

# **System Requirement Specifications (SRS)**

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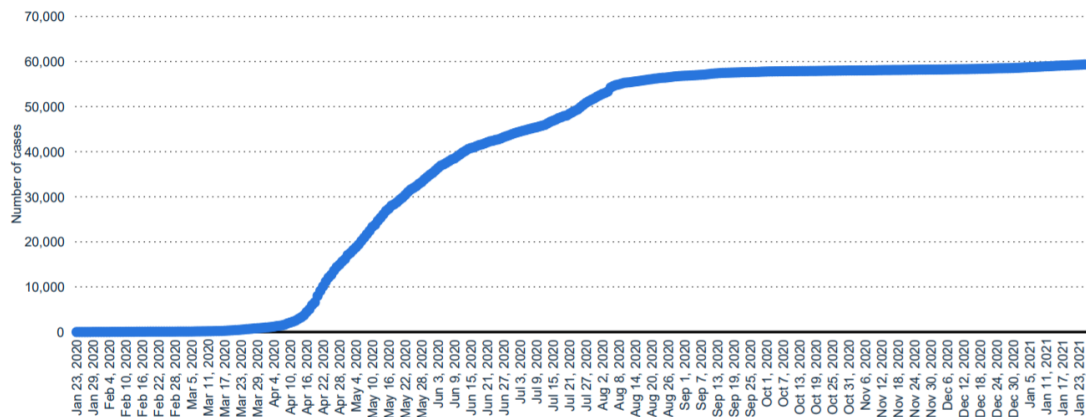
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## 2 Problem Statement

A year has passed since COVID-19 has surfaced and the trend is increasing at a slower rate as can be seen by the number of COVID-19 infections as shown below.

### Number of COVID-19 infections in Singapore as of January 26, 2021

Total cases of COVID-19 infections Singapore 2021



However, we have broken the record of going zero cases for 13 days [Begum, 2020] and the numbers are starting to hit the double digit again (29 cases for 31/01/2021) [CNA, 2021], despite safe distancing measures enforced by the Singapore Government [Elflein, 2021].

- Maintaining a safe distance of at least one metre between individuals
- Wearing of face masks at all times when outside one's home, unless when eating, drinking or doing strenuous exercises
- At home, there should not be more than five visitors at any one time
- Maintaining a safe distance of at least one metre between groups (each group is to comprise not more than five persons) and strictly no intermingling between groups.

Covid-19 is mutating and highly infectious [(Coronavirus disease (COVID-19): How is it transmitted?, 2020), (BBC, 2021)], hence we should exercise caution in our everyday routine to keep the spread in control. This includes our actions when we plan an outing to any of Singapore's abundant malls and restaurants. We must make sure we adhere to safe distancing measures and that's where our app - Mall-E - comes into play.

## 3 Overview

### 3.1 Background

Crowd density tracking on the market is limited and not user-friendly such as Spaceout [Spaceout, n.d.]. Spaceout lacks crowd data for every mall in Singapore. It being a web application may not be very mobile friendly / user-friendly.

Covid-19 is mutating and highly infectious [(BBC, 2021), (*Coronavirus disease (COVID-19): How is it transmitted?*, 2020)] . To exercise caution and control the spread, it is useful to know the crowd density in certain areas, especially malls which attract a large amount of crowd is essential. This allows us to avoid crowded areas with the data provided as there might be unknown active carriers of Covid-19. Crowd density tracking is available, specific to each level and restaurant.

After the Covid-19 situation has been dealt with and the world has gone back to its original pace, this app can be used by the mall security guards to send extra guards to areas of the mall with higher crowd density to ensure the safety of the populus. This could be quite useful in countries rampant with crime. The waiting time feature can also help the user to plan their outing better by avoiding restaurants with a high queue time.

### **3.2 Overall Description**

Our mobile application Mall-E provides crowd density specific to each mall, then levels and restaurants within.

The BestTime API will be implemented in our application to extract live crowd density data of each and every mall. Collaboration with restaurant owners as well as data extracted from Google Popular Times API will be implemented to know about the crowd and waiting time within the restaurants. We will also use CCTV footage to count the number of people in each level within malls and store it in our database. News articles with relation to Covid-19 will be available within the application.

Our mobile application will be using React-Native to create the frontend of the application while MongoDB will be used as our database to store the necessary data and act as our backend.

## **4 Investigation & Analysis Methodology**

### **4.1 System Investigation**

The application's services are opened to all registered users. Data shown will be with accordance to APIs from external sources. Google Maps will be used as our front-end to show which crowd density tracking efficiently. It will return values for specific searches.

Mall-E uses external APIs such as BestTime API and Popular Times API of Google to display the overall crowd density data for a mall and the estimated busyness of a restaurant respectively. Hence the data displayed in Mall-E will only be as accurate as the data extracted from the above APIs. Investigation into the accuracy of these APIs revealed that they are quite reliable as they were able to correctly report the crowdedness of Jurong Point (JP) and VivoCity (malls in Singapore) as proven by our field research. It also accurately showed the waiting time at

McDonald's (JP) and at Din Tai Fung (JP). The APIs also showed relatively no downtime which made them a good choice for our app.

