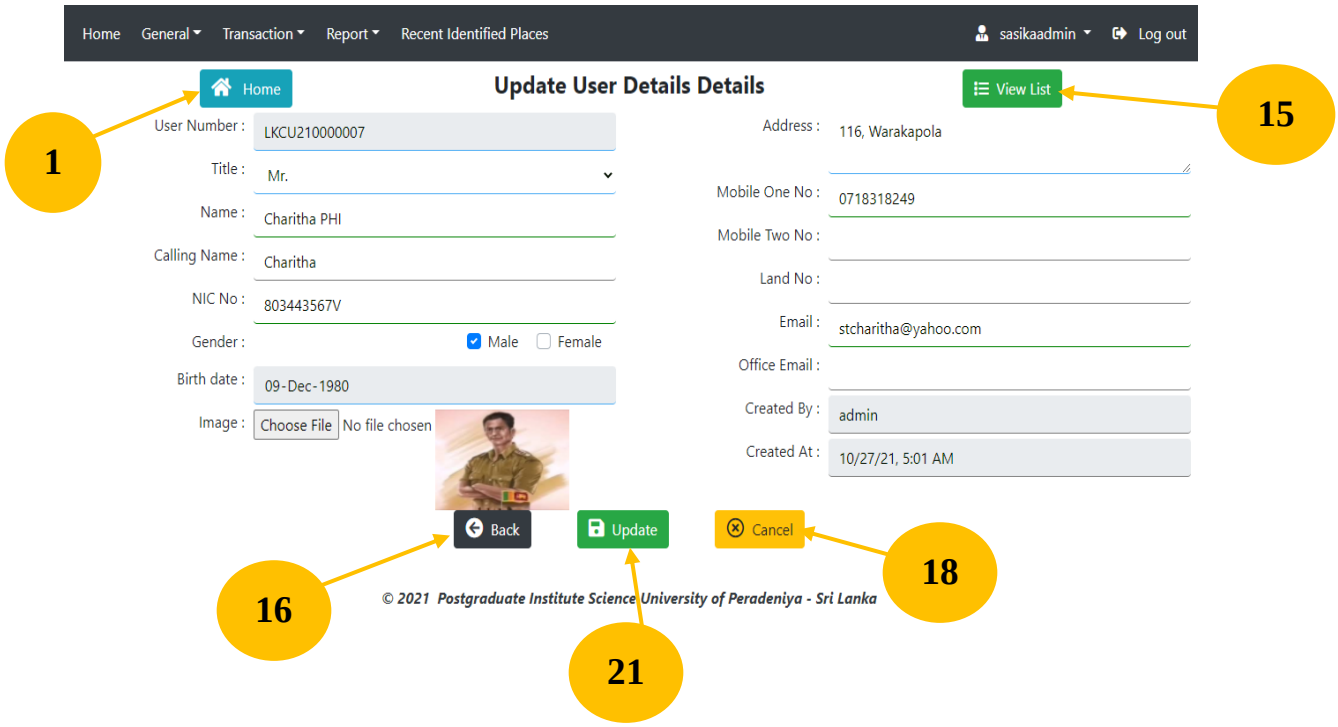


Figure 31:Screen to update user details

8. Save the updated information to system.

9. Add user.

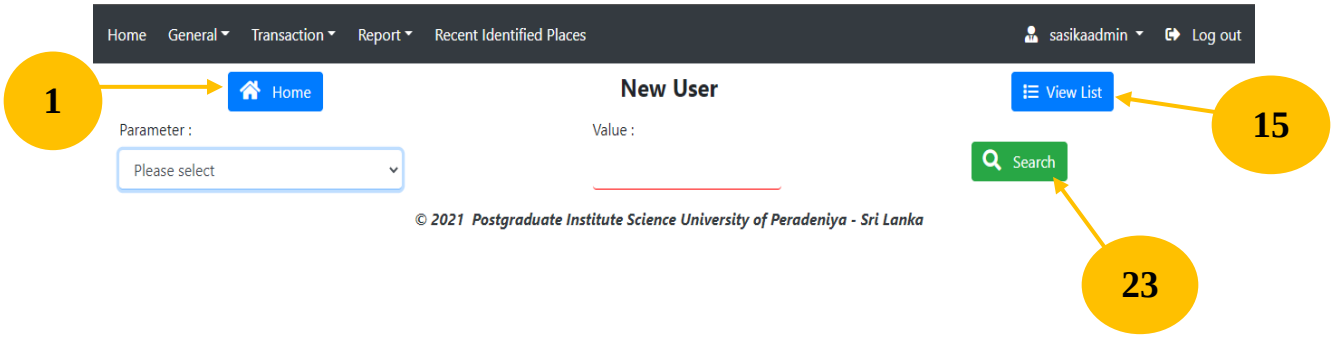


Figure 32: Screen to add user

10. Select parameter and fill the corresponding value then click the search button.

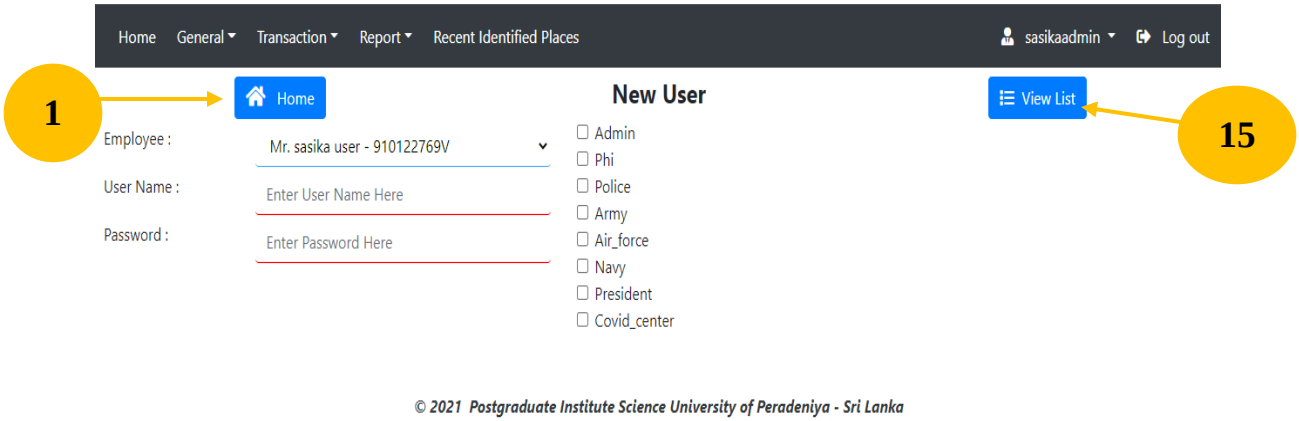


Figure 33: Screen to new user

When admin select the user roll save button appears, clicking save admin can change the user's roll.

