160170B / 160628M

MOBILE APPLICATION FOR FIGHTING COVID 19

Software Design Document

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1 Introduction

This document provides a comprehensive design overview of the system - Mobile application for fighting Covid 19, using a number of different architectural views to depict different aspects of the system. It is intended to capture and convey the significant design decisions which have been made on the system.

1.1 Purpose

The purpose of the system design specification document to present the system design of the mobile application for fighting Covid 19 to deliver specification of the system at a certain level that can be directly traced to specific system objective along with providing more specific information about the expected input, output, classes, functional requirements, non functional requirements and domain requirements for best design practices.

This document will verify that the design goals and proposed design specifications by the developer team will meet all of the explicit requirements contained in the system model as well as the implicit requirements desired. Also, this System Design Specification will be used as a definition of the design to be used for mobile application for fighting Covid 19.

1.2 Scope

The proposed application is intended for use in the health and privacy domain. This mobile application will promote social distancing practice among users. The App will be able to trigger an alarm when two persons are closer than 1.5miters distance. Also it will track and store user interactions with other users for three weeks. Thus those stored data may help to track all the users who have interacted with a Covid 19 positive patient. Therefore it may help to make the quarantine process more efficient as well as effective.

The system will support the following basic requirements.

- User login and registration.
- Getting an alert when someone is closer than 1m
- Get warning notifications if the user has interacted with a Covid 19 positive patient.

The system has basically two main components containing many sub components. A mobile application and a web server where it can store user ids and broadcast notifications and covid possessive patient ids to installed apps.. The application is basically developed as a solution to the social distancing issue and the covid 19 patient's contact tracing app.

Most important feature of this system is that it does not send or collect user location data on a cloud server. Thus ensuring user data privacy and security.

1.3 Overview

Due to the prevailing situation of the country and the world, we need to fight COVID 19 pandemic and save people's lives. Also practicing social distancing is a challenging task to countries like Sri Lanka.

In this system, we will be using the device's bluetooth functionality to take distance measurements with other devices. Any device that has active bluetooth connectivity broadcasts its MAC address to the nearby devices. Therefore an app with the functionality to measure the distance and keep track of which devices that it has identified in nearby can always capture their MAC address and store the id, date/time, distance and the location in a local database system. Each device has a unique Id (MAC address of the device) and it will be the user identification. Health Authorities are allowed to broadcast these device Ids when they find a COVID-19 patient. They can simply read the device MAC address and broadcast it through the system even if the patient has not installed the application. The devices which have installed the app will

receive these Ids regularly and will cross check with its database to see whether they have encountered close contact with these patients.

There will be two categorical contacts that can happen and be tracked by the application.

1. Close contact (Patient's device was very close 1m -2m)
2. Same premises (Patient's device has't encountered a close contact, but it was within the range of bluetooth signal strength)

Depending on the category, the app users will be notified with guidance how to act to take the correct quarantine process and prevent Covid 19 from spreading to others. Also they will get required medical instruction regularly. But it's solely their responsibility to respect these warnings and act accordingly.

1.4 Constraints

The mobile application design objective is to provide an efficient, modular design that will reduce the system's complexity, facilitate dynamic environment, and result in an easy implementation. This will be accomplished by designing a strong cohesion system with minimal coupling. In addition, this document will provide interface design models that are consistent, user friendly, and will provide straightforward transitions through the various system functions.

Design and Implementation Constraints:

- The users are supposed to have basic computer literacy. So the interface and functions will be familiar to normal mobile users.
- The system will try to give the user full real time experience to the user. But this will be limited by the speed of internet connection of the user.

- Accuracy of distance measurement depends on the Bluetooth type, version , device and environment obstacles.
- Mobile devices have limited battery and memory capacity, therefore apps should be working in an efficient manner to reduce the battery and memory usage.
- Developers should always respect app user privacy and user data should not be collected in any outside server without user's permission.
- The App should always record only required data and old data should be deleted automatically after the use.

Assumptions and Dependencies:

- This main system will be a mobile application which has an internet connectivity , bluetooth functionality and runs on Android OS.
- Devices need to have vibration and sound output devices to get alerts.
- Notification server is capable of handling traffic as needed.
- Mobile devices need to have a bluetooth connectivity module and it's expected to be in bluetooth enabled mode when people go outside their home.
- sers will respect warning messages they receive and act accordingly.