Moreover, the Covid news related to malls are pulled from the Google News API which also proved its accuracy since Google is the world's best search engine and thus would provide reliable news from reputable sources.

## **4.2 Analysis Methodology**

### **4.2.1 Feasibility study and requirements elicitation**

Organize a development and implementation team composed of 6 people that are highly experienced in full stack software engineering as well as machine learning algorithms.

A series of collaboration meetings will be held with the government for support and permission of data gathered using CCTVs and APIs.

Collaboration meetings will be held with mall managers to obtain insights on restaurant data and crowd trends within the mall.

A Feasibility and Risk Assessment study will be conducted to determine which solution(s) are most appropriate based upon the results of the meetings.

### **4.2.2 System analysis and requirements specification**

#### **4.2.2.1 Perform an analysis of the problem using object-oriented techniques**

An external view of the enterprise model of the application including the crowd data records per mall as well as the restaurant information and their corresponding queue data will be developed using Unified Modeling Language (UML). This System Requirement Specifications documents will form part of the documentation for the project.

Some desired features of the new system include:

- Selecting a mall marker from the map to check information about the mall
- Viewing crowd density data per floor of a mall
- Viewing waiting times of restaurants in a mall
- Viewing top 5 Covid related news articles in relation to Singapore malls

#### **4.2.2.1 Scope and Limitations**

Analysis methodology will involve business analysis, requirement analysis, data analysis, (web) and application architecture:

Business analysis – In order to monetize our app, we will have to place advertisements from our sponsors in the app. These sponsors can be the malls and restaurants represented in the app

which makes sense since users using our app would already be interested in these places so it would be wise to display deals and discounts related to them.

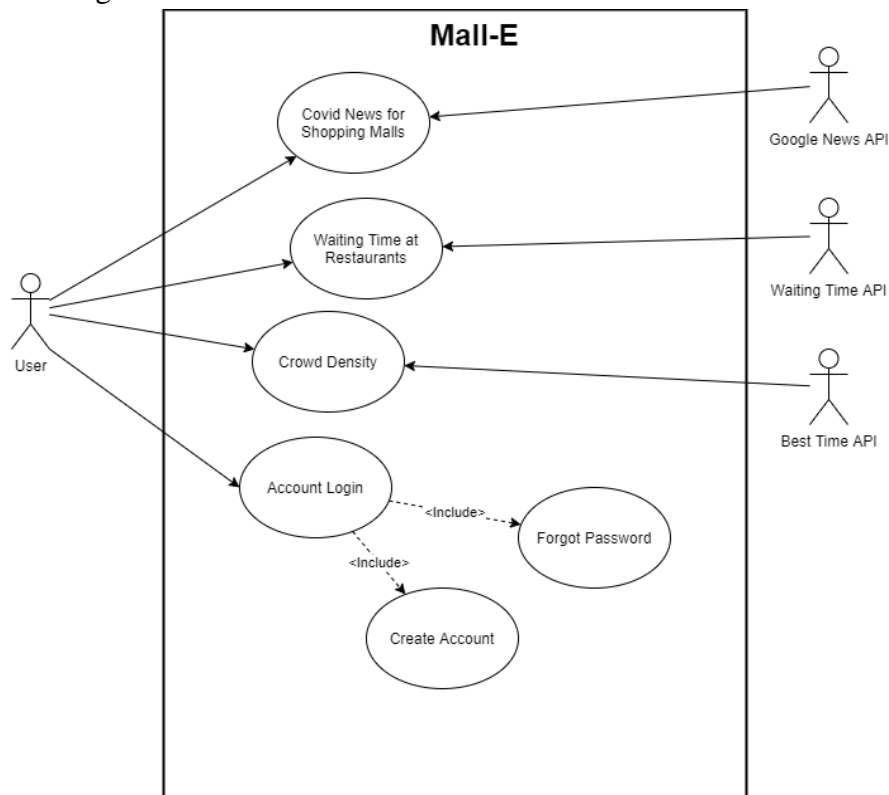
**Requirement analysis** – The input fields of the login and registration pages will be carefully sanitized to safeguard against hacking attempts such as code injection. The security of the user data will depend on the overall security of the MongoDB database where all the emails and passwords are being stored.

**Data analysis** – The floor by floor crowd data will be retrieved from computer vision algorithms running within the CCTV cameras of each mall. It will keep count of the total number of people in its Field of View (FOV) and the aggregate from each floor will be stored in the app's database. Therefore there might be some slight inconsistency as not all corners of the mall will be covered by the FOV of each CCTV camera and since the crowd is ever-changing and dynamic the data may vary accordingly.

**Application architecture** – The app will have all the pros and cons of the Model-View-Controller architecture as detailed in the Project Proposal document.