11. User can logout from account.

12. User.

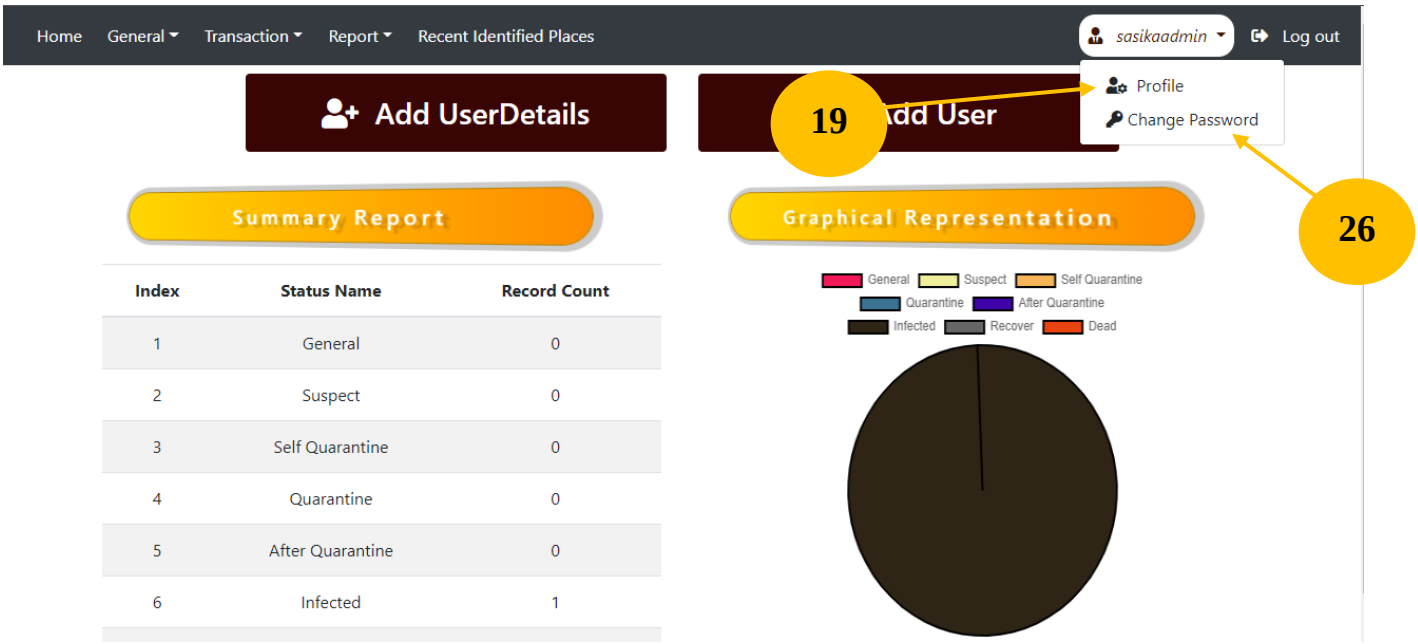


Figure 34: Screen to user logout

13. Change Password.

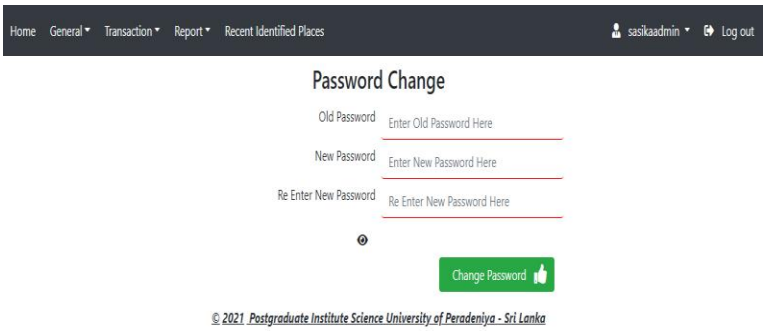


Figure 35: Screen to user change password

User can change the password after filling necessary information and clicking change password button.

14. General

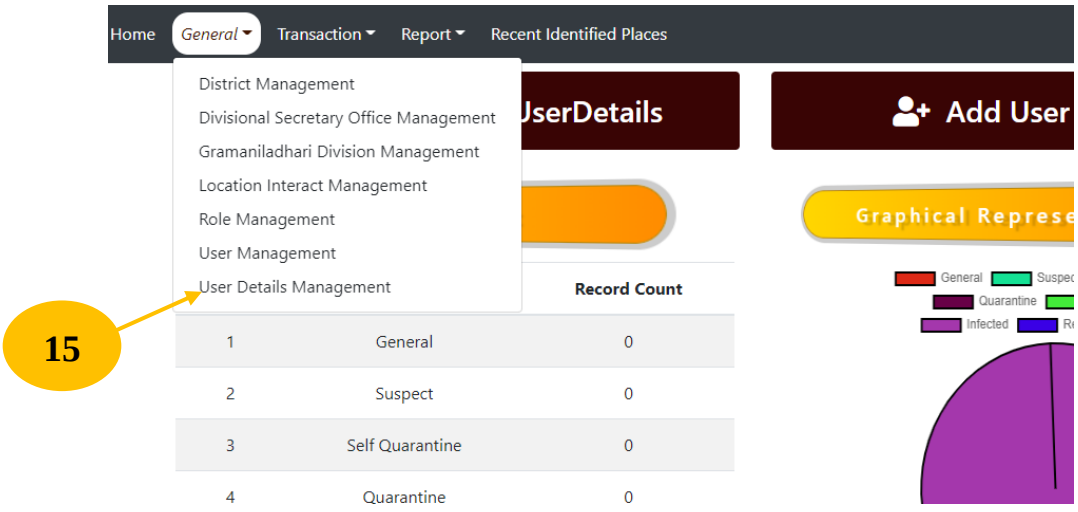


Figure 36: Screen to General view

District Management

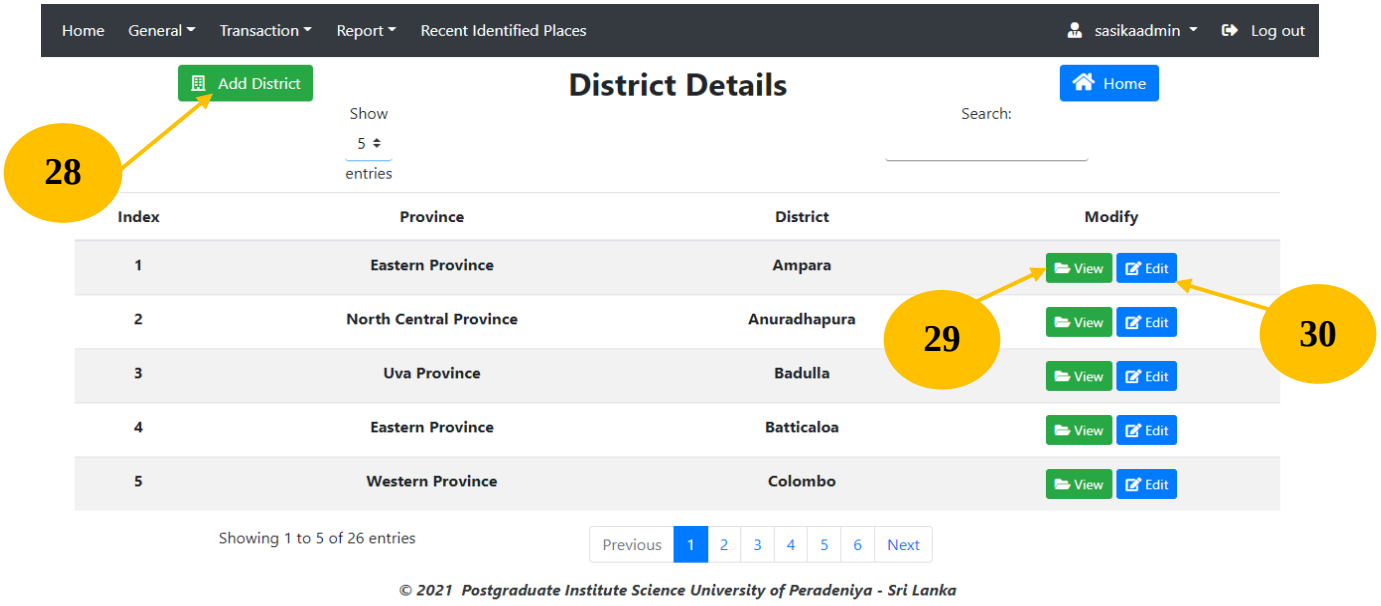


Figure 37: Screen to view district details

1. Add District.

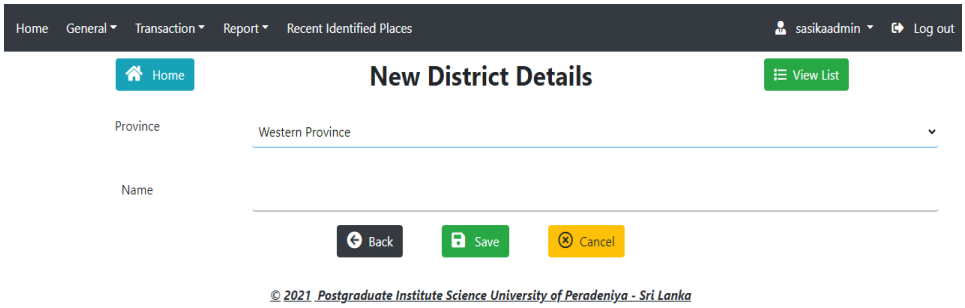


Figure 38: Screen to user change password

Filling necessary information admin can add new district and save.

2. View button direct to the view window of selected district.

3. Edit.

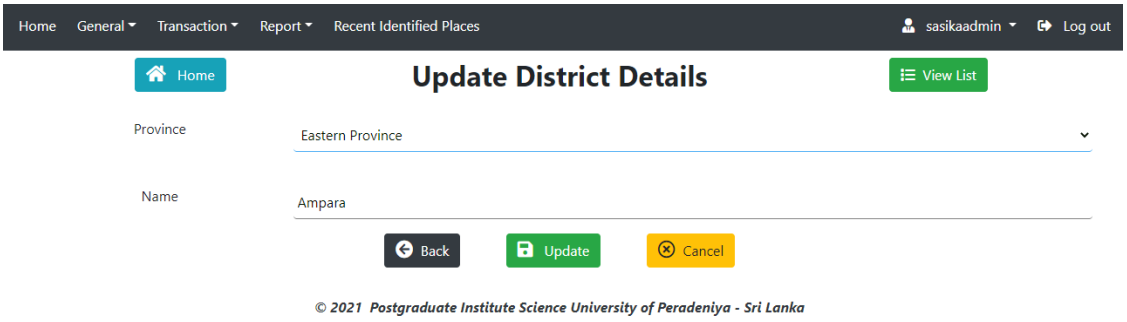


Figure 39: Screen to view update district details

Admin can edit district information and update clicking update button.

Divisional Secretary Office Management.