2 System Overview

The system is intended for use to fight against prevailing Covid 19 situations in the world. This mobile application will promote social distancing practice among users. The App will be able to trigger an alarm when two persons are closer than 1.5miters distance. Also it will track and store user interactions with other users for three weeks. Thus those stored data may help to track users who have interacted with a Covid 19 positive patient.

The one important aspect of the system is the ability to get alerts even if the other users haven't installed the app. However they will need to enable bluetooth on the device. This will be accomplished by the use of device MAC address and bluetooth strength measurement.

The system can be implemented in certain layers, such as

- Client
- Sever
- Local database
- Functional services

The client layer is basically implementing client requirements such as getting social distancing alerts and receiving notification if they have close contact with a Covid 19 positive patient. Also all user interaction data will be stored on the client device itself.

Server side layer should interact with the client layer to produce notification and alerts. Also server side will be accessible by health authorities and they will be able to broadcast Covid 19 positive patient's ids (Device MAC address)

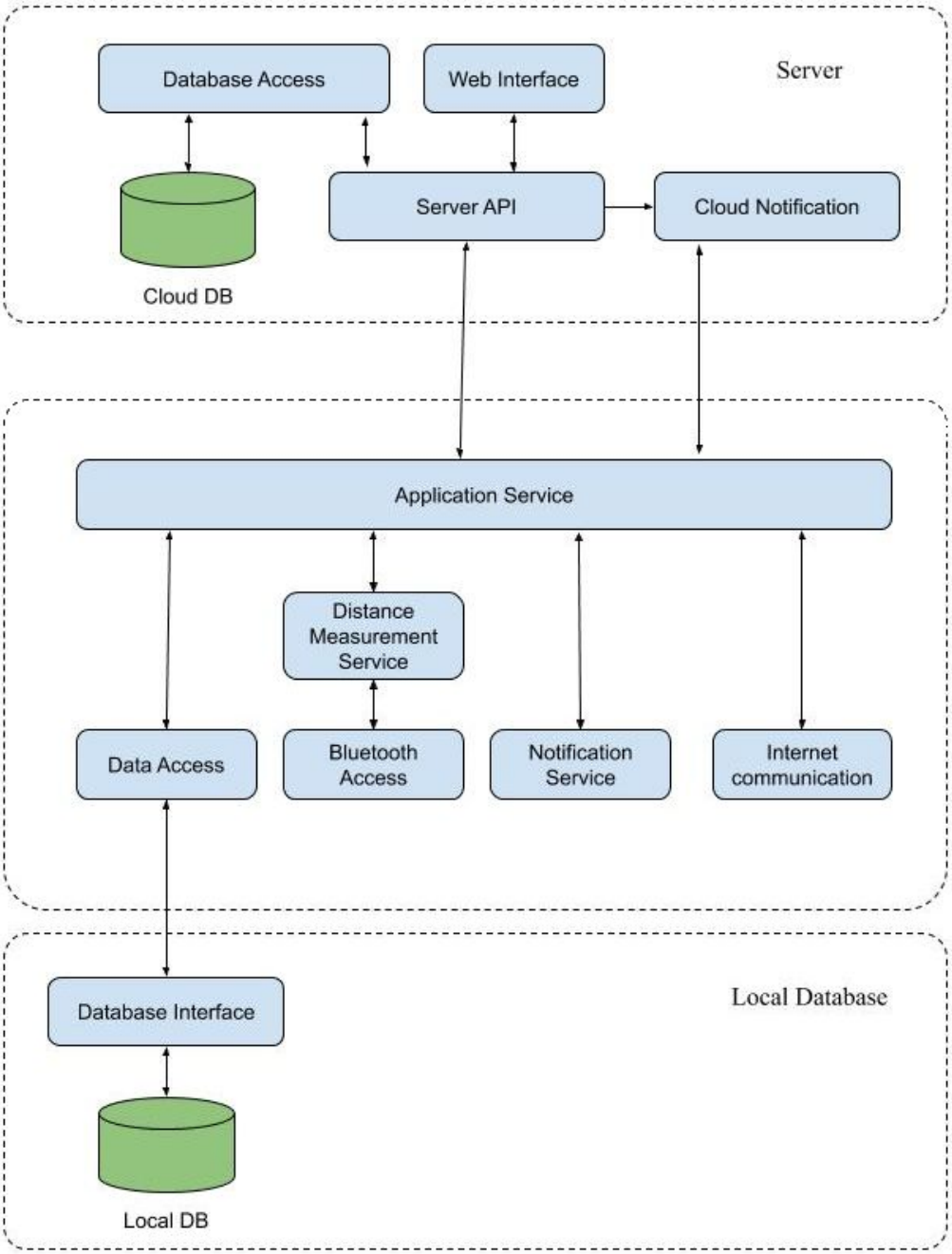
Local database will be used to store following data for certain functional requirements and these data will not be shared with anyone else. Also those data will be automatically deleted after 3 weeks.