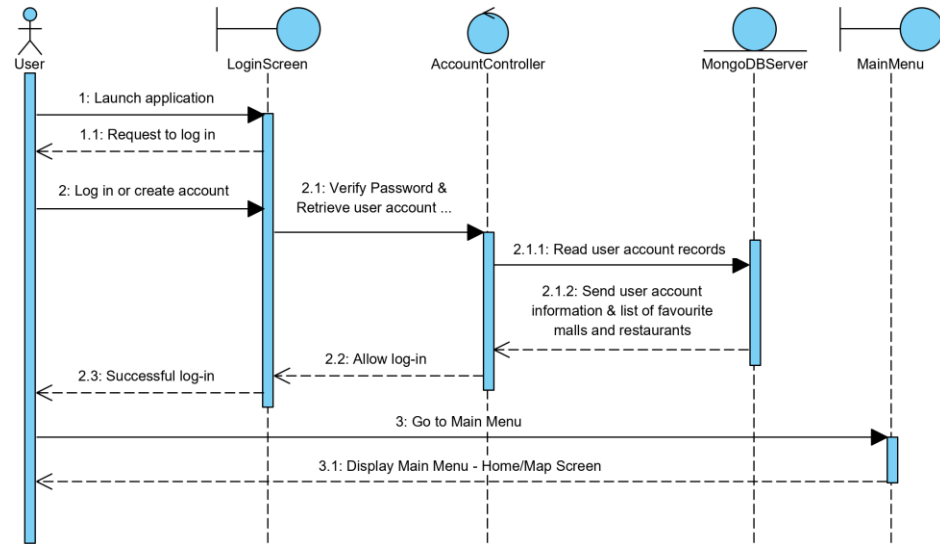
### 4.2.3 Object-oriented design using UML

