University Of Plymouth

Course Name: BSc (Hons) Cyber Security

Module Name: Computing Group Project

Module Code: COMP2003HK

HKUSPACE tutor: Dr. Ivy Wong

Project Title: Tree Survey Application

Date: 2022 May 31

Team Name: Group – B

Group Members	Student ID
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Mok Wai Tin, Tim	wai.mok
Cheuk Yiu Hung, Star	yiu.cheuk

Product URL	https://treesurveyproject.000webhostapp.com Login Name: ivy@plymouth.com Password: !@3R*/7b-`~ File to test Bulk Insert Function (On Github): **Bulk_Insert.csv**
Admin Panel	https://tree-survey-admin.web.app/
GitHub	https://github.com/hkuspace-pu/group-repository-comp2003hk_2122_group_b
GitHub - Frontend	https://github.com/hkuspace-pu/group-repository-comp2003hk_2122_group_b/tree/main/frontend
GitHub - Admin	https://github.com/hkuspace-pu/group-repository-comp2003hk_2122_group_b/tree/main/admin
GitHub - Backend	https://github.com/hkuspace-pu/group-repository-comp2003hk_2122_group_b/tree/main/backend

Contents

Introduction

Project Scenario

This project is to build a natural science survey system about the trees in Hong Kong. The purpose of the project is to draw public attention to the ecology and conservation of trees, and to provide channels for public participation.

The basic requirements were gathered from the client who requested two main features on the application. They are a tree library which allows the public to search the tree information, and the survey record submission function, which can let a registered user submit their survey information.

After the discussion, an agile software development strategy was adopted to implement our product. During the development cycle, multiple sprints were made based on a list of user stories. Clients were highly involved in our system development period. Each sprint was reviewed. Some guidelines and the direction for each feature of our product were provided.

As the survey program was required to run on both a desktop browser and mobile device, a web-based application was chosen to fulfil that important requirement. Vue.Js, which is one of the web application development frameworks for facilitating a small size of the application where high performance and quality is required, was adopted in our front-end part construction.

For the consideration of security, other than in-house server, cloud hosting service was adopted to host the database and API. Database security is maintained by the cloud hosting company which automatically rolls out cloud software updates, including a list of the latest security patches installation.

An administration panel was created for the administrators to manage the information stored in the back-end system including trees, users, and surveys.

Product Vision

Whether an end-user is an amateur, expert, or a tree-lover who wants to share their observations about trees in the Public, our application is an excellent on-line tool to submit those tree information and provide the latest tree knowledge for citizen education purposes. Unlike other applications, all information, before publishing in the Public, will be reviewed and approved by our qualified experts.

Project Assumptions

1. Sufficient tree data, which is sourced from the third parties via popular downloading tools (such as Internal Explorer) is available. There is no cost to be involved in purchasing their copyright from these data providers. All data can become a part of our project material.

2. All tree data on the database is supposed to be accurate and reflect the fact. Those data will not be validated by the project team.

3. It is assumed that the end-user accepts our personal data collection and handling policy.

4. All programming tools are free of charge for non-commercial purposes.

5. A reasonable time can be contributed by project teams to complete their assigned jobs on time. Everyone has basic skill and knowledge to deal with the functions required by his assigned role. All team members have powerful equipment (laptop, computer) to finish the project.

6. Our whole web application can be hosted on the third party (web server or clouds) to carry out its function properly.

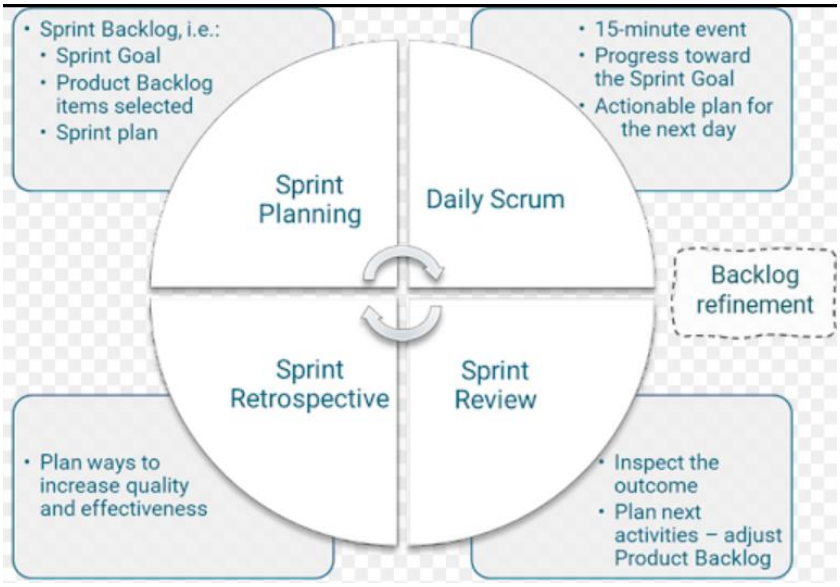
7. All material and tools (GPS, Google Map) will not be expired or terminated during the project cycle.

8. User requirements will not be significantly changed by the end-user after the project starts.

Project Management

(A) Approach

Agile Development strategy was followed to be our project management approach. The element includes sprint plan, backlog, regular meeting with our end-user, internal discussion, action plan for the next day and continuous product testing.



https://en.wikipedia.org/wiki/Scrum_(software_development)#/media/File:Scrum_Agile_events.png

1st Role Rotation Schedule

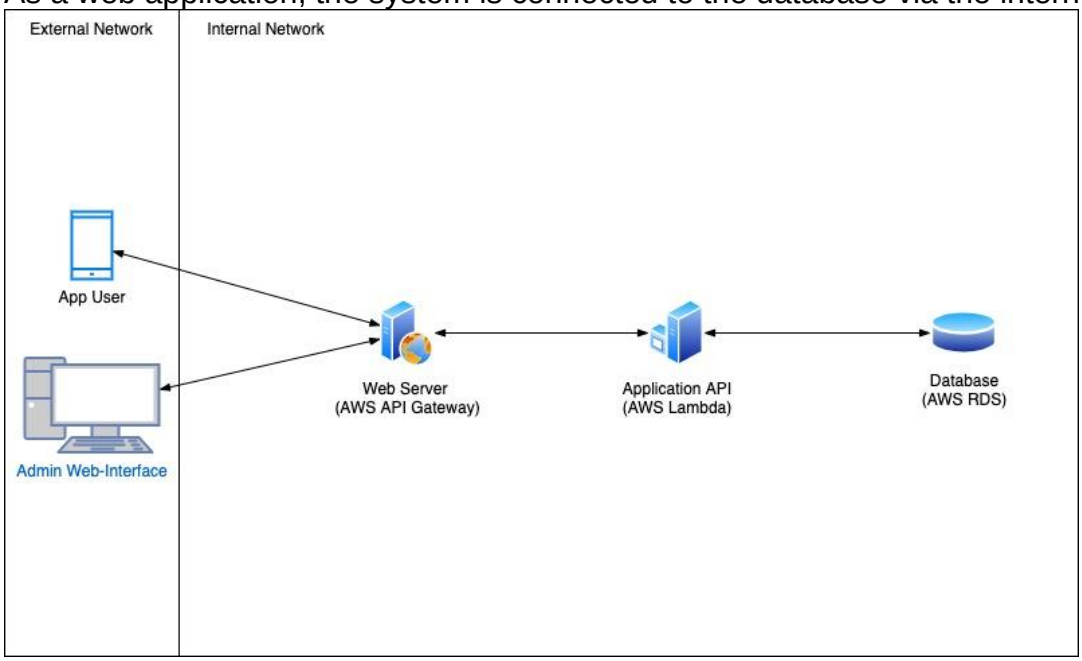
Name	Leadership Role
Ao Wai Pong, Calson	Technical Lead
Mok Wai Tin, Tim	Product Owner
Cheuk Yiu Hung, Star	Scrum Master

2nd Role Rotation Schedule

Name	Leadership Role
Ao Wai Pong, Calson	Product Owner
Mok Wai Tin, Tim	Scrum Master
Cheuk Yiu Hung, Star	Technical Lead

(B) System Design Direction (IT Architecture)

As a web application, the system is connected to the database via the internet.



For system design direction, Amazon Web Service (also known as AWS) has been chosen as a cloud hosting of database and API for achieving the improvement of security. If the database and API is hosted on in-house servers, it falls on us to think seriously about security. This is perfectly possible to do, but the reality is that many companies either don't do it or do it poorly.