1. User authentication data.
2. Interacted device ids.
3. Date/Time of the interaction.
4. Type of the contact / Proximity to the other device.

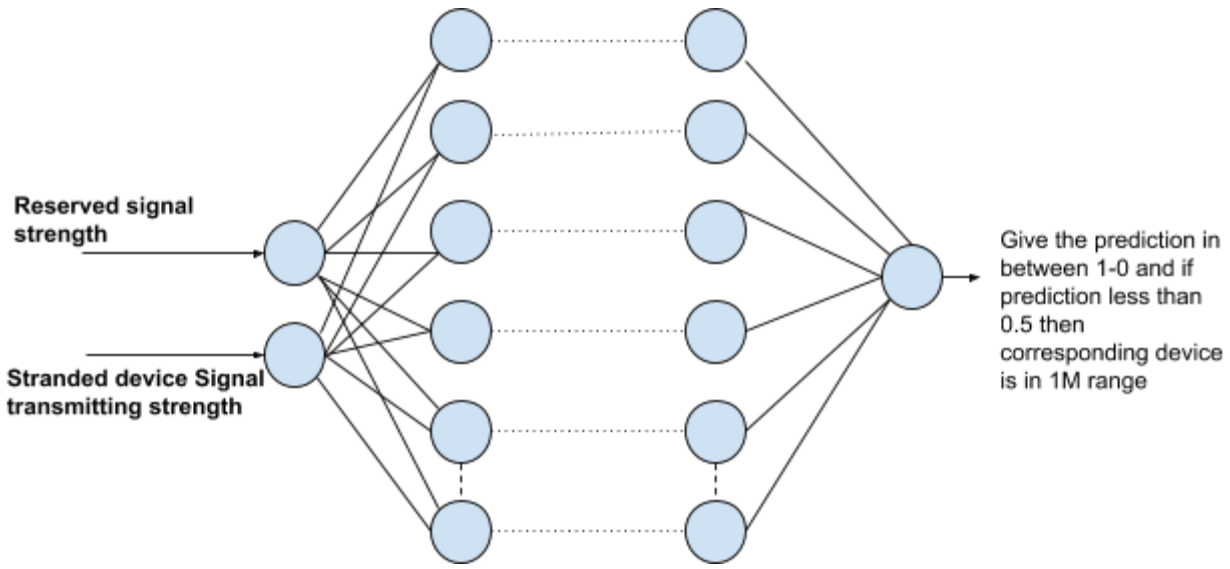
As functional services the system will use cloud notification services like Firebase push notifications to broadcast patient ids and other details.