#### 4.2.3.1 Use Case Diagram

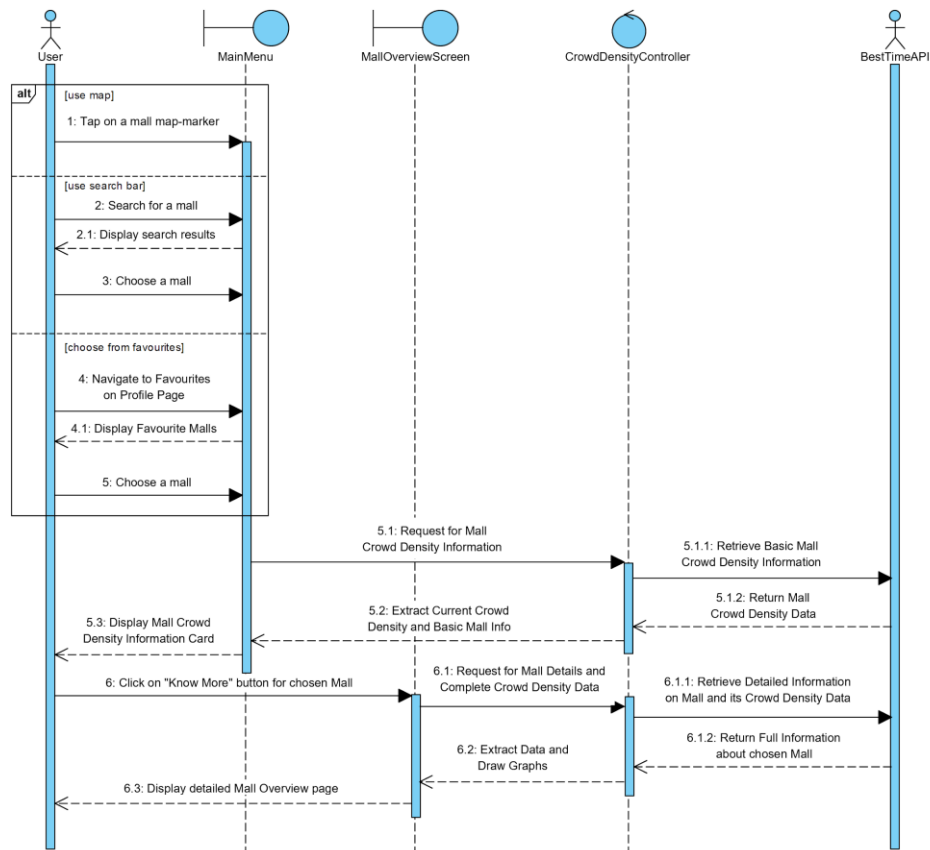


#### 4.2.3.2 Sequence Diagrams

##### Account Login

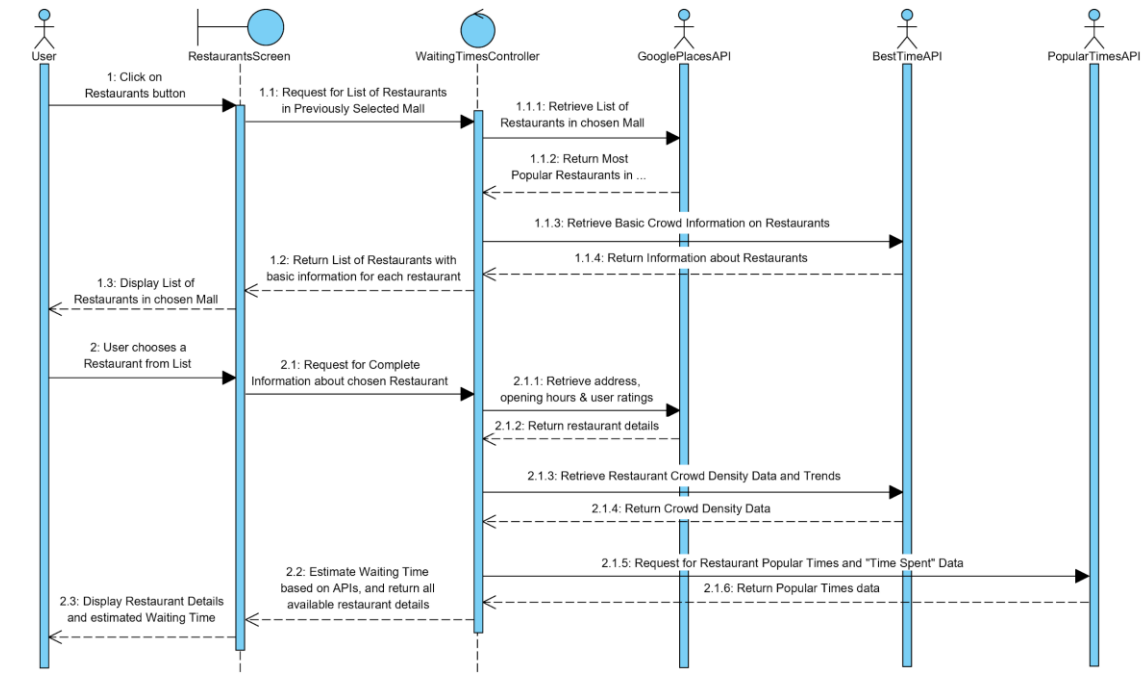


##### Mall Crowd Density

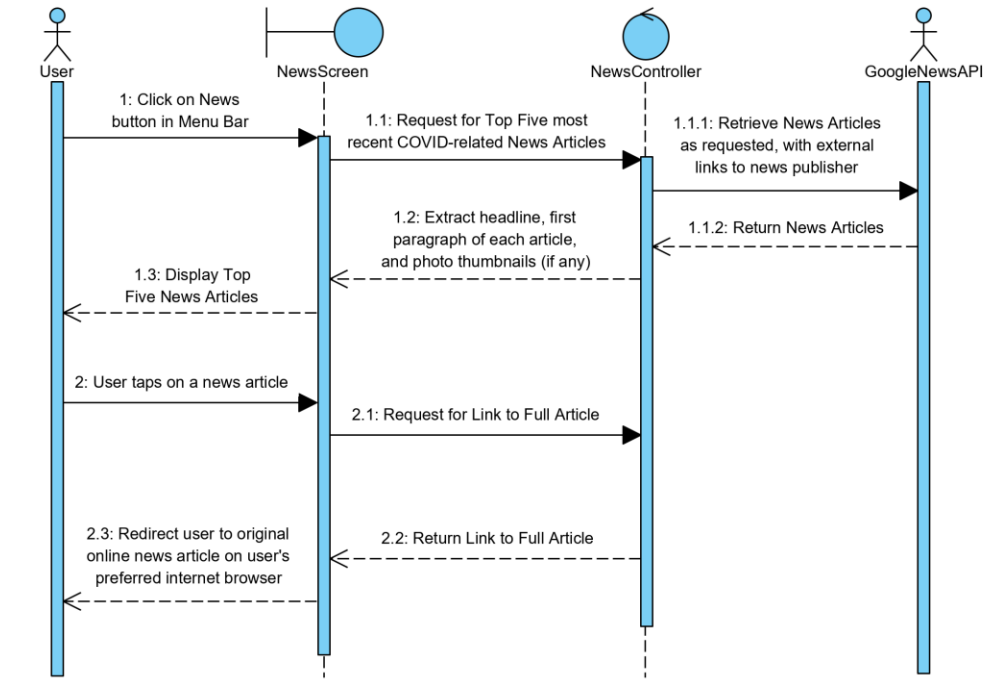




## Restaurant Waiting Times



## COVID-related News



#### **4.2.4 Prototyping**

The Object Oriented Rapid Prototyping (OORP) method will be used to implement a limited and functional prototype for the registration system. A prototype for how the crowd density will be counted by the CCTV cameras of the malls will also be developed. It would use Computer Vision to build bounding boxes around each person in its FOV and count the number of people. The prototype will be a working example of part of the system for demonstration and proof of concept purposes only. The prototype will be presented to the implementation team.

### **5 Constraints**

#### **5.1 Scalability**

Our application, Mall-E, does not scale well to increasing system demands as MongoDB can only support up to 65536 connections [MongoDB, n.d.].

#### **5.2 Policy**

Data published on Mall-E is strictly for crowd density tracking and data obtained may not be circulated through any platform.

Data involves CCTV footage which may be an intrusion of privacy.

#### **5.3 Proprietary hardware and software**

- Hardware
  - CCTVs required as human images captured will be used and machine learning algorithms will be applied to obtain crowd density of people within malls.
- Software
  - Data obtained from Best Time API
  - Data obtained from Google's Popular Times API

#### **5.4 Batch updates vs. (close) Real-time updates**

Real-time updates can only happen up to 15 minutes per update as a high amount of resources would be required for updates that occur within every second.