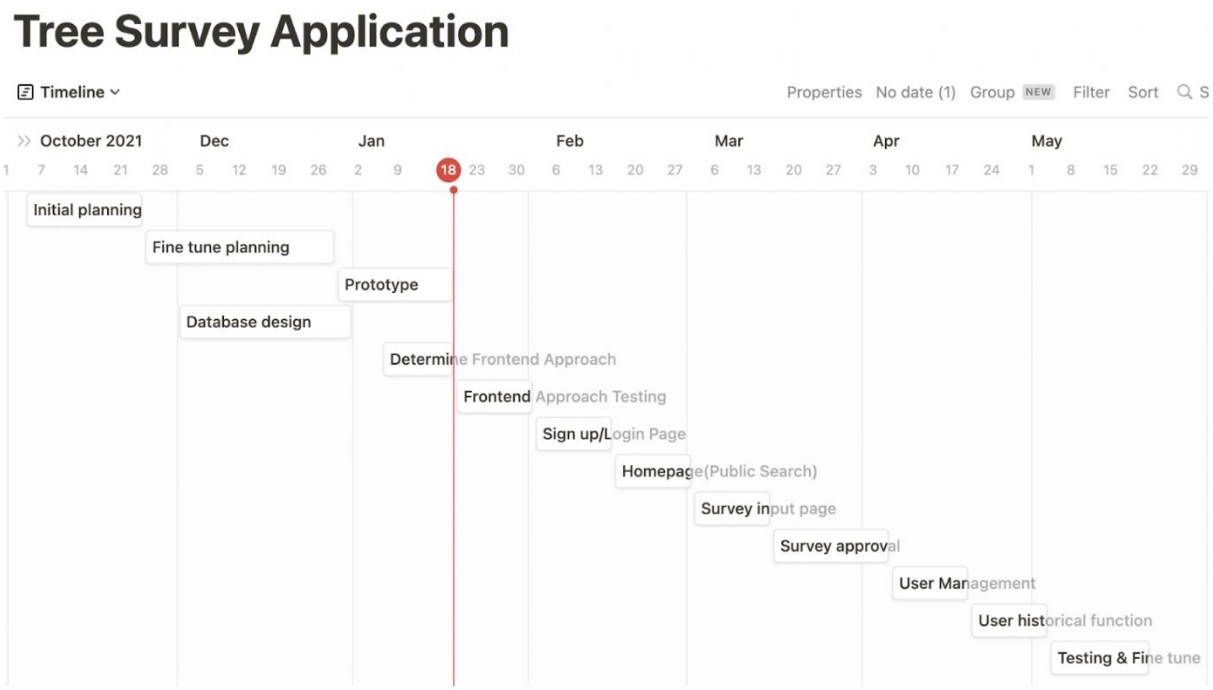
Leave database security to the cloud hosting company, and we'll buy ourselves some peace of mind, and have one less thing to worry about. The appropriate provider will automatically roll out cloud updates, including security improvements, for us as part of the service that they provided.

(C) Sprint Plans & Reviews

For the system development life cycle, agile development has been decided for the development approach which is developed as a series of versions with the client involved in version specification and evaluation.

The application would be divided into various sprints and the client would be closely involved throughout the development progress. At the end of each sprint, a specific function that has been implemented would be found and the comments would be provided by the client.

Project Timeline



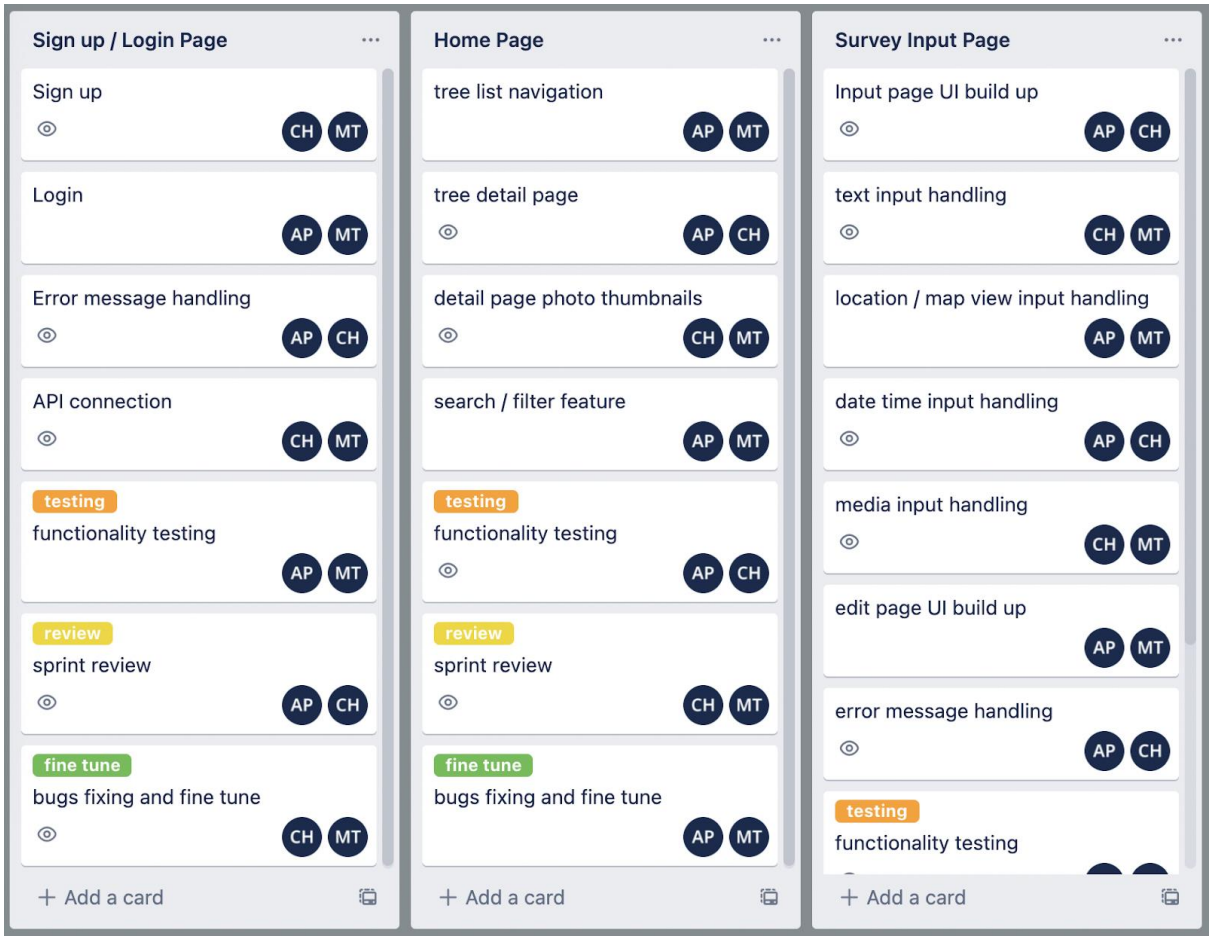
The system development life cycle of the application is divided to 7 sprints which are the main function pages. The first sprint of the implementation will be started in February and the final product will be produced around the middle of May. Each sprint is arranged around 2 weeks.

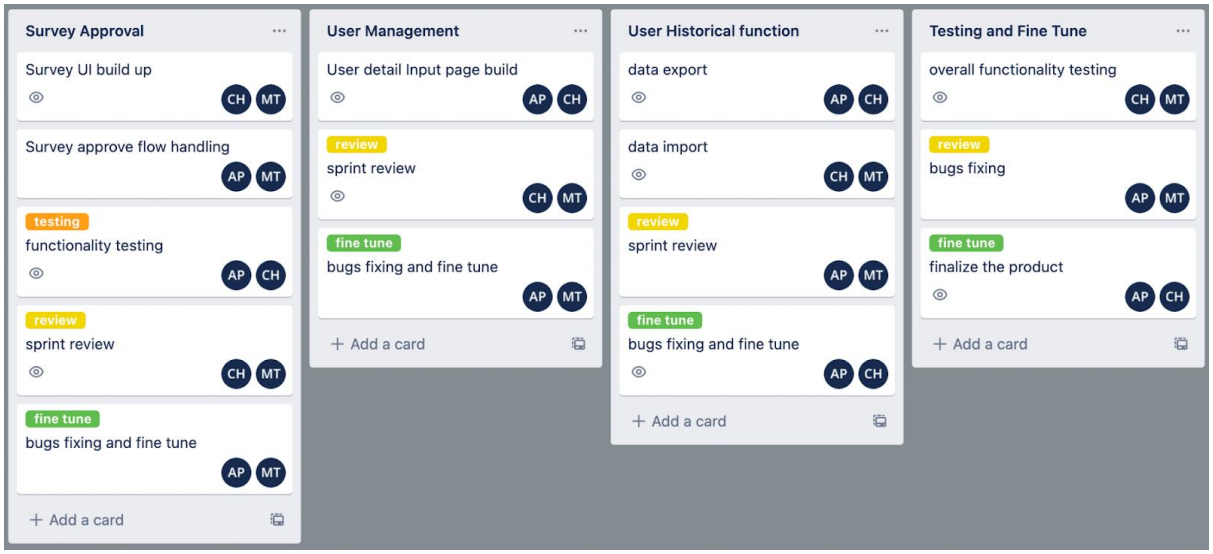
Sprint	Start date	End date	Review / Comment	Progress
Sign up / Login Page	02/02/2022	15/02/2022	User registration had been completed. Password security protection had been added	Completed
Homepage(Public Search)	16/02/2022	01/03/2022	Homepage search feature had been completed UI enhancement work had been completed	Completed
Survey Input Page	02/03/2022	15/03/2022	Frontend survey page had been completed with mock data	Completed

Survey Approval Page	16/03/2022	05/04/2022	Due to the epidemic, the schedule could not be completed	Not Completed
User Management Page	06/04/2022	19/04/2022	User management function in admin panel had been completed	Completed
User historical Page	20/04/2022	03/05/2022	Due to the epidemic, the schedule could not be completed	Not Completed
Testing & Fine tune	04/05/2022	21/05/2022	Finalize the Github content / Final profolio / Github readme file	Completed

(D) Overall Approach

Sprint board





Every piece of work has been separated and visualized in each sprint as a central information hub. All tasks have been visible and never gotten lost which brought transparency to the whole work process. Every task would be quickly updated by each team member.

Each task has been assigned to two members as the risk management approach. Each task has been assigned a support member to back up each other in case of any accidental issue for the task.

Every sprint has arranged its own testing, reviewing and fine-tuning task as a small development life cycle which is provided by the benefit of agile development to make sure the direction of development is what the client wants.