3 System Architecture

3.1 High Level Architectural design



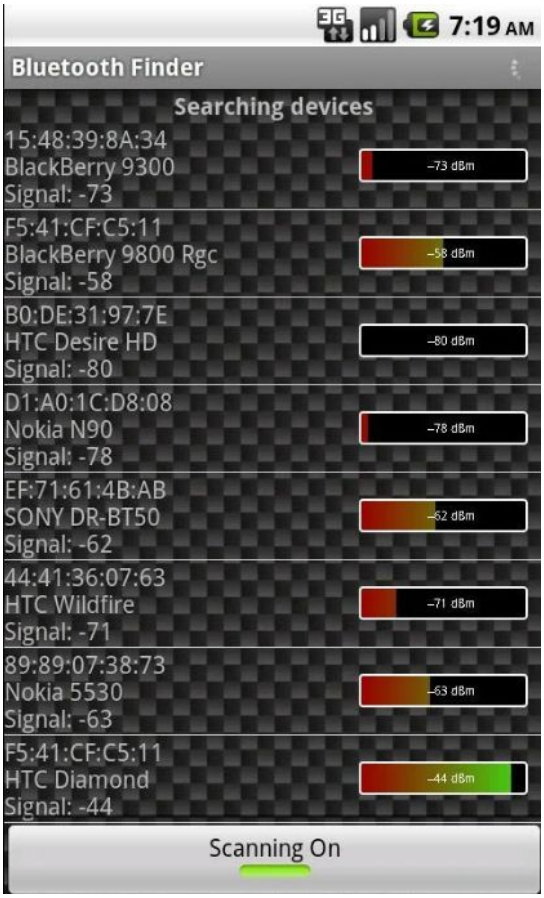
3.2 Neural Network Architecture



When we calculate distance between two devices according to the bluetooth signal strength, this observed bluetooth signal strength depends on the device type, which means bluetooth version and signal transmitting power in (dBm). So, we have identified that the input layer should have two neurons that are responsible for the observed signal strength value and stranded device signal transmitting strength value [2].

As in the output layer we take the prediction according to the calculated value if the value is less than 0.5 than those two devices are in the warning distance.

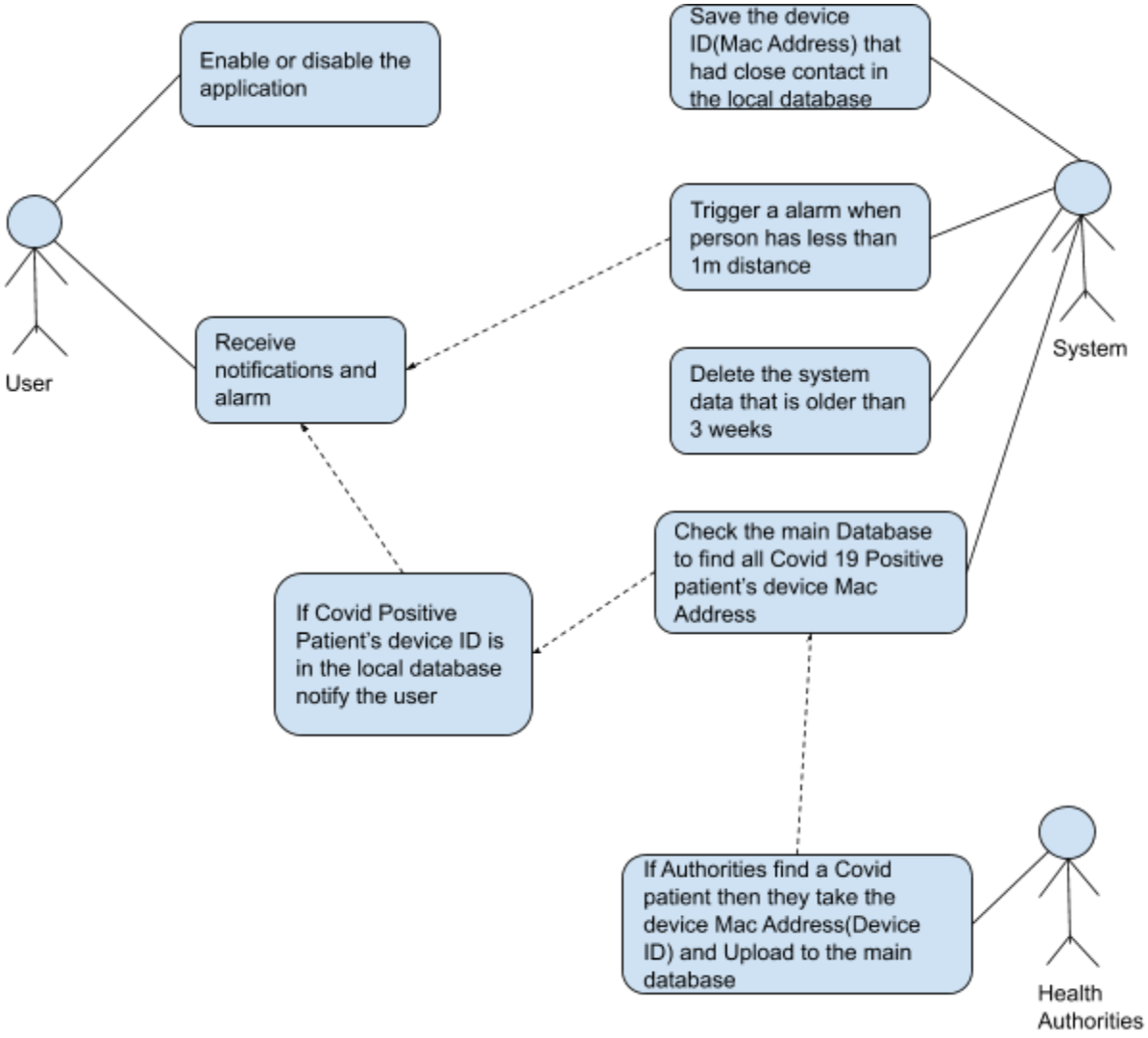
For the dataset we will use this [1] but in there we don't have the device type.because of that we will have to make up our own data set using the (Bluetooth Finder) mobile app.Bluetooth Finder app gives observed signal strength in dBm ,device name and device Mac address which is like below.