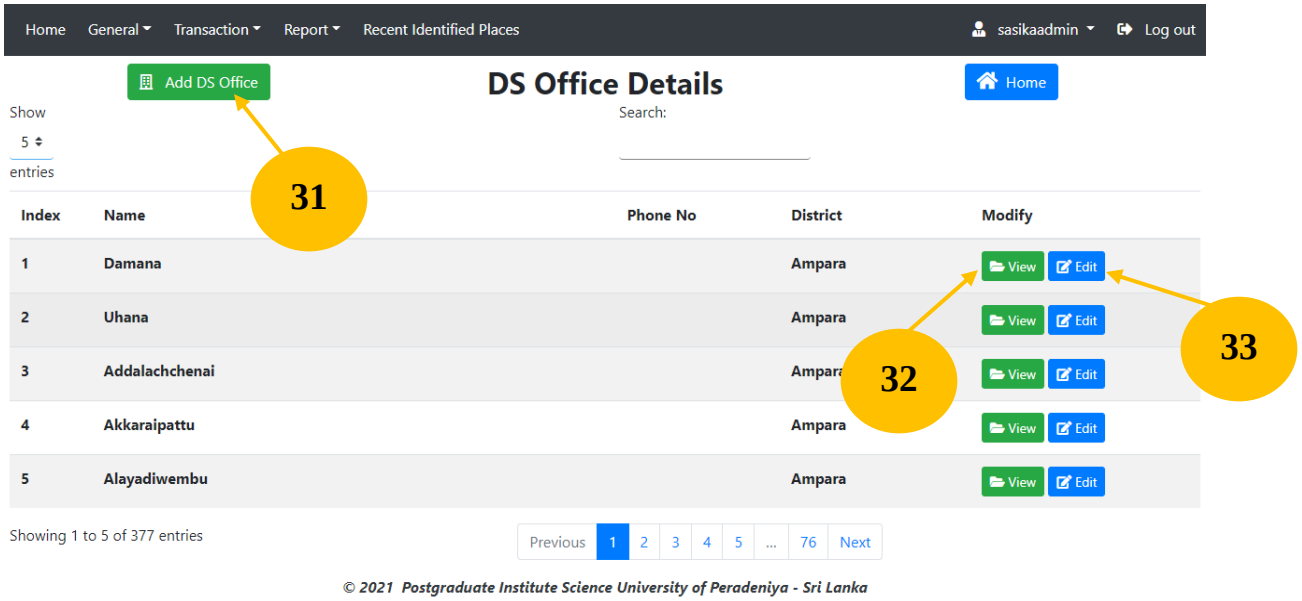


Figure 40: Screen to DS office management

1. Add DS Office

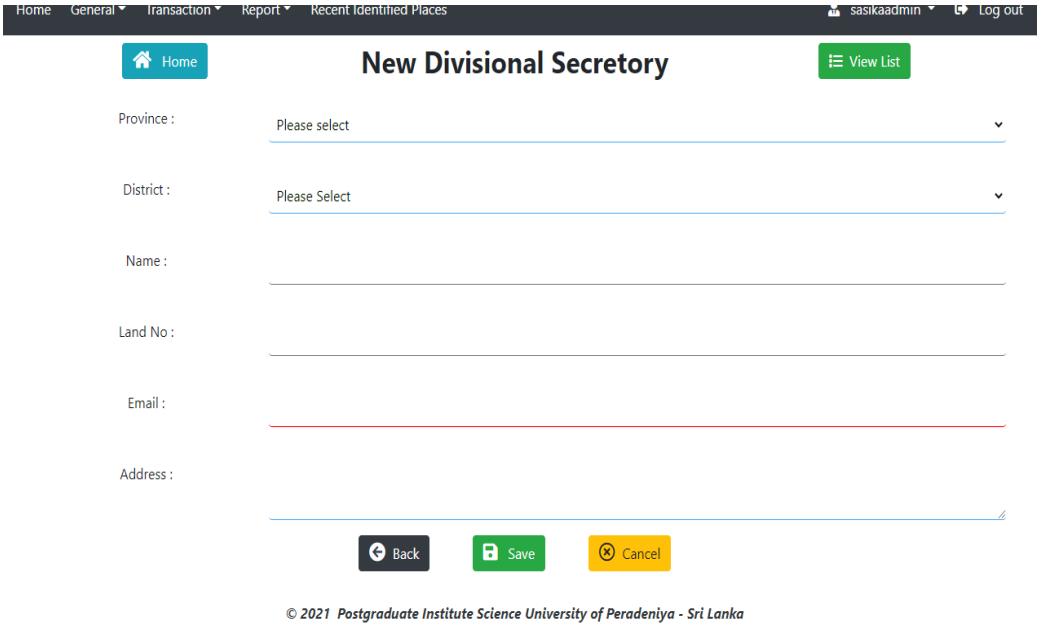


Figure 41: Screen to view DS office

Filling necessary information admin can add new divisional secretory.

2. Selected divisionary secretory details can be viewed.

3. Admin can change the already added details and update.

Gramaniladhari Division Management.

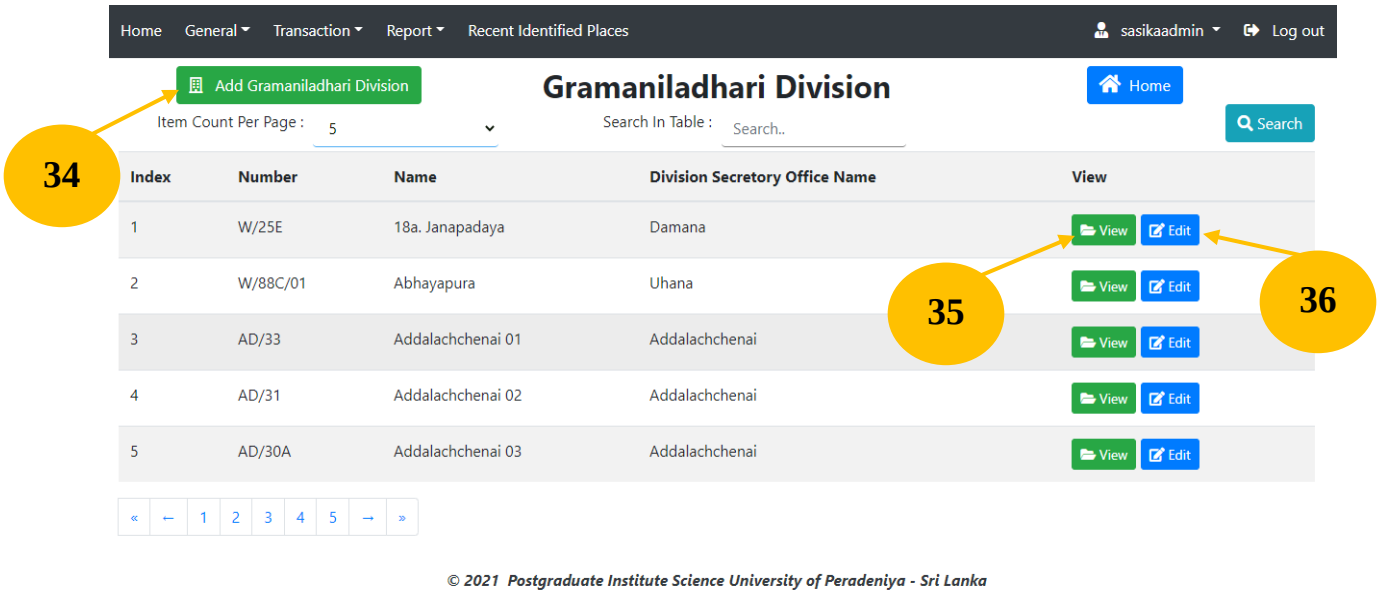


Figure 42: Screen to view GS Division

1. Add Gramaniladhari Division.

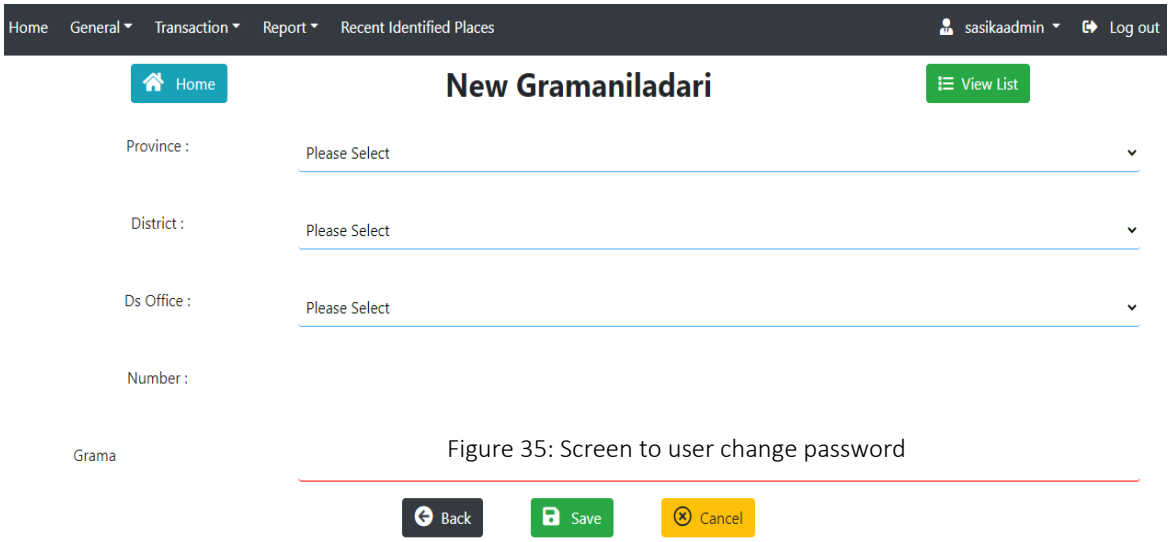


Figure 35: Screen to user change password

Figure 43: Screen to view new GN

Filling necessary information admin can add new gramaniladari division.