(E) Discussion about the difficulties and our workaround

1. In order to find a suitable programming language which not only fulfils the requirement of the user but also makes the development cycle feasible in Agile style, VUE, Bootstrap, node.js, PHP as our main programming tools was adopted to develop our full application. Some were new to our members. To study those language techniques, to make them run among different versions, to make every component work in close collaboration, to test a lot of scenarios, in a short period of development time during the Pandemic was indeed arduous.

Our workaround

a. Technical Information and knacks from a lot of worked examples illustrated on “GeeksForGeeks”, “W3schools”, “Youtube”, “CodeGrepper”, “Stackoverflow”, Vue.org were collected as our technical reserve for development.

b. Advice was sought from experienced developers.

c. A list of complicated tasks were broken down into small pieces of tasks. A list of simple methods were developed and combined to work out a final result other than using an unfamiliar and profound step to obtain the same thing.

2. Whether the appearance of a layout (i.e. black or white, circle or square box) is appealing enough or information visualization (i.e. histogram or chart) is appropriate to everyone, is very subjective according to the importance level to a user. To find the best one was very time consuming and sometimes it was in vain to get a united idea. Knowledge about color management and matching between them was lacking for us to be referenced.

Our workaround

a. Simple is always the best.

b. HCI Principles were followed.

c. Some popular applications or web sites were referenced. A lot of feeling and response was required from any users to fine tune our direction.

3. Collecting qualified information is always not a piece of cake.

a. Complete tree information is not possible. Some data sources provide descriptions, some do not. Some provide fruiting information. some only provide flowering information. Maintaining data integrity was a huge challenge.

b. There are few or no Chinese translations about the tree name and description. Introducing the App to local people who have never studied trees in English is a challenge, even insignificant.

c. Image size resolution among the different data sources is not all standards. This was time consuming to adjust on every picture.

d. We were not professional enough to decide which kind of data should be included in the survey form and a format to express them in an appropriate way (i.e. tree condition).

Our Workaround

The highest quality (i.e. have a high integrity data level) set of tree information among different tree information providers was selected. The absence of images can be solved by obtaining other images sourced on the Internet. The image size presentation can be solved by technical setting on the front-end. The data format will be finally confirmed by the end-user.

4. Unskilled members, especially in programming languages, make it difficult to meet the task deadline very often.

Our workaround

Part of non-technical jobs (i.e. product testing, usability assessment, information collection, UI design, data filing) will be assigned to those members who are weak in programming languages.

5. A few test cases were always not sufficient to cover all scenarios. Filtering those cases according to their functionality critical level usually misses some critical errors in another area which causes the whole program to totally fail.

Our workaround

The tests, which involve function requirements, were prioritized in our product testing schedule.

6. Poor debug programming technique is painful for newbie programmers in web applications. For example, most of the error results can only be traceable on the Internet console. Intentional behaviour of making backdoor (i.e. skipping login action) to obtain a testing result faster during the development may become a security disaster.

Our workaround

Most of the testing was carried out on the debugger and editor, nevertheless the console where some errors can only show on-line, cannot be inevitable.

7. ad-hoc change after confirmation of infeasibility on our original idea is a casual meal. Everything may need to be redesigned from scratch. For example, When a mouse is hovering a row on a Bootstrap table, a hovering colour, which is too bright to hide the content of a hovered row, violates the HCI principles. Consequently, Bootstrap tables should be given up and we were forced to use other alternative techniques. A lot of such technical difficulty usually created a sense of failure during the development cycle.

Our workaround

Internal Brainstorm discussion was carried out to figure out a feasible solution when we encounter technical difficulties at once.

(F) Review Of Risk Analysis

(i) Risk Management Plan

If-then statements

If wrongly identified complex functionalities or time needed, then the sprints may be delayed.

If unexpected project scope expansion, then the deadline of the final product may not be met.

If the sprint progress gets delayed, then the deadline of the final product may not be met.

If third party software or service was not free, then the budget may be needed.

If the prioritization of feature development was incorrectly evaluated, then the pressure will be increased in the second half of the development cycle.

If the communication in the team was not enough, then the work process may not be effective.

If the program had too many bugs, then more time may be spent for implementation

If some of the members left the team, then some workloads cannot be finished.

(ii) Risk register

Impact: High 5 to Low 1
Probability: High 5 to Low 1
Priority = Impact x Probability

Risk	Consequences	Probability	Impact	Priority	Response Plan	Assignee
wrongly identified complex functionalities or time needed	the sprints may be delayed	2	3	15	add support member to implement that specific functionality	Tim
unexpected project scope expansion	the deadline of the final product may not be met	1	3	3	communicate with client to identify functionality priority	Calson
the sprint progress gets delayed	the deadline of the final product may not be met	4	5	20	eliminate unnecessary features	Star
third party software or service was not free	the budget may be needed	1	2	2	seek another software or service	Tim
the prioritization of feature development was incorrectly evaluated	the pressure will be increased in the second half of the development cycle	3	1	3	review each sprint carefully to make sure every sprints were on the schedule	Calson
the communication in the team was not enough	the work process may not be effective	2	1	2	strictly schedule meetings each week	Star
the program had too many bugs	more time may be spent for implementation	4	2	8	arrange code review on every sprint	Tim
some of the members left the team	some workloads cannot be finished	4	5	20	1. hire another members 2. re-assign tasks responsibility	Star

(G) Communication Plan

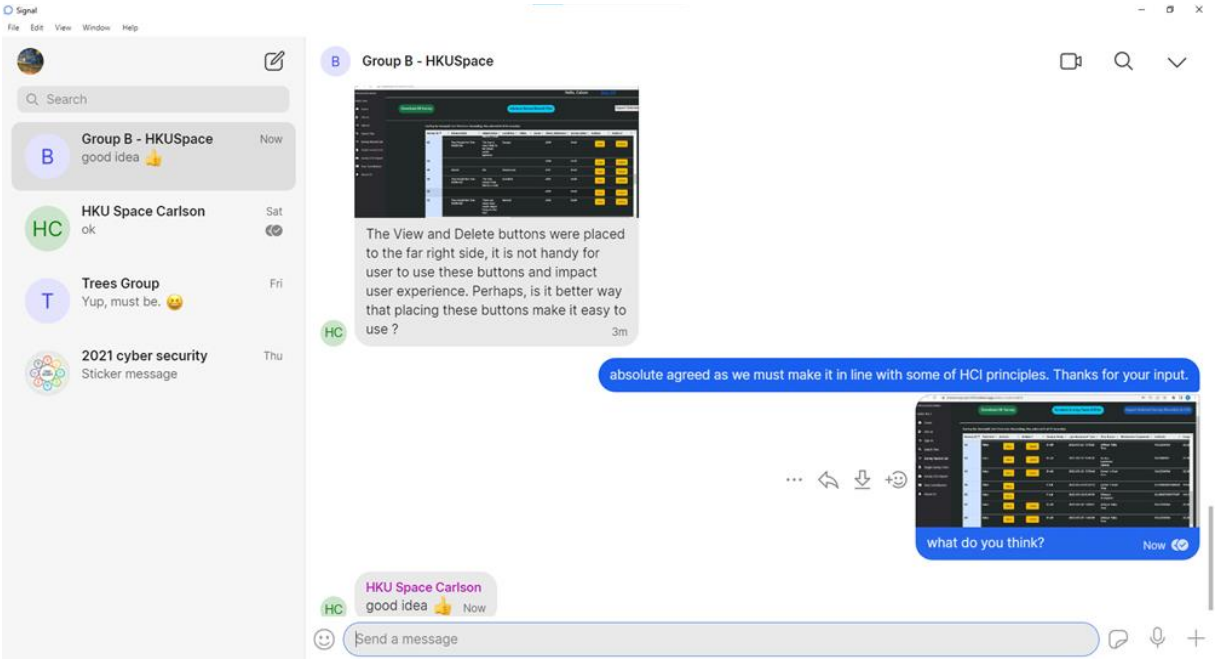
Stakeholder Communication

Name	Title	Frequency	Channel	Notes
Dr. Ivy Wong	Client	Every Sprint	Meeting / Email	Provide Requirements /