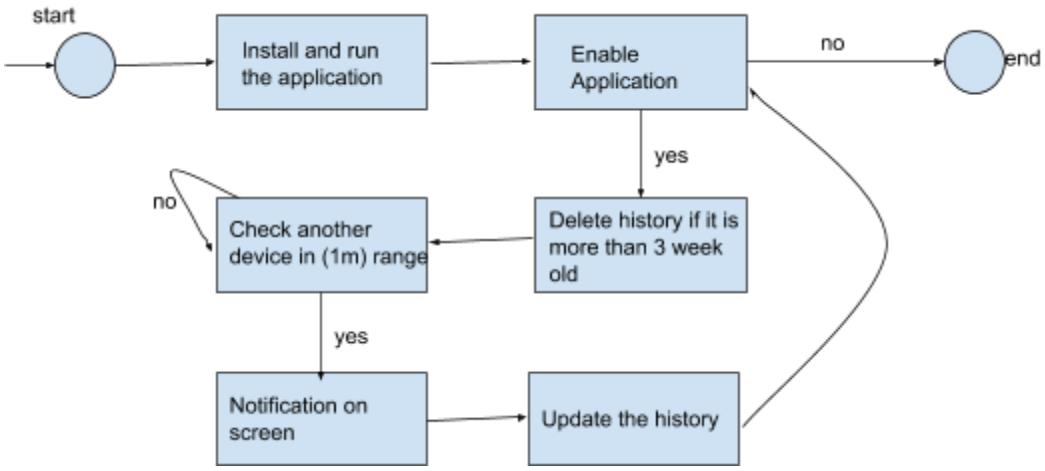
Here we selected three devices one with Bluetooth Finder app installed. Other remaining devices are in the same distance approximately and have enabled the bluetooth feature. As you see here they have given diffrane dBm values. That's because received signal strength depends on device type and bluetooth version. So we need signals transmitting strength value as the input of the neural network.


5:39 | 0.1KB/s
Bluetooth Finder
Looking for devices - Total Listed 2
HUAWEI GR5 mini...
44:6E:E5:AE:38:7E
HUAWEI TECHNOLO...
-49 dBm
Kamith
24:92:0E:60:B9:A9
Samsung Electro...
-66 dBm