3. Selected gramaniladari division details can be viewed.
4. Admin can change the already added details and update.

Location Interact Management.

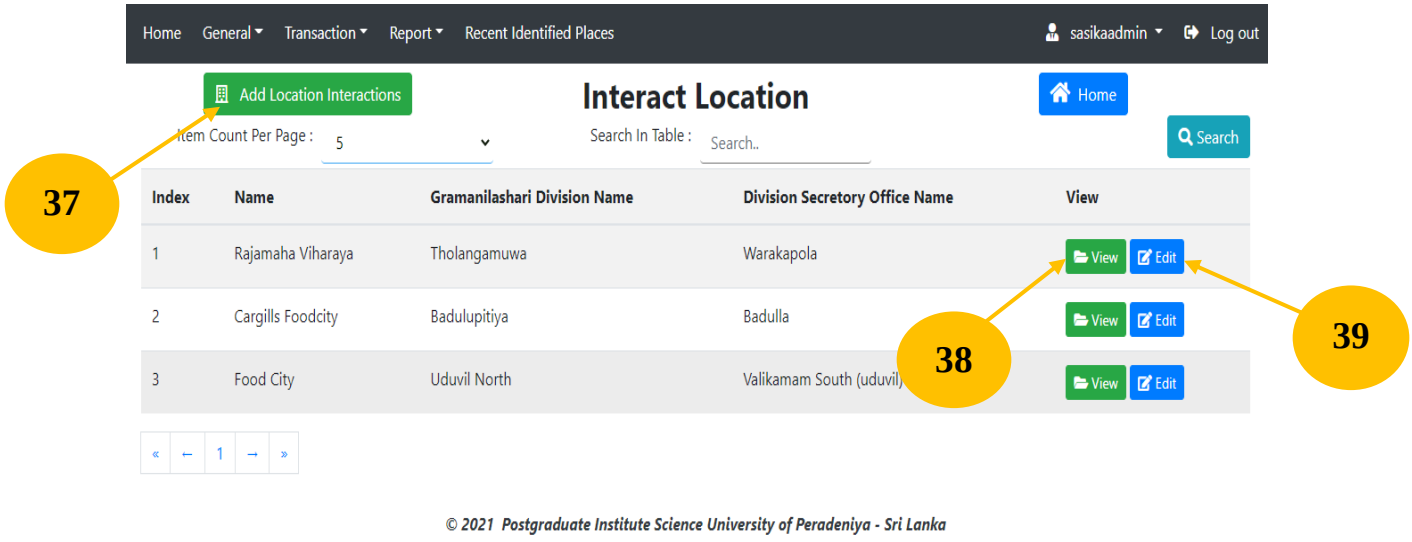


Figure 44: Screen to view user view interact location

5. Add Location Interactions.

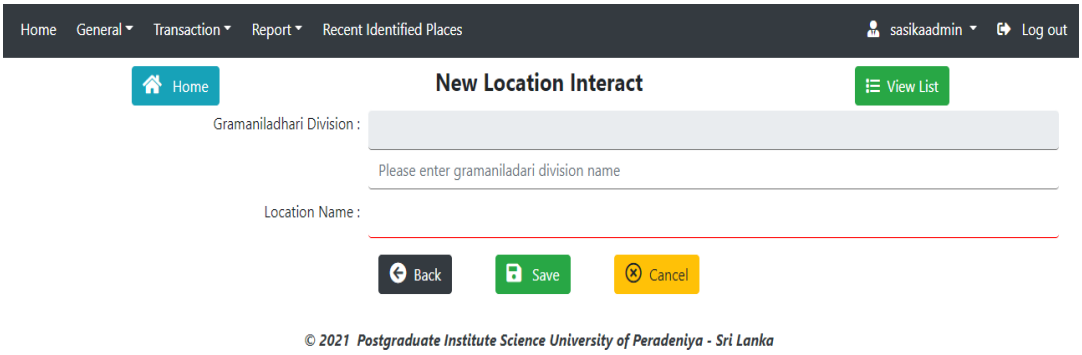


Figure 45: Screen to view user view new interact location

Filling necessary information admin can add new location.

6. Selected gramaniladari division details can be viewed.

7. Admin can change the already added details and update.

Role Mangement.

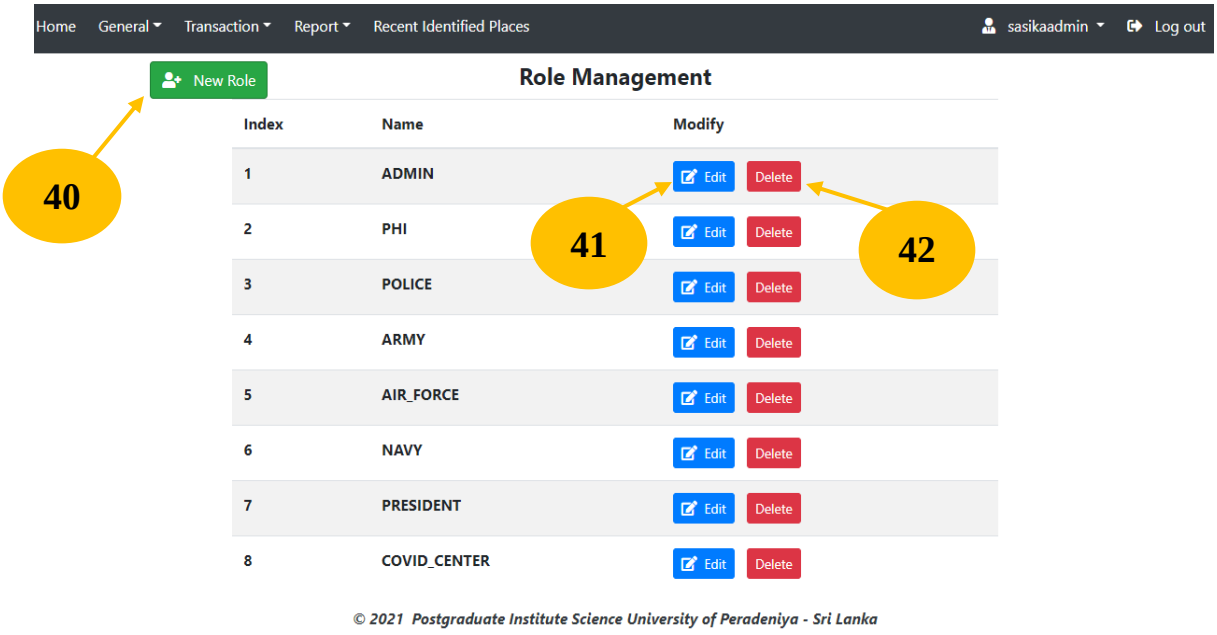


Figure 46: Screen to view role management

8. New Role

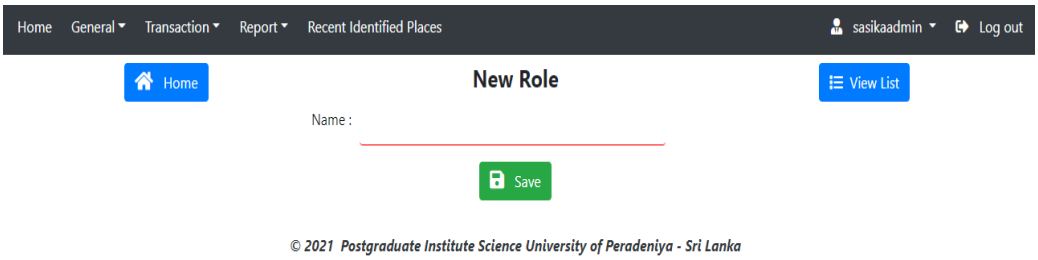


Figure 47: Screen to view new role

Filling new role name and saveing that role can be added to the system.

9. Role name can be update clicking edit button.

10. Existing role can be delete clicking delete button.

User Management.