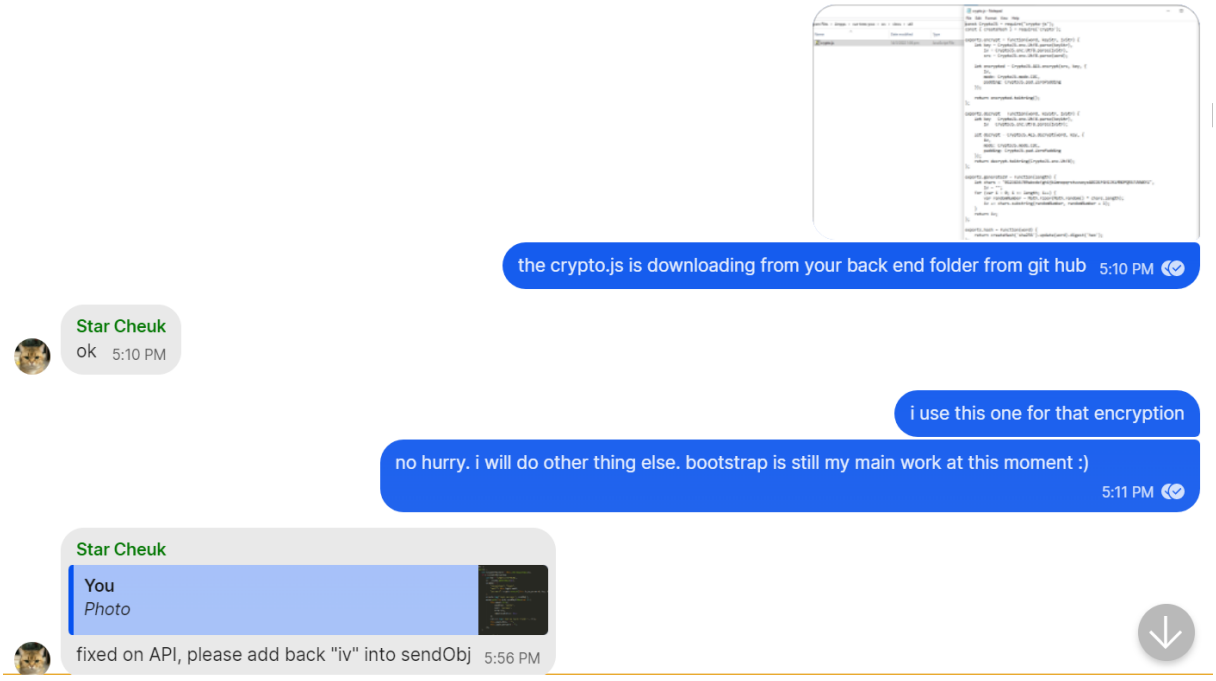
Team Communication

Type	Method	Frequency	Goal	Owner	Audience
Team Meeting	Zoom	Weekly	report status, identify issue, develop solution	Scrum Master	Project Team
Functionality testing	Signal	By sprint	Check the completion of functions	Product Owner	Team member
Sprint review	Zoom/ Google Meeting/ TeamViewer	By sprint	Review issue, develop solution	Technical Lead	Team member
bugs fixing and fine tuning	Signal	By task	optimize the specific function or task	Team member	Team member

The below picture shows our discussion on Signal Application regarding the layout design about the location of the button on the table



The below picture shows our discussion on Signal Application regarding a bug found when a login function test was carried out.



(H) Backlog Records in our project management

Date	No	Items
21/5/2022	1	Fine Tune on Layout Presentation on Mobile Device
21/5/2022	2	Implementation of Approval of moderator
21/5/2022	3	Implementation of “Forgot Password” Function
21/5/2022	4	Output User Activity Report
21/5/2022	5	CSV File Import Implement and Testing
21/5/2022	6	Billingual Features
21/5/2022	7	Download of Published Survey List Download Function
21/5/2022	8	Investigation of reset Password failure
21/5/2022	9	Back-End Enhancement
21/5/2022	10	Sign-In/Off State and Username should be shown on the top of Menu
21/5/2022	11	Add a “Tree Survey Application” title on the top of Application UI.
21/5/2022	12	Capability of relocating the columns on the survey list table (on Survey Record List Page)
21/5/2022	13	Spelling Mistake on "Submit" button on Individual Survey Page

Date	No	Items

26/5/2022	1	Fine Tune on Layout Presentation on Mobile Device
26/5/2022	2	Implementation of Approval of moderator
26/5/2022	3	Implementation of “Forgot Password” Function
26/5/2022	4	Output User Activity Report
26/5/2022	5	Billingual Features
26/5/2022	6	Download of Published Survey List Download Function
26/5/2022	7	Investigation of reset Password failure
26/5/2022	8	Sign-In/Off State and Username should be shown on the top of Menu
26/5/2022	9	Add a “Tree Survey Application” title on the top of Application UI.
26/5/2022	10	Capability of relocating the columns on the survey list table (on Survey Record List Page)
26/5/2022	11	**UI Layout Enhancement Request after Interview with Ivy**

Date	No	Items
28/5/2022	1	Fine Tune on Layout Presentation on Mobile Device
28/5/2022	2	Implementation of Approval of moderator
28/5/2022	3	Implementation of “Forgot Password” Function
28/5/2022	4	Output User Activity Report

28/5/2022	5	Billingual Features
28/5/2022	6	Download of Published Survey List Download Function
28/5/2022	7	Investigation of reset Password failure
28/5/2022	8	Add a “Tree Survey Application” title on the top of Application UI.
28/5/2022	9	Capability of relocating the columns on the survey list table (on Survey Record List Page)
28/5/2022	10	Investigation of losing of connection with the database occasionally (Session Issue?) on the deployed web site.
28/5/2022	11	Relocating “Collapse” button from the bottom to the top of the left-side menu bar
28/5/2022	12	Score calculation based on the approved survey records
28/5/2022	13	Species distribution on Hong Kong Map based on the approved survey records

(I) Future Improvement not listed on the Backlog.

Below recommendation will be considered in the next future stage:

1. Front End Background colour. (Black colour should be replaced with other colours (i.e. green) that matching the nature topic)

2. Title and Creation of menu Icon for activating sidebar menu collapse and expansion.

3. High-light colour when an item is hovered by mouse or finger.

4. Font Styles

5. Feature for enhancing “Easy of use” experience (i.e. One-hand manipulation)

6. Security features Review to handling the risks specified on the latest top ten “OWSAP”. For example:

a. Mobile security and the Application Management
b. SQL Injection and Data Validation
c. Data Encryption
d. Security Vulnerability inside our coding
e. Two-factor authentication (i.e. Email / Soft Token etc)
f. Session
g. Cache Data management

7. Offline access (i.e. User can download our database and read in Offline)

Requirements Analysis & Design

(A) User Stories

- A surveyor wants to view all of their submitted information which is uploaded.
- A surveyor wants to amend their drafts many times.
- A surveyor can remove their drafts before submission.
- A surveyor wants to have a list of tree information so that they can look for a tree which they target.
- A surveyor would like to have a list of submitted survey information downloaded on a file so that they can amend and re-upload them in one time without editing them on the App record by record.

- A surveyor wants to write down his observations on each survey record to accurately report a tree's health condition.

- A surveyor wants to receive a notification when his submitted survey status is changed (i.e. submitted -> rejected)

- A surveyor wants to re-submit his survey record after being rejected.

- A surveyor wants to download all approved survey records in public for their reference.

- A moderator wants to approve a survey record.

- A moderator wants to reject a survey record if it cannot provide enough information to be checked and validated.

- A moderator wants to download a list of survey records in an Excel file so that they can examine them on a file without pursuing them on the App record by record.

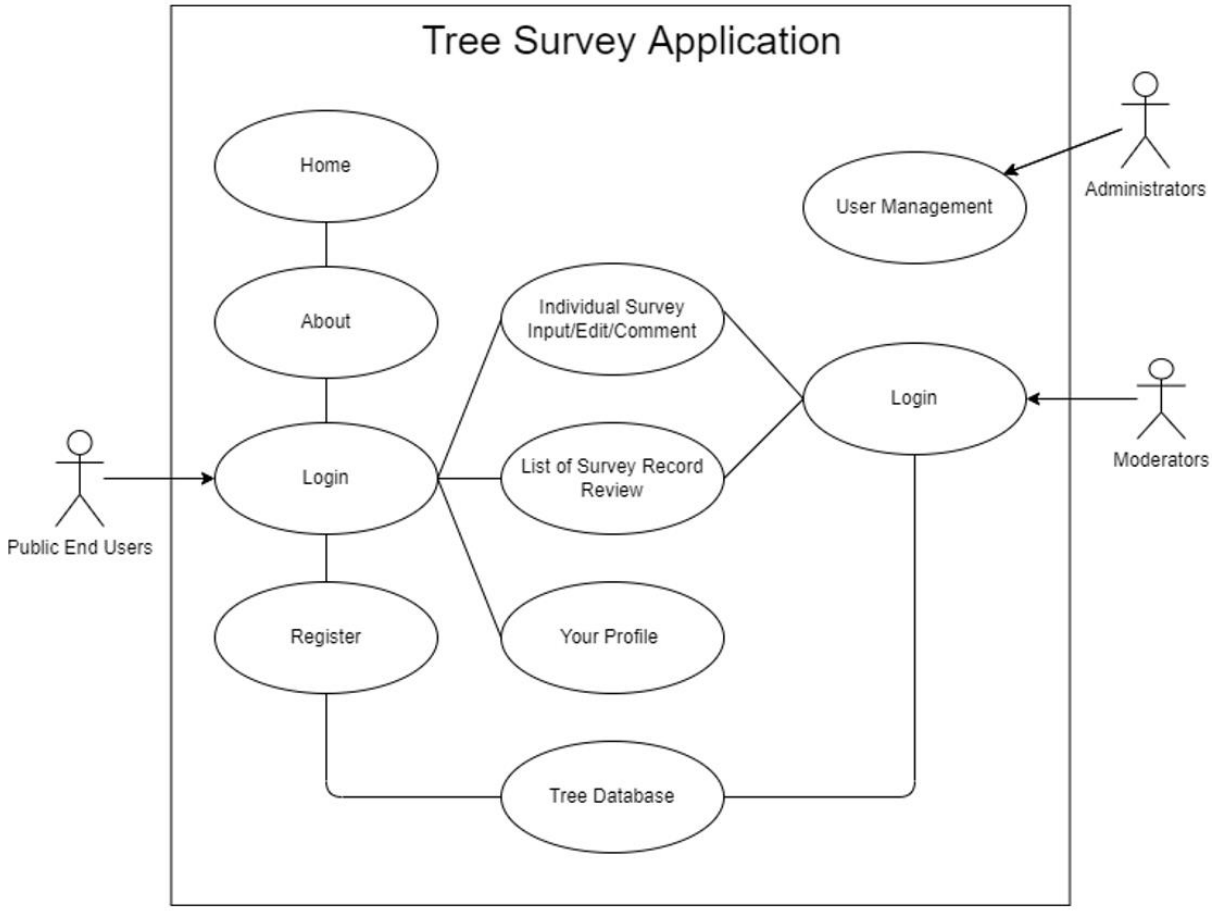
- A moderator wants to specify a comment in a survey record and inform a surveyor what’s wrong on his submitted information.