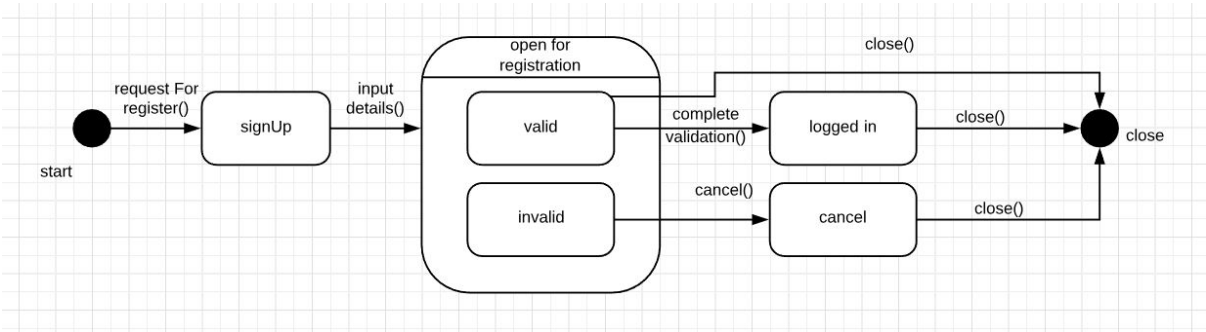
3.3 Use Case Diagram



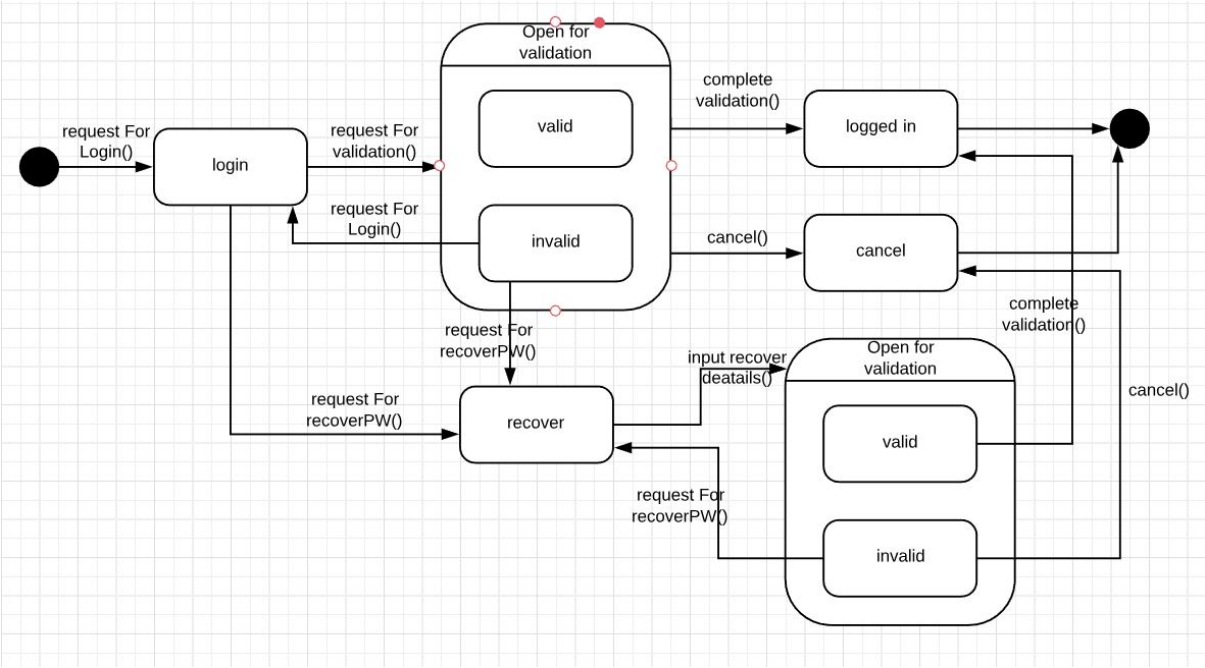
3.4 Block Diagram



State Diagram for system functionality

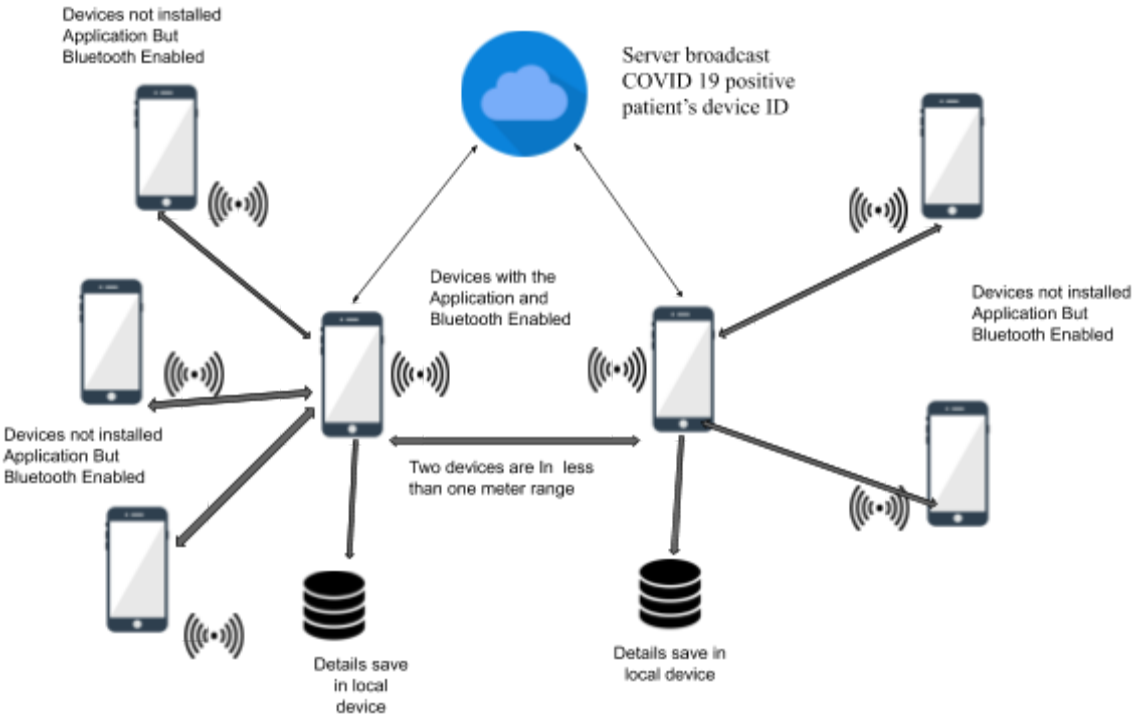


State Diagram for user registration



State Diagram for user login and recover password

3.5 Design Diagram


Devices not installed
Application But
Bluetooth Enabled
Server broadcast
COVID 19 positive
patient's device ID
Devices with the
Application and
Bluetooth Enabled
Devices not installed
Application But
Bluetooth Enabled
Devices not installed
Application But
Bluetooth Enabled
Two devices are In less
than one meter range
Details save
in local
device
Details save in
local device

4 Design Rationale

The design architecture of the Covid 19 Social distancing system is composed of the following architectural design patterns.

- Layered pattern
- Client - Server pattern
- Model view controller pattern

These design patterns were selected considering the functional and nonfunctional requirements of the system.

4.1 Layered pattern

The complete system is structured into several interconnected components (layers) with a particular level of abstraction in each layer. Each layer provides a service to the higher level and at different abstraction levels. Main layers are client, server, functional services and the local databases.

4.2 Client - Server pattern

The system basically consisted of the client server pattern. The server provides notification and alert services to multiple clients. Client application is designed to minimize the data communication with the server. Furthermore cloud messaging service APIs like Google Firebase Cloud notification will be used to broadcast notification from server to device.