Crowd density is fluctuant as there will be changes per second.

## **6 Operational Requirements**

### **6.1 Customer Support**

System users have a 24x7 access to telephone assistance for questions that are technical in nature, such as, slow or sluggish system response time, incompatible browser features, application errors, system downtime inquiries, account lock-out assistance, etc.

### **6.2 Application Services and Technical support**

Technical support will be formed with experienced programmers and application developers. This team will have access to source code to address bugs or system enhancements as deemed necessary. Network Administrator and DBA support is also required to maintain a 24x7 system uptime.

### **6.3 Administration Features**

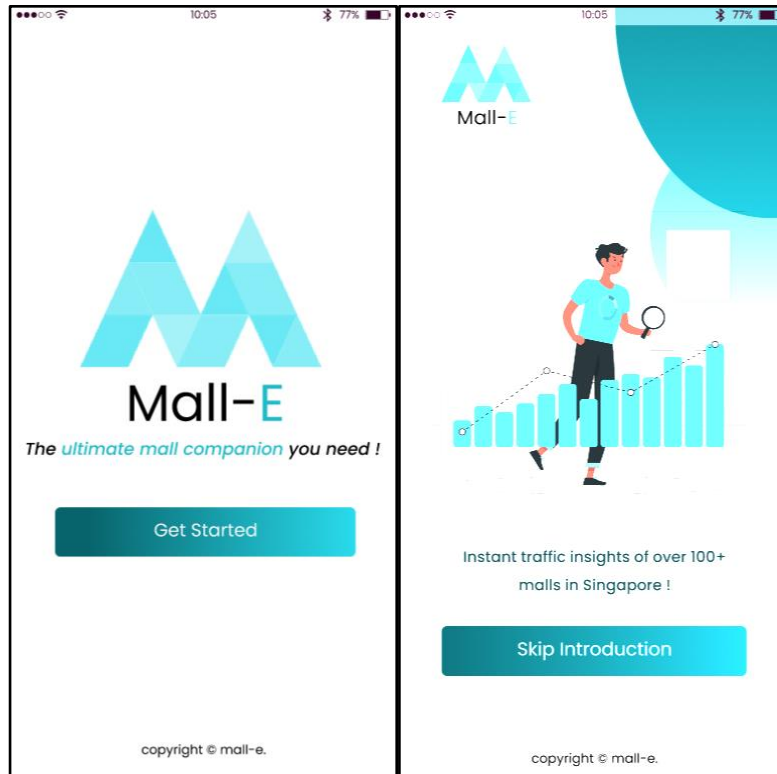
System security and access levels are provided. Administrators will have the ability to manually add new malls and restaurants to the map. Customer analytics dashboard will be available to administrators based on the users' usage of the application which may be useful for future reference to provide targeted advertisements to them.

### **6.4 System hardware fail over and routine back up**

Application will be able to handle system tasks such as data back-up, fail over, scheduled system patches and maintenance.

## **7 Functional Requirements**

The Mall-E app contains 3 main features - a mall crowd density visualizer, a list containing restaurant waiting times, and information about COVID-related news for malls.



## 7.1 Login and Registration

The user can create an account and sign in to the app so that all their particulars can be saved.

### 7.1.1 Registration

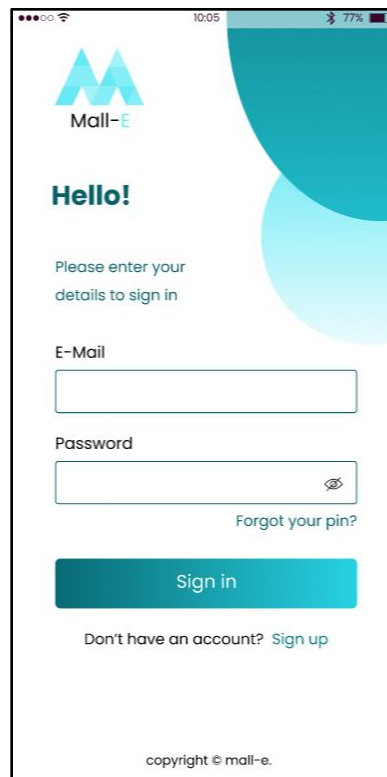
7.1.1.1 The system must have 3 text fields - email, name, and password - so that the user can fill in their credentials. The password field will have constraints such as minimum 8 characters and at least one ASCII symbol and one digit.