- An administrator wants to remove any kind of user (i.e. moderator) when they don't exist.

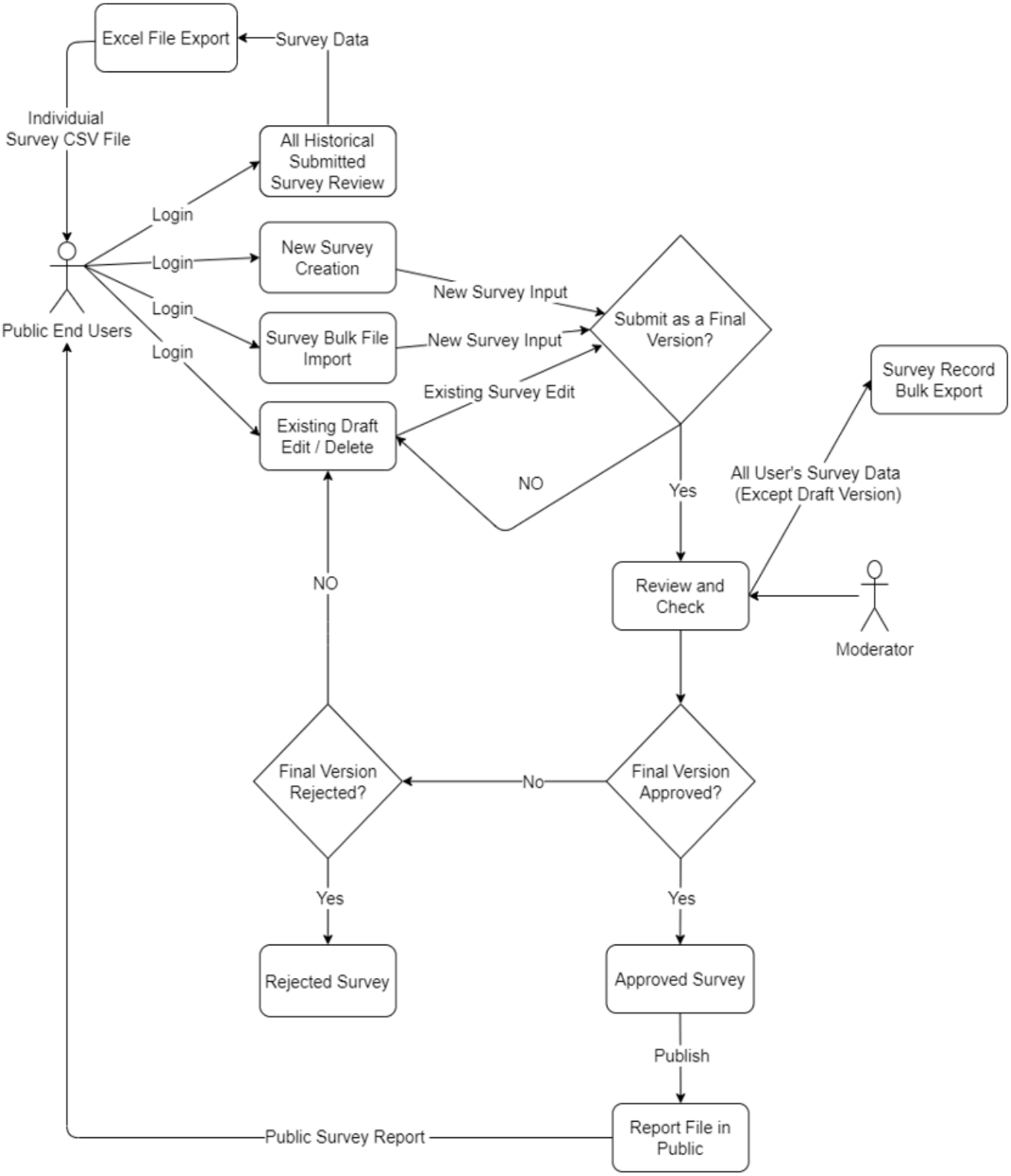
- An administrator wants to download a user audit trail report when they discover inappropriate actions taken by any end user. (i.e. repeatedly submits an empty survey record without any reason)

- An administrator can assign/revise a role to any user (administrator, moderator, a public user) according to valid instruction and request (i.e. moderator resign).

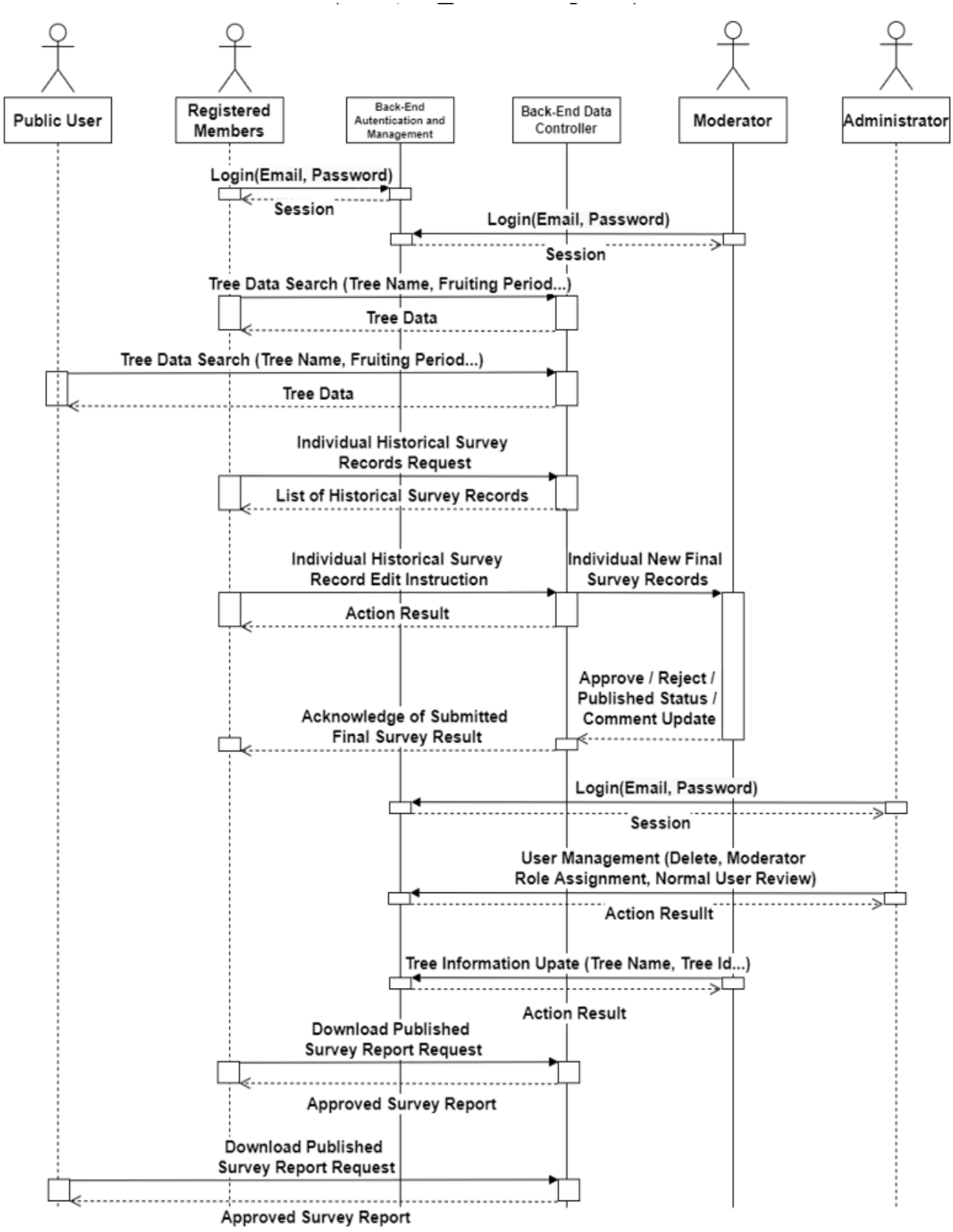
(B) Use Case Diagram



(C) Survey Information Flow Diagram



(D) Operation Sequence Diagram



(E) Workflow Explanation

1. A surveyor login and enter the App.

2. Tree information is
a. created, saved as a draft, or submitted as a final version.
b. imported via an Excel file which contains a list of all private submitted survey information.

3. When tree Information is saved as a draft, it can be amended many times by surveyors. (i.e. save as a draft-> edit -> save as a draft -> edit)

4. When a tree survey information record is submitted as a final version, a moderator is assigned to this record.

a. Draft
b. Final
c. Approved
d. Rejected
e. Published

5. In an ideal information system, a surveyor will be notified by email when a survey case changes status. Moderator comments may be provided along with a notification. When the status of the submitted survey record is revised to “Draft” by a moderator, end users can amend and submit it again (or just save as a draft and submit it later) and wait for next approval.

6. An approved survey will be published in public.

7. A rejected survey will be permanently freeze in a system (or relocated to other places i.e. archived in other databases).

(F) Requirement analysis of the application

i. Functional requirement

1. Server components (i.e., web server, database) should be established to process, store data collected from different end-users including administrators, moderators, and general citizens.

2. Different kinds of devices, such as mobiles, computers, tablets are supported.

3. Tree information published on the App (i.e. search tree function) is accessible to the public.

4. Last Amended date and time, surveyor email, tree name, tree location, observation note, measurement, survey status, moderator comment and other multimedia data (e.g., photo files, video file or its' link) should be included in survey information.