4.3 Model-View-Controller pattern

The MVC pattern separates the web application (for health authorities to enter data) into 3 parts namely model, view and the controller. The model contains the classes and data, view displays information to the users and the controller handles the inputs and processes.

4 Human Interface Design (Screens)

4.1 Overview of the User Interface

The system is a mobile application developed for Android and iPhone (in Future) users. The interfaces are designed with those constraints. The interfaces will be simple and easy to use.

4.2 Screen Objects and Actions

4.2.1 Register and Login

This screen allows registered users to login using email & password. And there is a link to reset the password if the user forgets the password. There is a seperate screen for registering new users.When a user tries to login the system will validate the inputs and it will display an error message if there is any problem.

4.2.2 Home screen

In here distance identificator runs as the background process and when any device in the 1m range that will save the device MAC Address. Also By pressing the enable button enable the Bluetooth feature in the device.

References

[1] S. Sadowski and P. Spachos, "RSSI-Based Indoor Localization with the Internet of Things," in IEEE Access. doi: 10.1109/ACCESS.2018.2843325 GitHub Link-https://github.com/pspachos/RSSI-Dataset

[2] Goldoni, Emanuele & Prando, Luca & Vizziello, Anna & Savazzi, Pietro & Gamba, Paolo. (2018). Experimental data set analysis of RSSI‐based indoor and outdoor localization in LoRa networks. Internet Technology Letters. 10.1002/itl2.75.