7.1.1.2 A confirmation email is sent to the email ID.

7.1.1.3 Upon acceptance of the confirmation email, the user is redirected to the main menu.

## 7.1.2 Login

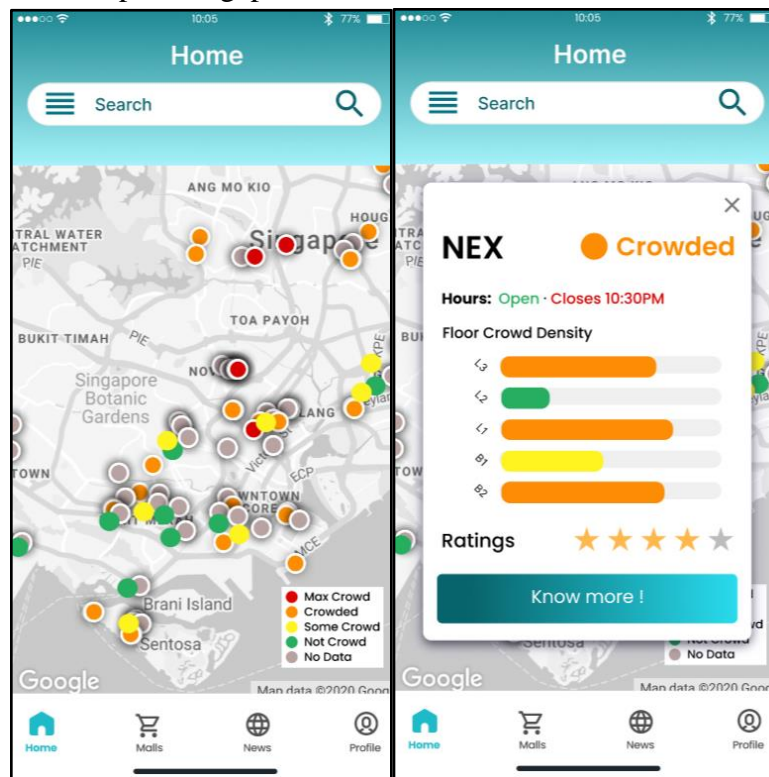
- 7.1.2.1 The system must have 2 text fields - email, and password - so that the user can fill in their credentials.
- 7.1.2.2 The system must contain a link that allows the user to create an account if they do not have one.
- 7.1.2.3 The system must be able to validate that all the text fields are filled up before submission.
- 7.1.2.4 The system must be able to validate the user's credentials with the database before letting them into the main menu.
- 7.1.2.5 The system must display an error message when the email and password do not match with the ones stored in the database.
- 7.1.2.6 The system must contain a link titled "Forgot Password?" which sends a password reset link to the email which the user has entered during registration.



The image shows a mobile application login screen for 'Mail-E'. At the top, there is a status bar with signal strength, Wi-Fi, time (10:05), and battery (77%). Below the status bar is the Mail-E logo, which consists of a stylized 'M' made of two overlapping triangles. The text 'Hello!' is displayed in a bold, dark font. Below this, a message says 'Please enter your details to sign in'. There are two text input fields: 'E-Mail' and 'Password'. The 'Password' field has a toggle icon (an eye) to the right of it. Below the 'Password' field is a link that says 'Forgot your pin?'. A large, teal-colored button labeled 'Sign in' is positioned below the links. At the bottom, there is a link that says 'Don't have an account? Sign up'. The footer of the screen contains the text 'copyright © mail-e.'.

## 7.2 Main Menu

The user can access the map of Singapore and the COVID-news for malls from here.



### 7.2.1 Home Screen

7.2.1.1 The system displays a map of Singapore containing colored markers (based on crowd density) highlighting the positions of the various malls in Singapore.

7.2.1.2 The system will display information related to each mall when the user clicks on a particular marker in a dialog box such as name, address, opening hours, and a short description of the mall.

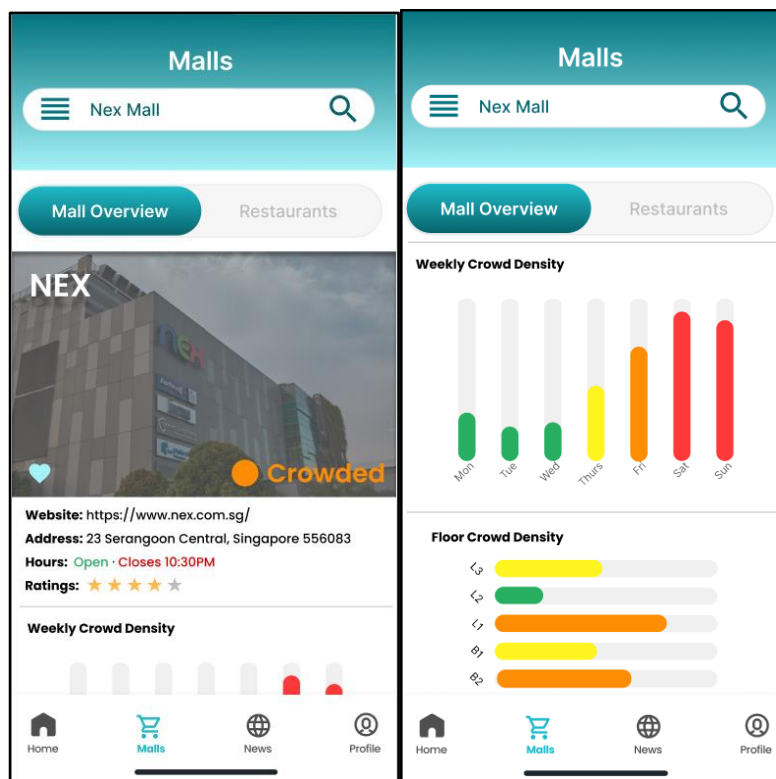
7.2.1.3 The system's dialog box will contain a button called "Know More!" which when clicked would allow the user to check the Crowd Density, and the Restaurant Waiting Times.