5. All kinds of end users (administrator, moderator, public user) should be registered and login to the system before uploading/revising their data to the database.

6. A list of open published survey records can be downloaded on the application.

7. Six statuses will be set on each survey records:

a. "Draft"

Survey record can be revised in the next login. "Draft" status is obtained when survey information is uploaded as a "Draft". This kind of survey record will not be validated by moderators. A new survey ID will be created at this stage. A "Draft" button is provided for this action.

b. "Final"

Survey record's status will be set to "Final" when the "Submit as a final" option is taken by a surveyor. The record will be waiting to be assigned a moderator on this stage. Before approving a submitted survey record, "Final" status is still kept during this period.

c. "Approved"

If a survey information is approved by a moderator, "Approved" status will be assigned to this survey.

d. "Rejected"

If a survey information is rejected by a moderator, "Rejected" status will be assigned to this survey.

e. "Published"

If a survey is published in public, "Published" status will be assigned. Only approved surveys can be published. Only published survey records can be downloaded on the App for all end users.

8. The type of an end user and their basic rights:

a. Below rights are granted to a public user to:

➔ view a survey in any survey status provided that it has not been archived.

➔ edit a survey only in a “Draft” status.

➔ remove a survey only in a “Draft” status.

b. Below rights are granted to a moderator to:

➔ view a survey in any survey status if it has not been archived.

➔ edit anything of existing survey information (apart from survey ID and survey creator information) only in a “Final” status, “Approved”, “Rejected” and “Published” status.

➔ A moderator can change the status of the survey from “Final” to “Draft”. It is to request a survey to amend his submitted data until it is qualified to be approved.

c. Below rights are granted to a an administrator to:

➔ View: A list of all users, not survey record information can be viewed.

➔ Edit: The role of all end users. (i.e. to assign a moderator role to public users and let them become a formal moderator or administrator) can be edited.

➔ Remove: Any kind of end user including themselves can be removed in the system.

9. Different views for enhancing user experience can be provided. For example, it includes tables with sorting feature, a map view (i.e. Google Map) showing the tree location, a list of pictures showing different tree species.

10. Selected survey records can be exported in CSV format.

11. Export published data in CSV format by public users should be feasible. A standard template in this format is provided in the App.

12. Only one species in a specified location for each survey is recorded. A tree name can be blank when the end user does not know it at the time of submission. However, Some information (i.e. at least one image file) is still mandatory.

13. A user management report can be generated to check the time series of historical actions taken by any kind user.

ii. Non-Functional requirement

1. Activity records of the users can be kept in a database for a long time (i.e. 7 years).

2. English and Chinese language can be supported.

3. The terms and conditions could be clearly specified. Below is included but is not limited to:
   a. Personal information protection.
   b. Purpose of data collection.
   c. Conduct of end user and their responsibility.
   d. Risk of abuse of the App/system.

4. 500 user connections simultaneously with no performance issue is supported.

5. For each survey, the overall size of media files should not be over 52M in total (i.e. 5 files of 500K image and one 50M-sized video file).

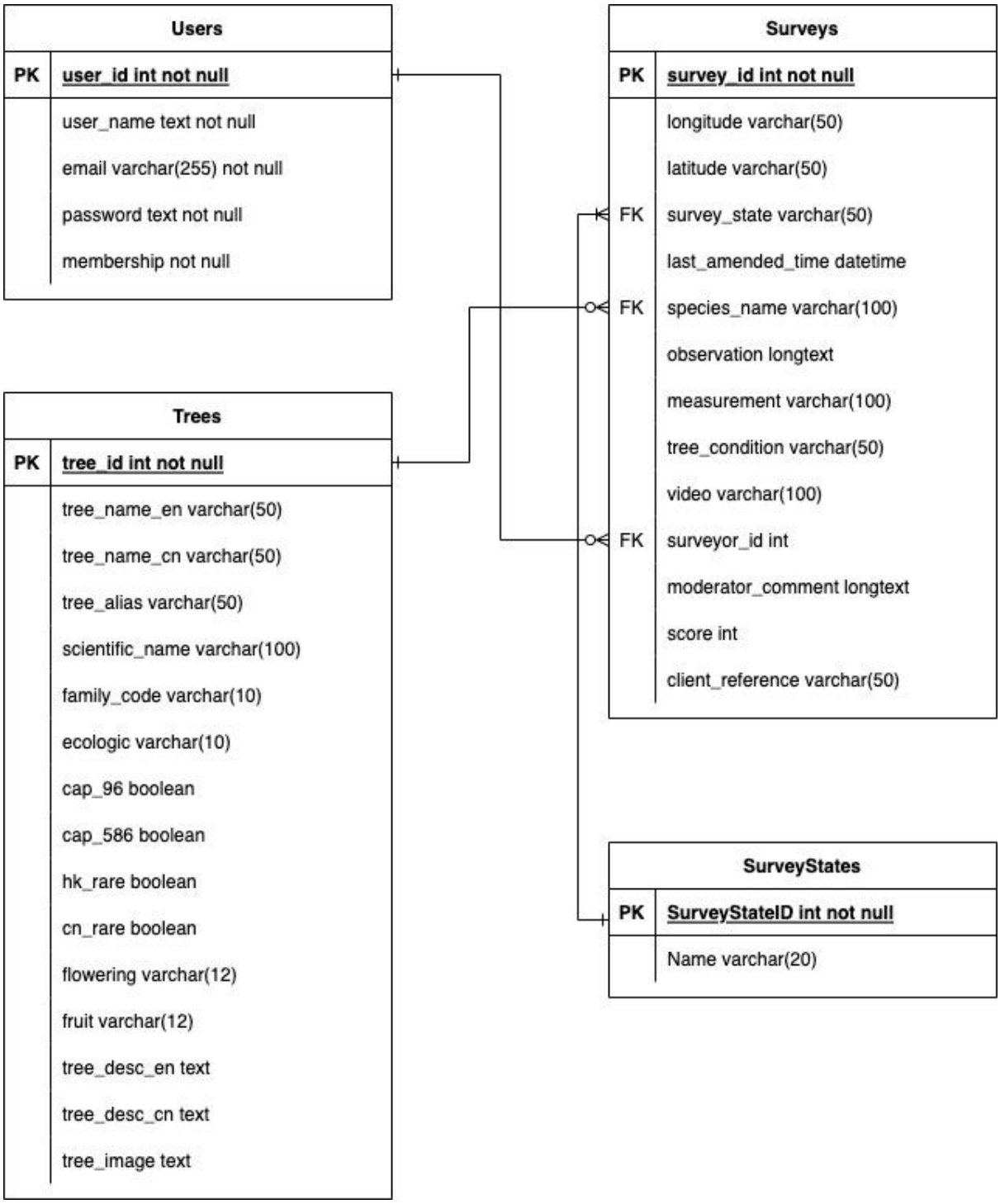
6. All data communication is encrypted.

7. Any end user is allowed to change their profile setting and password

8. The User Password can be reset by pressing the “Forget Password” button. Temporarily password will be sent by user personal email.

(G) Database Design

Entity Relationship Diagrams



The database has been hosted on the RDB of AWS. It was written in the MySQL language with three main entities. The tree entity for the tree detail of the library. The user entity for all characteristics of the system, the users were classified by the membership level which are “Surveyor”, “Moderator” and “Administrator” currently.

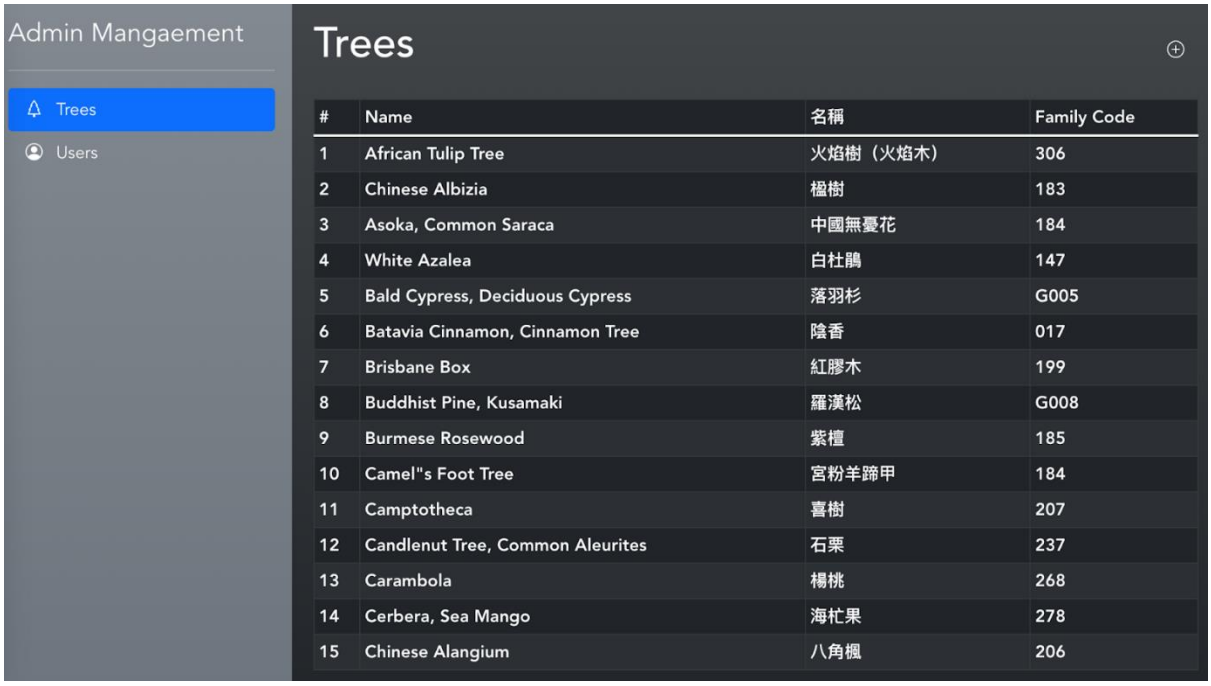
The survey entity has included all the survey details including local time, tree information etc.