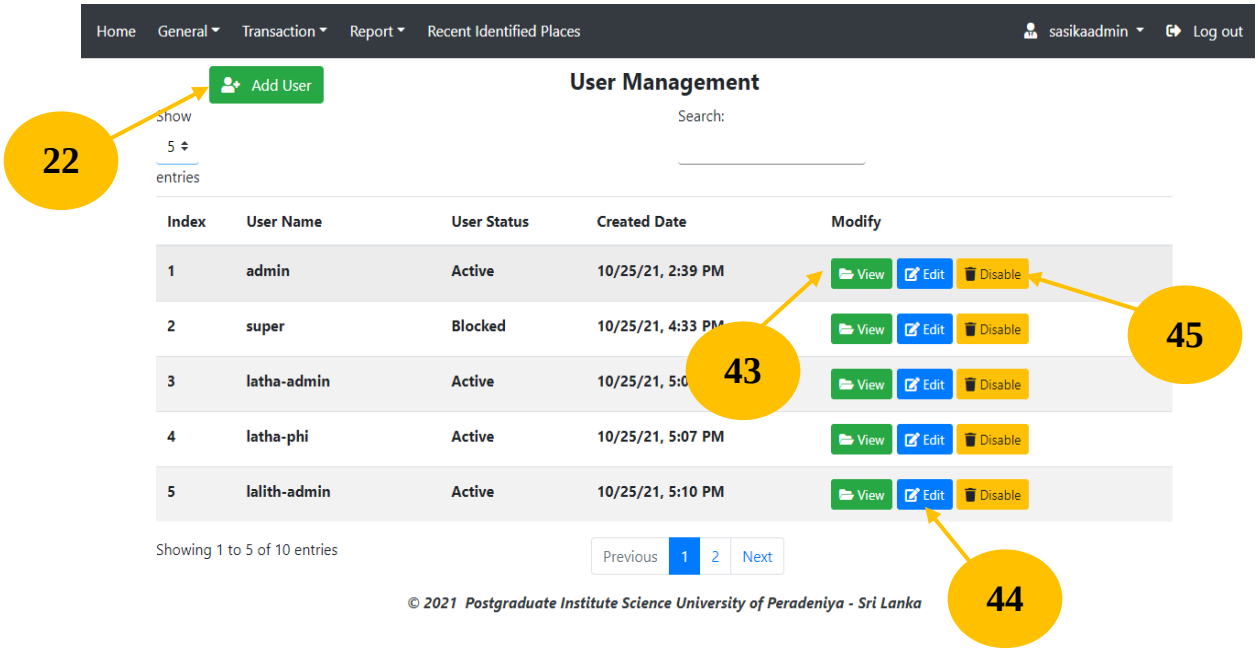


Figure 48: Screen to user management

1

12. Admin can change the already added details and update.

13. Admin can disable the user.

14. Transaction.

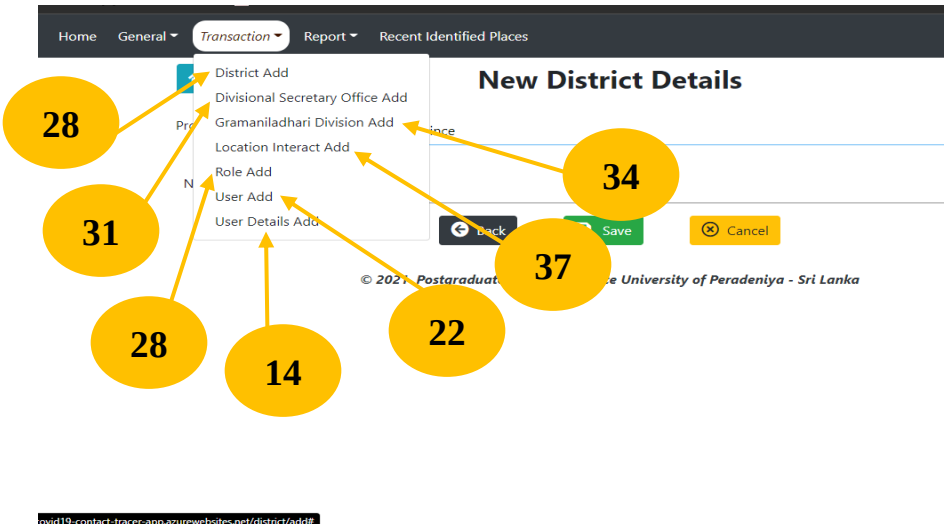


Figure 49: Screen to view Transactions

15. Report.

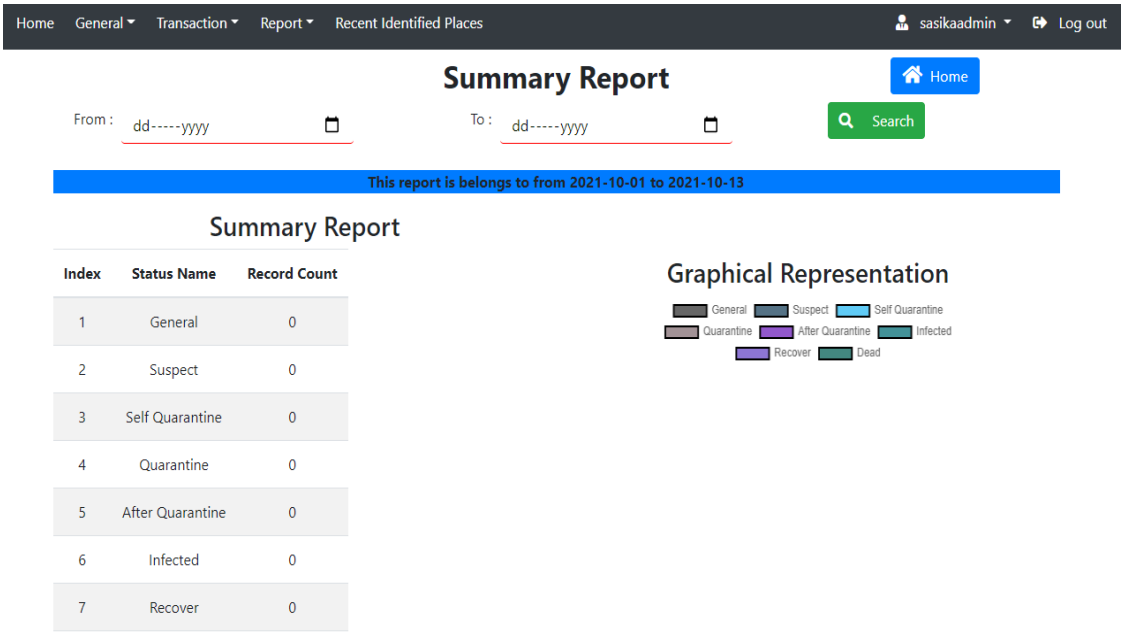


Figure 50: Screen to view summary report

Filing from date and to data summary report can be generated.

PHI

Successful login direct PHI account to the following window.