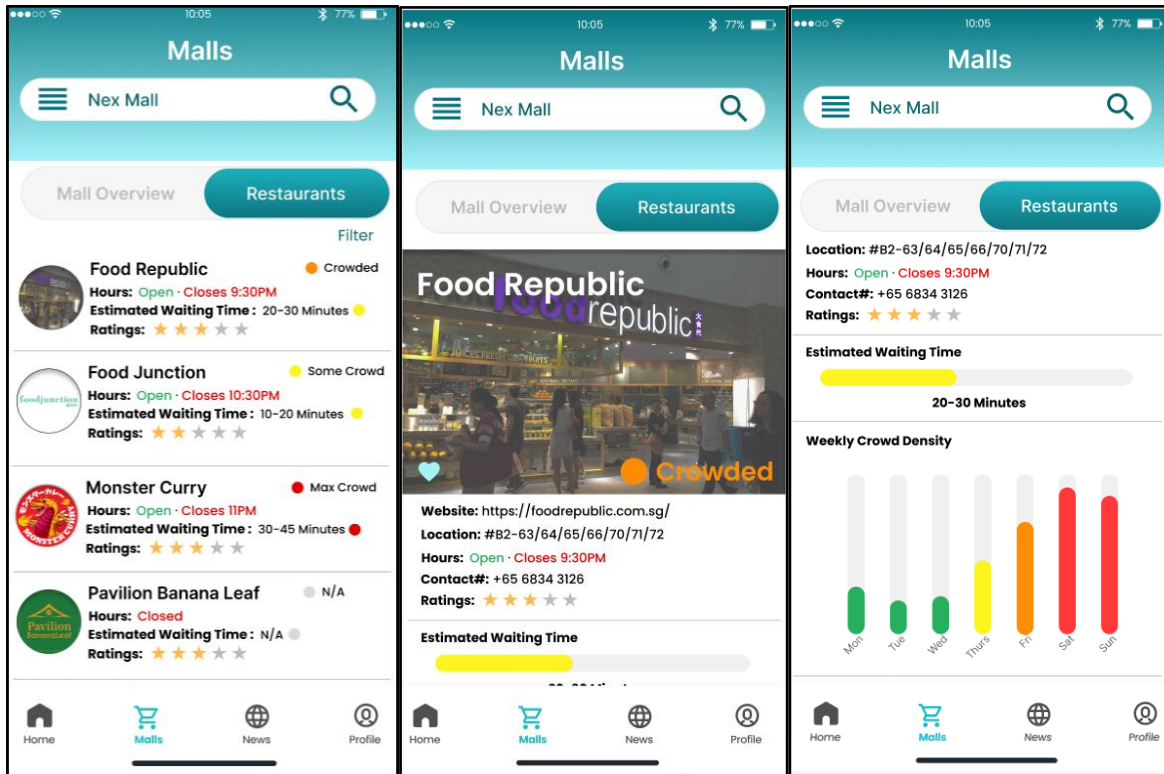
7.2.1.3.1 Check Crowd Density redirects the user to a page which displays overall crowd density of the mall over the hours the mall has remained open throughout the day. It will also have a detailed representation of the crowd segregation by floor where each floor of the mall is divided into multiple sections and color-coded to represent the crowd density ranging from green to red (low to high).

7.2.1.3.2 Check Restaurant Waiting Times redirects the user to a page which displays a list of available restaurants in that mall. Each listing will contain the name, cuisine, rating, location, description, and a picture of the restaurant. It will also contain estimated waiting time for the restaurant based on its overall busyness.

7.2.1.4 The system must allow the user to favorite certain malls of their liking which would then be added to a 'Favorites List' which can be accessed through a menu at the top-left of the map.

7.2.1.5 The system must contain a legend describing the various markers on the map.





## 7.2.2 COVID-related News for Malls

7.2.2.1 The system must display the top 5 news articles from Google News related to COVID in Singapore malls.

7.2.2.2 Each article listing must have a headline, a picture, and the first 50 words of the article truncated. Clicking on the article hyperlink must redirect the user externally to the news-site the article is hosted in.

## 8 Input Requirements

### 8.1 User login

Each user can create an account using an email address or phone number and a password. Account creation is required as it will allow the user to save his/her favourite malls and restaurants.



## **8.2 Malls and/or Restaurants**

As the purpose of the app is to show users the crowd density and waiting times at malls and restaurants respectively, the users must specify which malls they wish to check, as well as the restaurants within those malls. Alternatively, the users can see an overview of crowd density for all the malls in Singapore.

## **9 Process Requirements**

The following are among the inherent requirements that Mall-E must be able to handle.

### **9.1 Performance**

The application must handle concurrent use of the system on a 24x7 basis. The application must also be able to perform its functional requirements as well as send, receive and display user messages/feedback to assist the overall user experience.

### **9.2 API Transaction**

The application must be able to handle search requests by users, hence sending search queries to respective API and receiving results from respective API.

### **9.3 Data Repository**

The application will use the database for storage of the repository of users' personal information. The database will also be used for other administrative purposes as deemed required.