Implementation

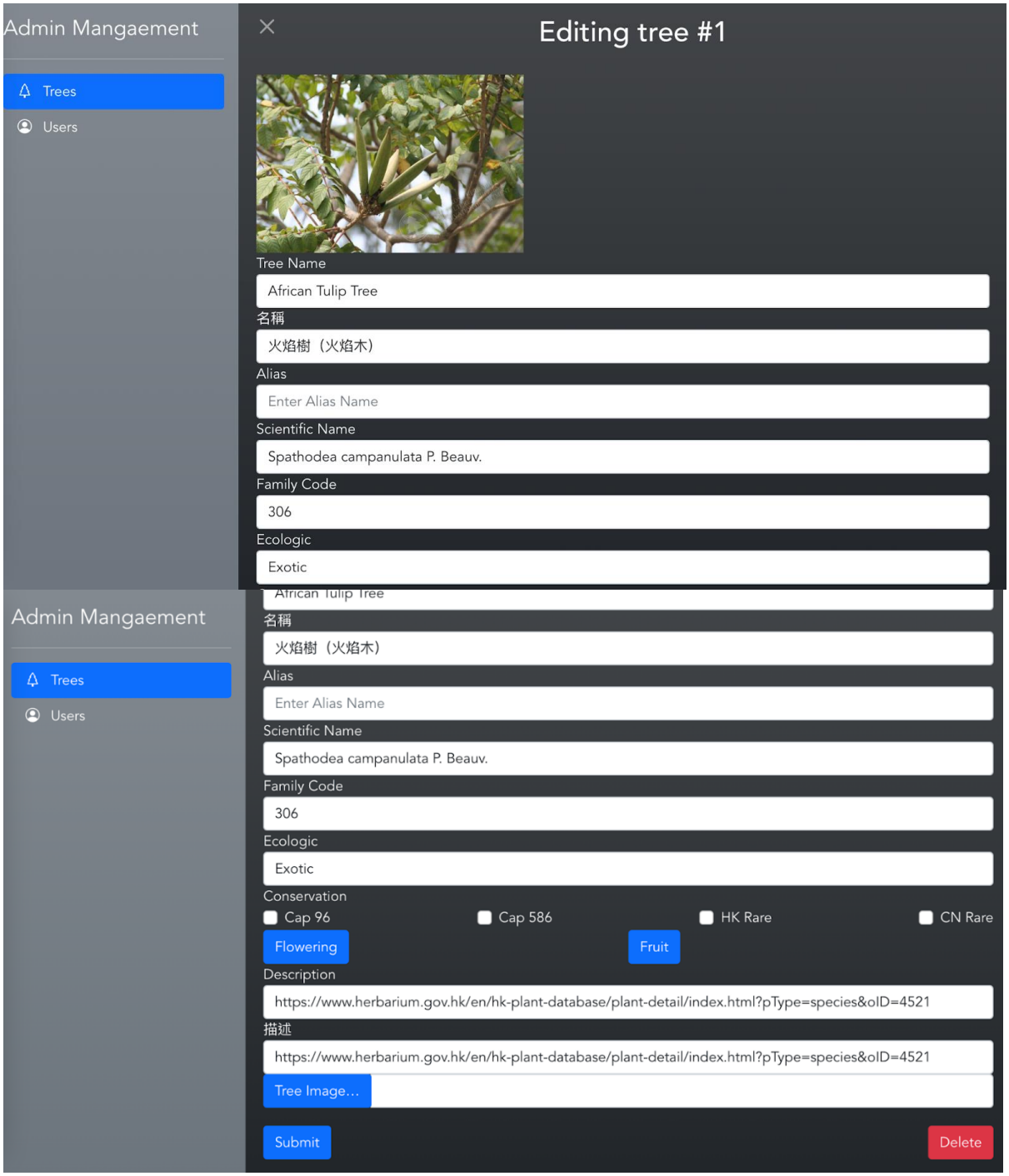
(A) Admin Panel

(1) Tree Information Management

For the tree information management of the database, an administrational panel has been provided for this purpose.



#	Name	名稱	Family Code
1	African Tulip Tree	火焰樹（火焰木）	306
2	Chinese Albizia	楹樹	183
3	Asoka, Common Saraca	中國無憂花	184
4	White Azalea	白杜鵑	147
5	Bald Cypress, Deciduous Cypress	落羽杉	G005
6	Batavia Cinnamon, Cinnamon Tree	陰香	017
7	Brisbane Box	紅膠木	199
8	Buddhist Pine, Kusamaki	羅漢松	G008
9	Burmese Rosewood	紫檀	185
10	Camel"s Foot Tree	宮粉羊蹄甲	184
11	Camptotheca	喜樹	207
12	Candlenut Tree, Common Aleurites	石栗	237
13	Carambola	楊桃	268
14	Cerbera, Sea Mango	海杧果	278
15	Chinese Alangium	八角楓	206



The tree data can be added, edited, and removed in the admin panel by the administrator for easy management.

(2) Image File Management

On the initial approach, the BASE64 was used for storing and transferring images between the web application and the database. Unfortunately, the loading speed

was extremely slow, especially the images were large. After researching and discussing with teammates, the better solution was to use Google Firebase cloud storage. Whenever users upload the images to Google Firebase cloud storage, the return URL link is stored on the database instead of the BASE64 string. When the web application called the url link, the image downloaded the image from Google Firebase.

The below picture shows the file organization in the Firebase for storing images submitted by an end-user. All survey images are placed on the “Survey Image Files” folder pre-created on the firebase file server. When the server receives an image from a new survey record, a folder, which is named according to the survey ID number (i.e. 1), is created under the “Survey Image FIles” to store those images. A name of an image, which is composed of survey number, image file no and file extension (i.e. survey ID - Image No.png, e.g. 1-1.png) is assigned to each image file. The path of an image URL likes “\firebase\Survey_Image_files\1-1.png” is stored in the database.

Survey image file organization on the Firebase

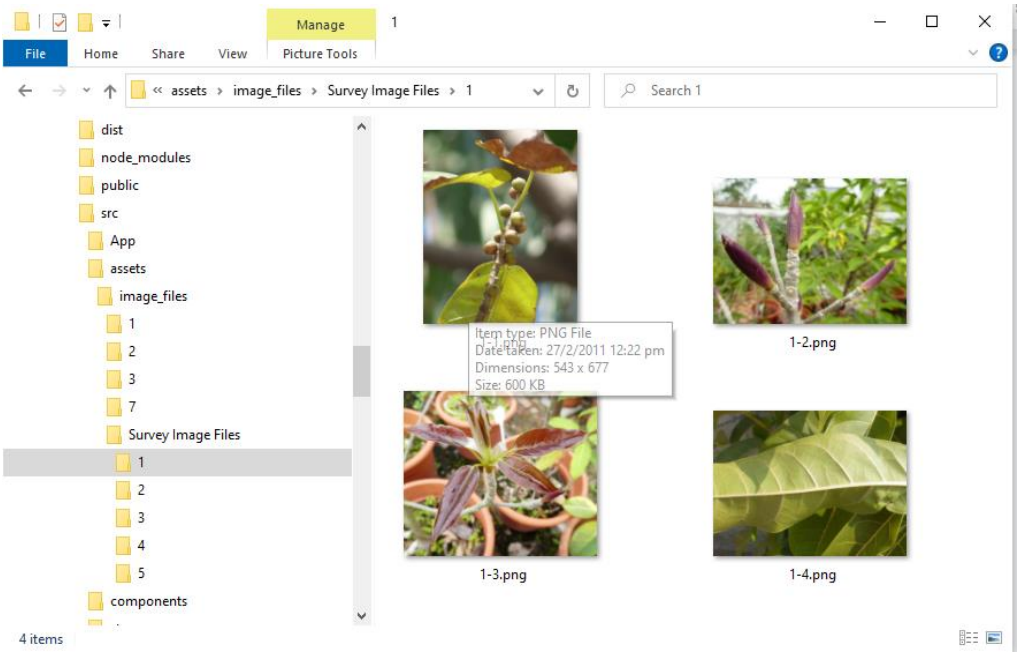
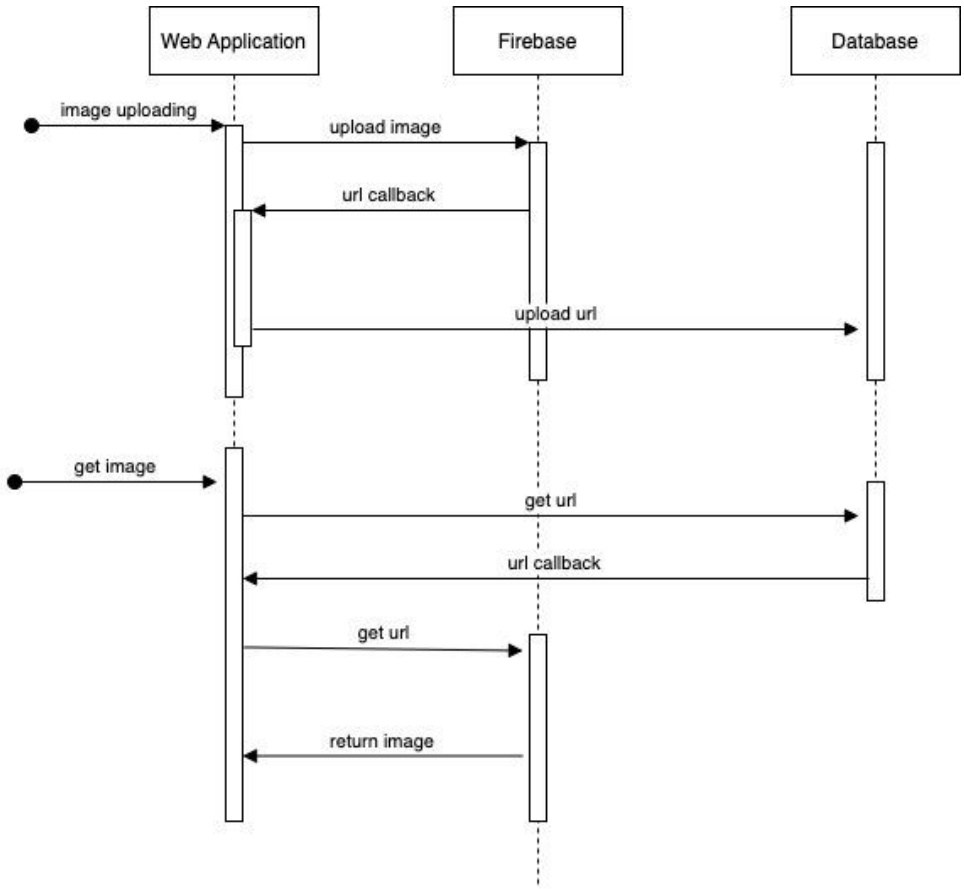