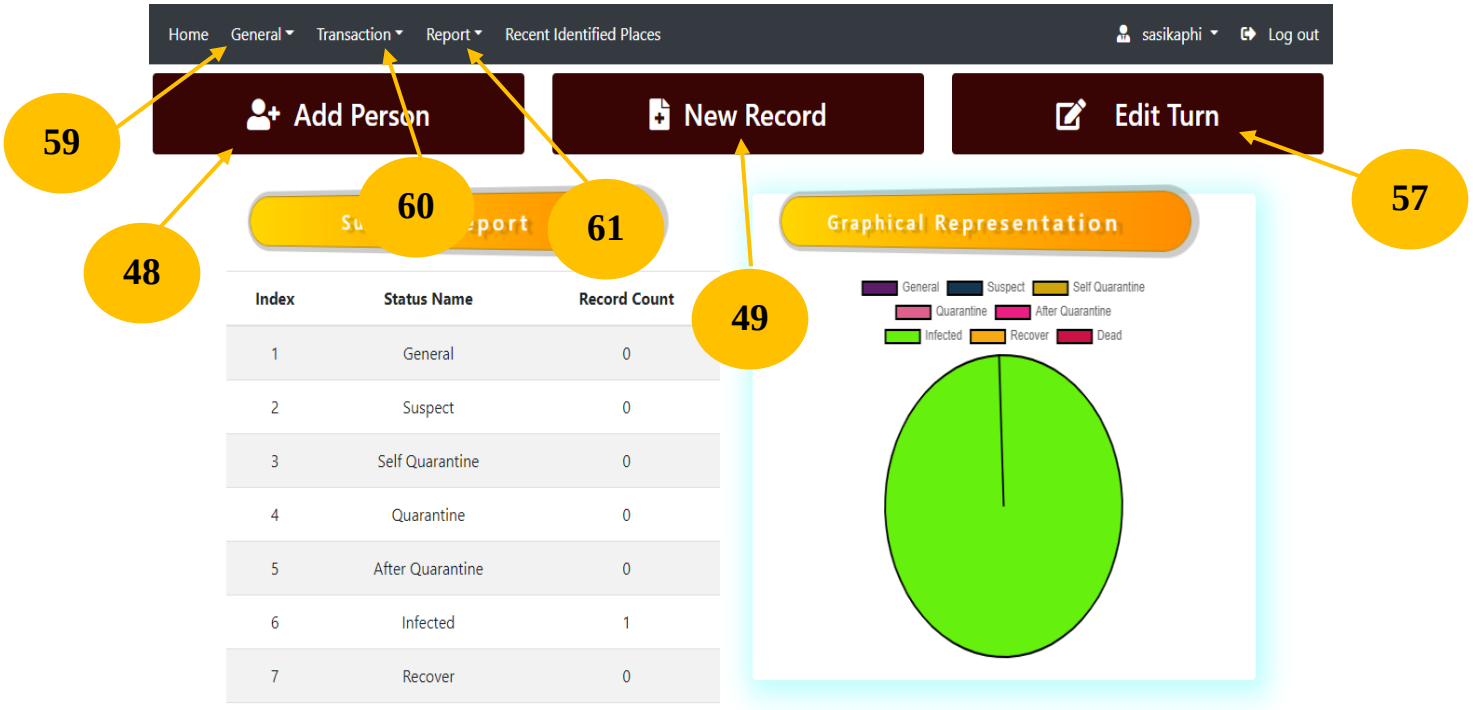


Figure 51: Screen to view PHI login window

16. Add Person

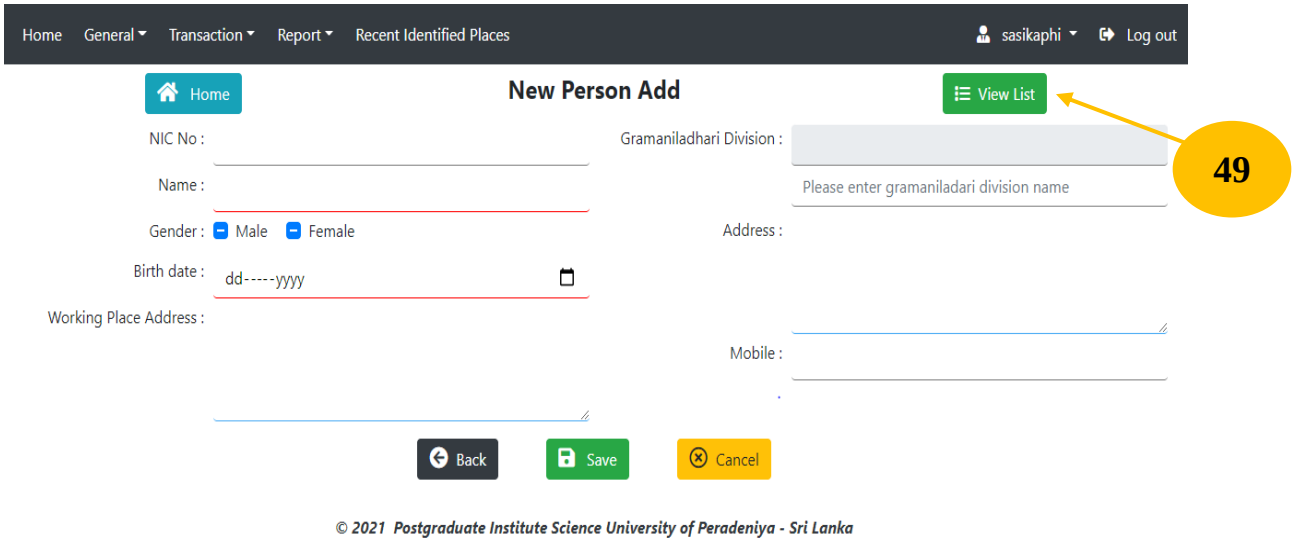


Figure 52: Screen to view add person

Filling necessary information PHI can add new person.

17. New Record.

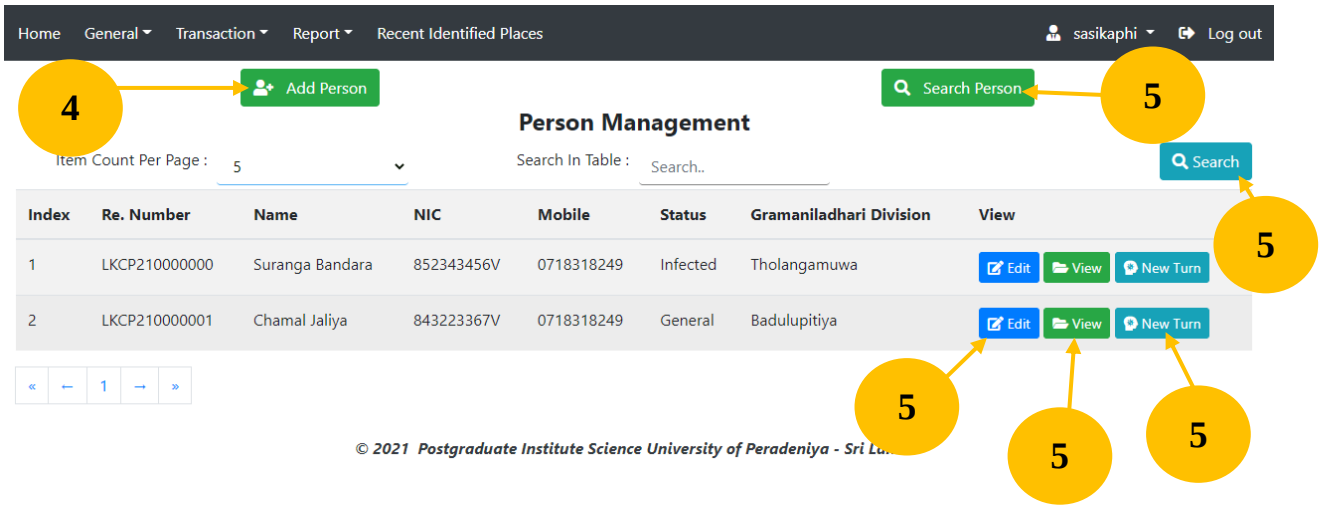


Figure 53: Screen to view new records

18. User details can be update clicking edit button.

19. User details can be view clicking view button.

20. Search.

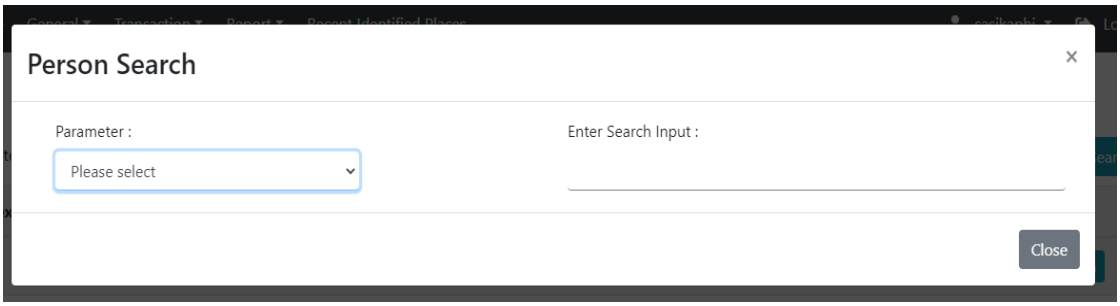


Figure 54: Screen to search

After selecting parameter should fill the search input then search results appears.