### **9.4 Data Integrity**

Commit transactions that are completed and/or rollback unfinished or time-out transactions. For example, error message feedback for transactions that failed due to time-out / API transaction failure etc. Successful search results for successful transaction

## **10 Output Requirements**

### **10.1 Map of Singapore showing crowd density of malls**

The main screen of the application displays a map of Singapore using Google Maps, where “markers” on the map represent the malls. Each marker is coloured based on the crowd density of the mall relative to that mall’s peak crowd density during that week. Below the map is a bar with four buttons – Home, Malls, News, and Profile. The home button leads to the map page.

### **10.2 Mall Crowd Density**

On the map, the user can select a certain mall by tapping on it. The application then leads to a mall page that retrieves data from the BestTime API to display the real-time crowd density of malls, as well as trends in the mall’s crowd levels over the current week. Additional data is also provided, such as peak hours, and level-by-level crowd densities.

### **10.3 Restaurant Waiting Times**

From the mall page, the user can select a certain restaurant by tapping on it. The application then leads to a restaurant page that retrieves data from the BestTime and Popular Times APIs to display approximate waiting times for the restaurant, as well as a trend in the restaurant’s waiting times over the day.

### **10.4 COVID-19 news**

The news button in the application displays the top five latest news articles related to COVID-19, and Singapore’s malls and restaurants. The application can also provide notifications on the user’s device for COVID-19 news (news headlines).

### **10.5 Mall & Restaurant related updates**

The application can provide notifications to users regarding their favourite malls and restaurants. Notifications include updates on crowd density at “favorited” malls, if the crowd density increases beyond 80% at these malls, and crowd density 30 minutes prior to and during peak hours.

## **11 Hardware Requirements**

### **11.1 Network**

Network connectivity is required at all times in order to access real-time data on mall crowd densities and restaurant waiting times. Thus, the client's device (smartphone) must be connected to the internet before the application is launched.

### **11.2 Client Devices**

The client can use any mobile Android or iOS smartphone to run the application. The minimum system requirements for the application are as follows:

- Memory - 512 Megabytes
- Screen Resolution – 720 x 1280

The smartphones should have a touch-screen. To allow the clients to connect to the internet, network connectivity of the device (Wi-Fi and/or cellular data) should also be functioning.

### **11.3 Production support systems**

MongoDB server computers are required to store information on user accounts in the MongoDB database. Since the application retrieves data from the BestTime and Popular Times APIs on the client's smartphone itself, there is no further need for dedicated server computers to support the application.

## **12 Software Requirements**

### **12.1 Client Operating Systems**

The application is designed for both Android and iOS smartphones. For Android, the recommended specification is Android 8 or higher, and for iOS, it is iOS 10 and above.

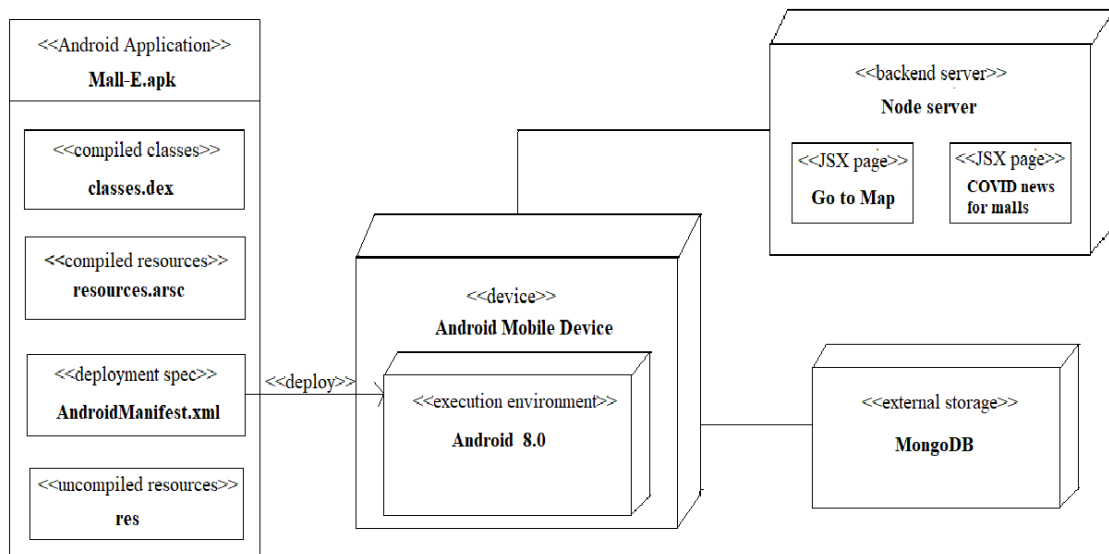
### **12.2 Client Application**

The application can only be run on a smartphone device. The device must be connected to the internet via Wi-Fi or cellular data to retrieve real-time data on mall crowd density, restaurant waiting times, and COVID-related news updates.

## 12.3 Network system

The network protocols and software required for communication between systems includes the following: TCP/IP, HTTP, HTTPS and FTP.

## 13 Deployment Requirements



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