21. Search Person.

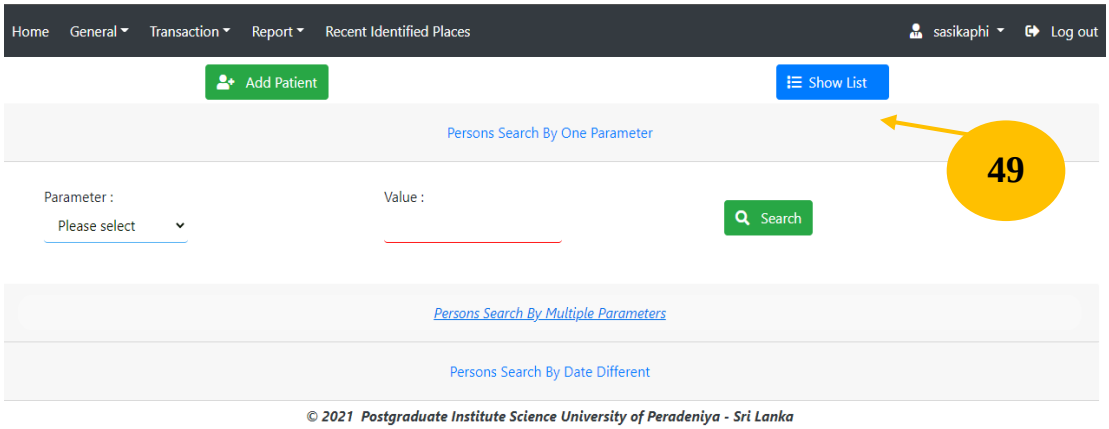


Figure 55: Screen to search person

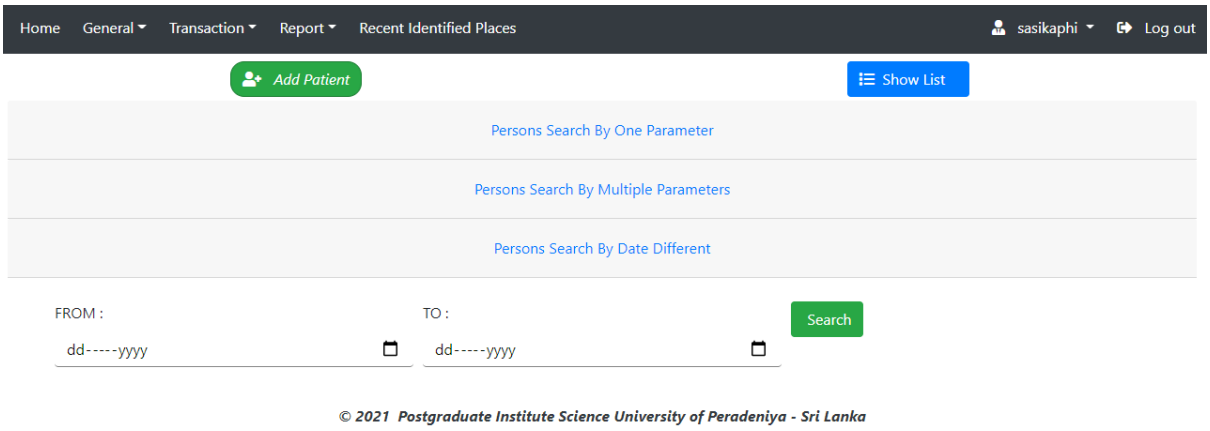


Figure 56: Screen to search by parameter

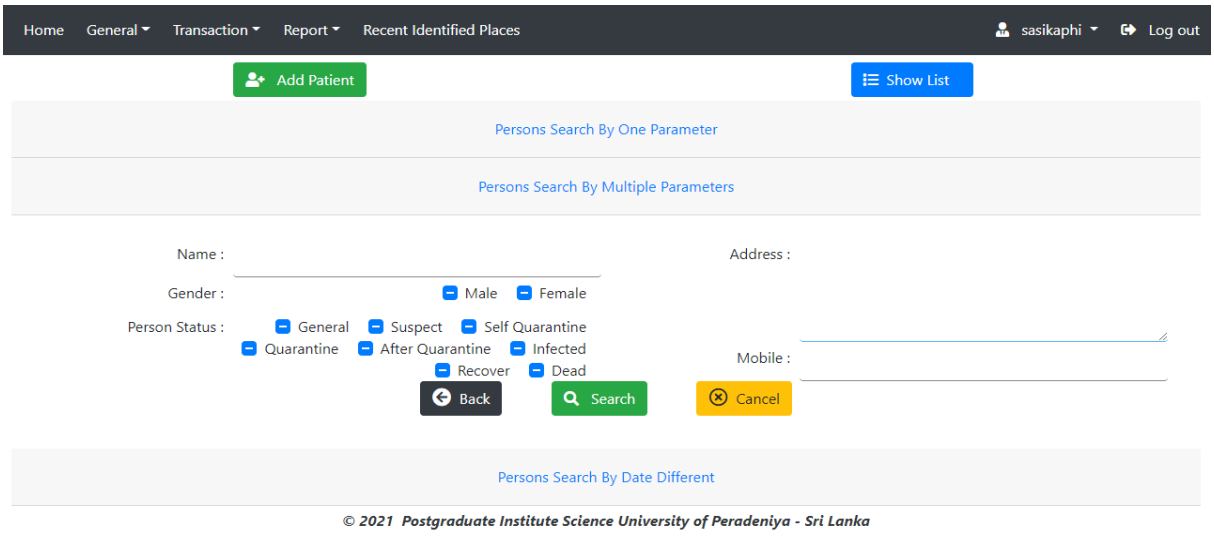


Figure 57: Screen to search by parameter

Here PHI can search a person according to different parameters.

22. New Turn

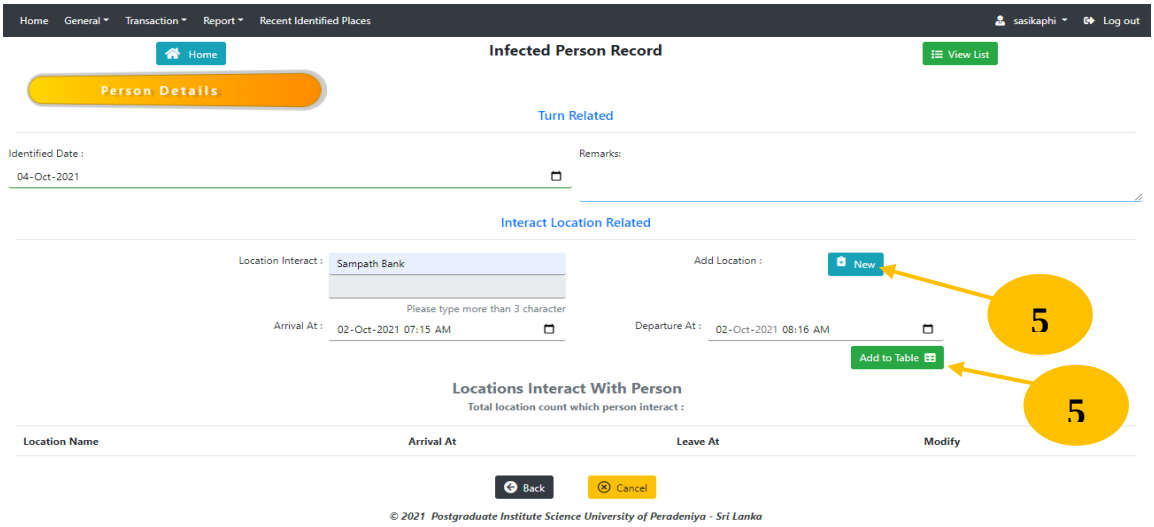


Figure 58: Screen to search by parameter

23. After filling necessary information and click add to table button to save the data to system.

24. New

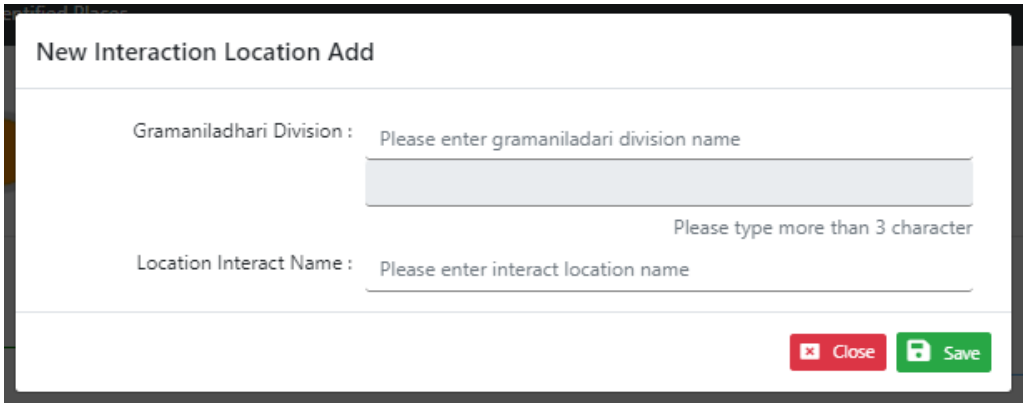


Figure 59: Screen to view new records

Filling necessary information and click save button so save new location to system.

25. Edit turn

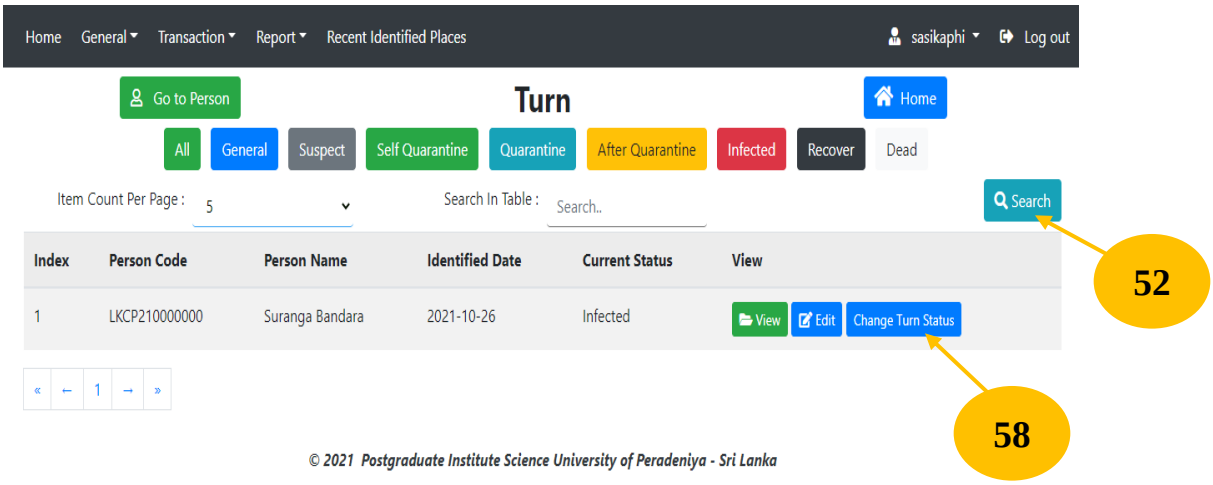


Figure 60: Screen to turn

In this window user can get list of people suspect, self quarantine, quarantine, after quarantine, infected and recover.

26. Change turn status.

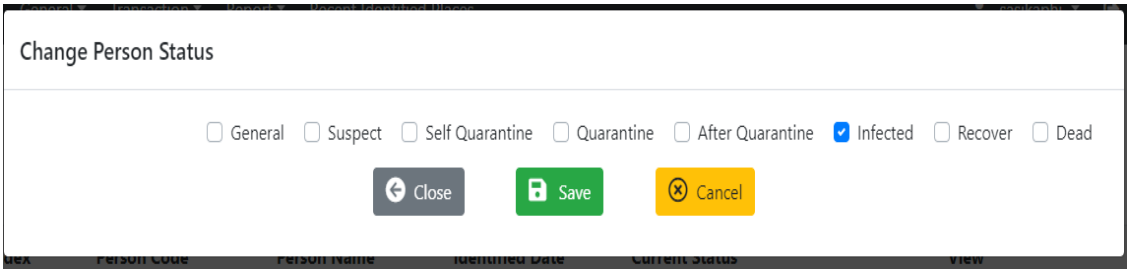


Figure 61: Screen to change person status

Selecting current status and clicking save, persons new status save to system.

27. General.

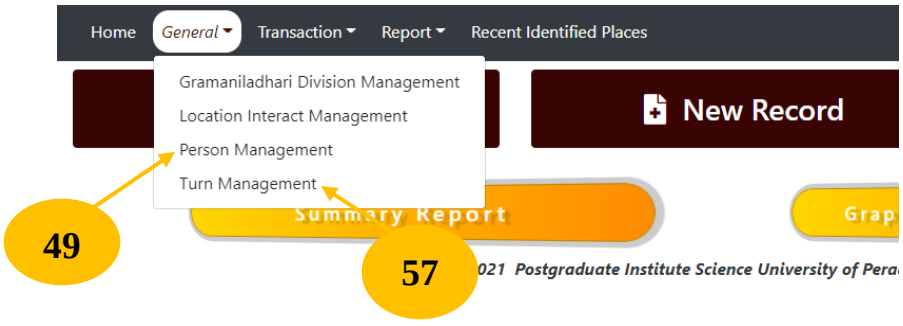


Figure 62: Screen to change person status

Gramaniladhari Division Management.

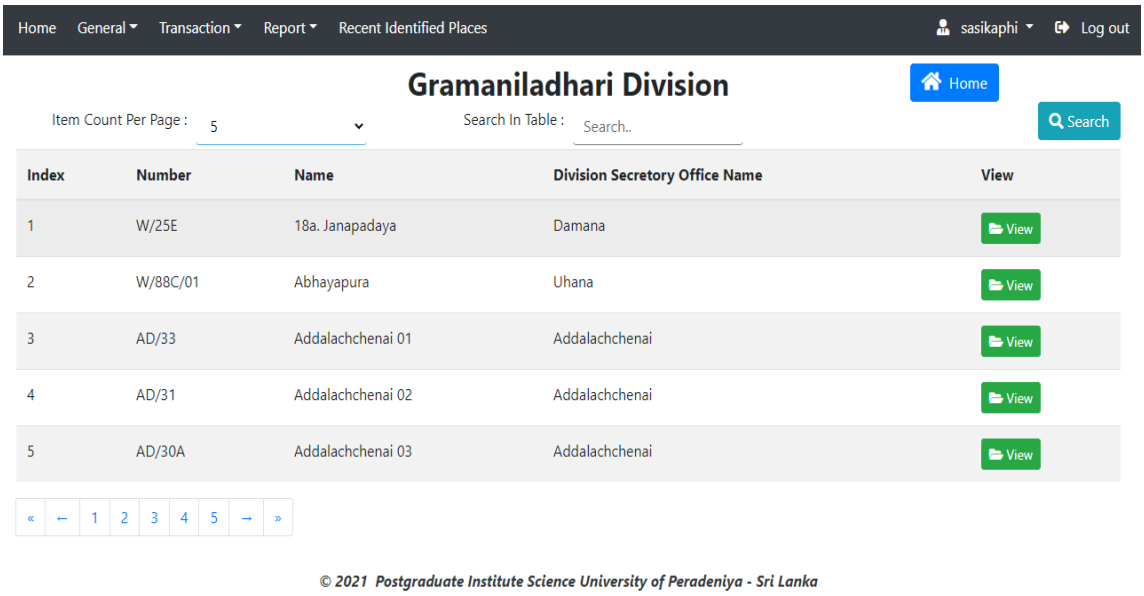


Figure 63: Screen to GN Division

PHI can view gramaniladhari divisions and their infomations.

Location Interact Management.

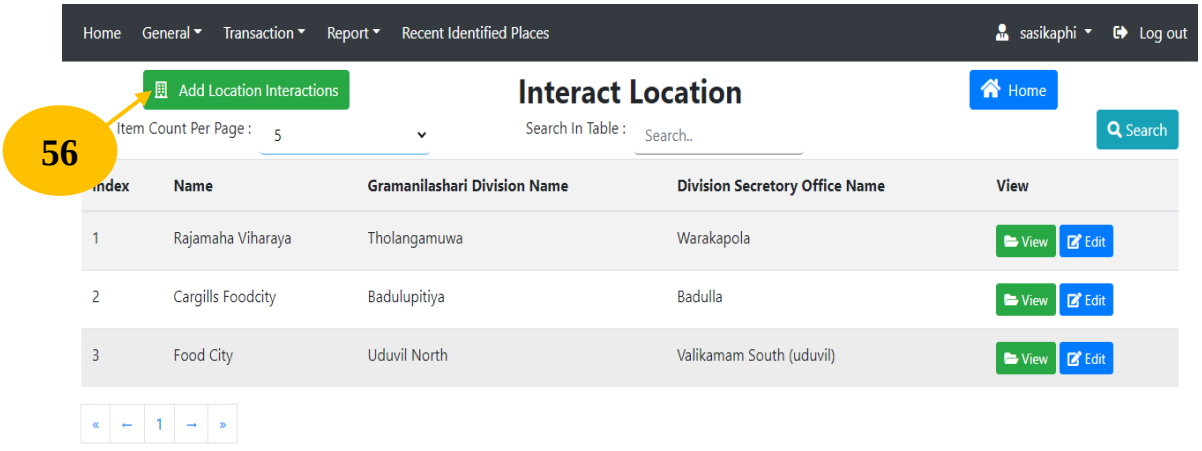


Figure 64: Screen to Interact location

PHI can view locations details and update them.

28. Transaction.

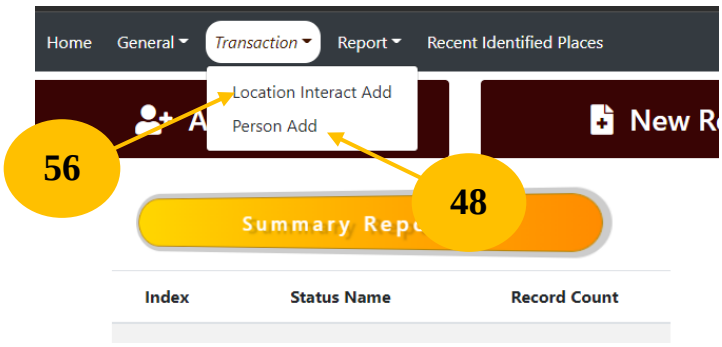


Figure 65:Screen to user Transaction

29. Reports

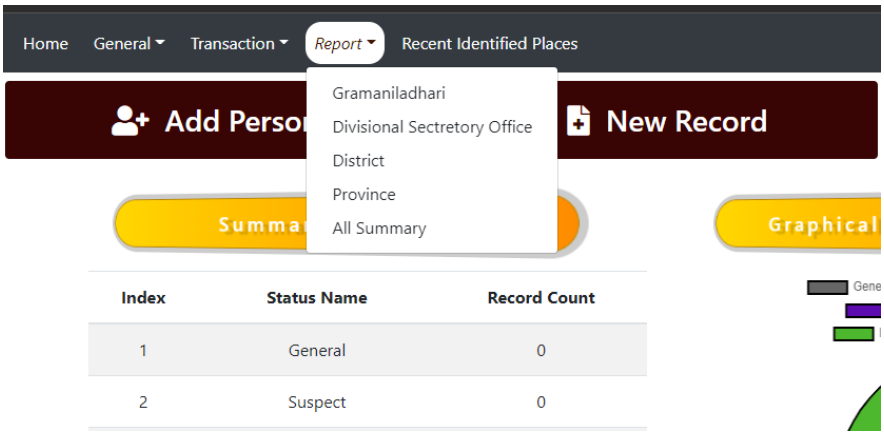


Figure 66: Screen to view report

Here PHI can get reports according to gramaniladhari division, district and province in a given date range.