Image Download Sequence Diagram



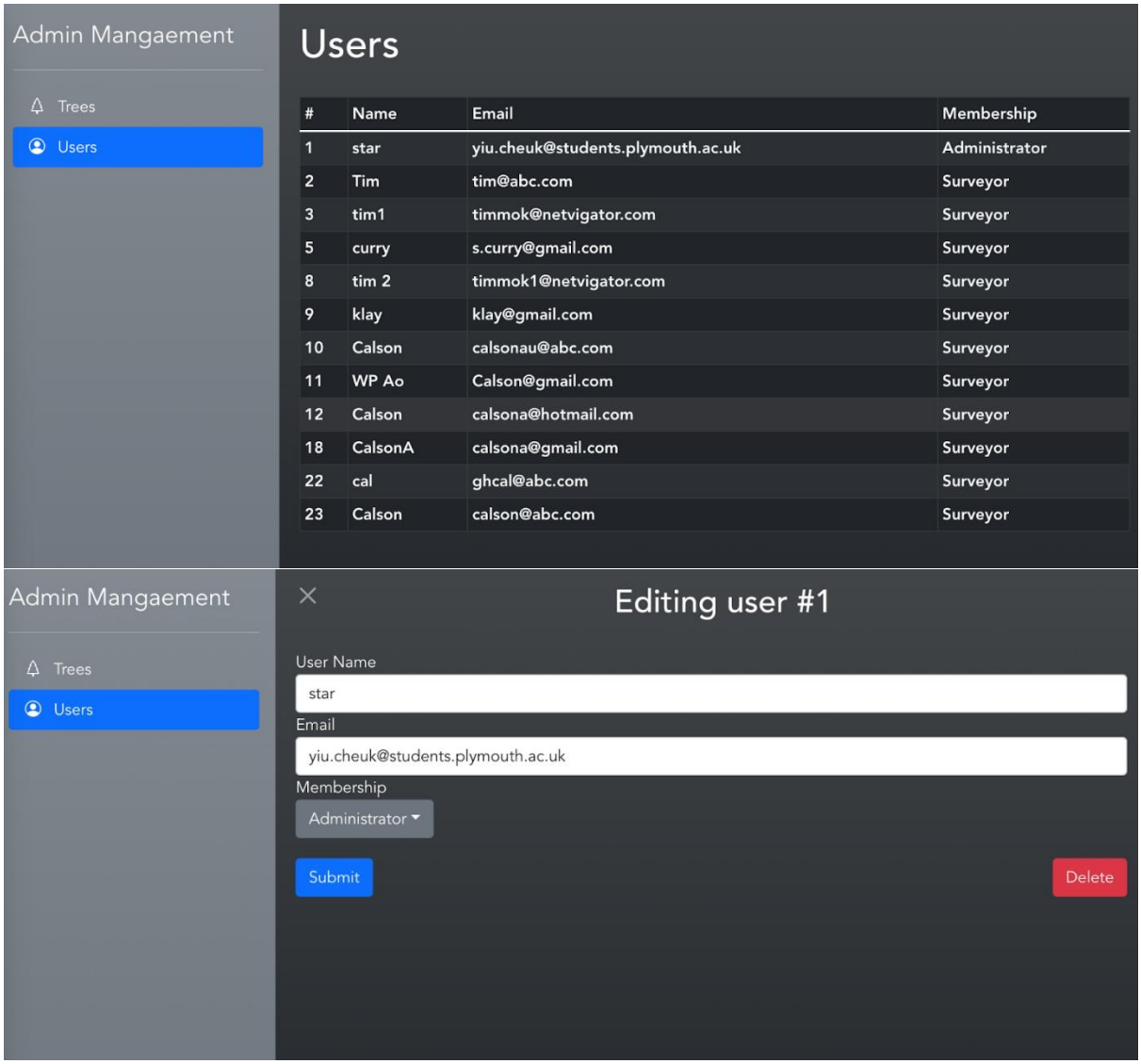
The Pos and Con of the approach

As an image download process has been segregated from the data download process, the users have an option not to take a long time to download a lot of images before accessing the pure textual information. The user experience can be improved under this approach, especially when the back-end system needs to handle a large amount of tree data and images simultaneously (i.e. multiple information requests received from the Public).

The downside of this approach is that the images under the same survey case would not appear simultaneously with the survey information. To minimize the impact of user experience, the image placeholder icon will temporarily be shown at the location of the image box on the web page until the image downloading process is completed.

(3) User Management

Any end-user (i.e. the Public, moderator) data can be edited and removed in this panel. However, creation of the end-user account for the Public was not belong to the job domain of this panel.



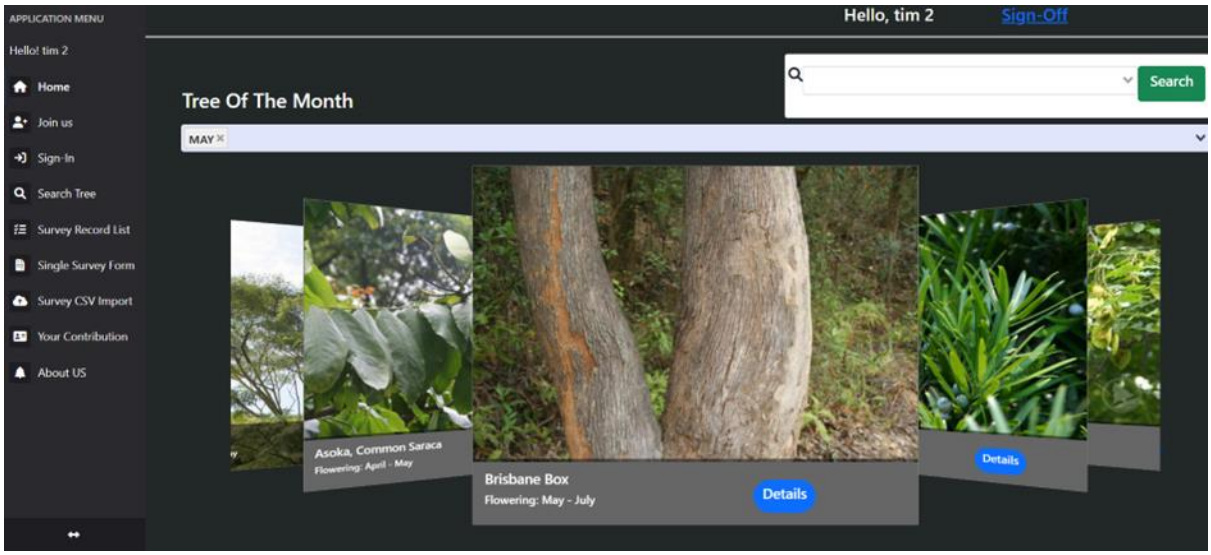
(B) Front-End Application

There are 9 pages in the Tree Survey Application. Each page can be accessed directly via the left menu bar. These pages are placed intentionally in an orderly sequence of working flow. While the menu bar is collapsed or expanded, the main page is also acting in the opposite way correspondingly to maximize the working area.

(1) Home Page

There are four sections on this page. They are “Tree Of The Month”, “Recently News”, “Prized Q & A” and “Number of Published surveys vs their distribution on the Hong Kong Map”

i. Tree of the Month



In this page, end users can learn a list of trees (i.e. Brisbane Box) currently flowering in the current month. The picture is automatically continuously sliding in a Carousel box. Users can type other months additionally under the box of “Tree of the Month". The corresponding list of tree pictures for that month will be shown up automatically in the Carousel box.

Users can enter “Details” to read the tree details as below Image A. The information includes English Name, Chinese Name, scientific name, Alias Name, Fruiting Period, Flowering Period, Ecologic, Rarity in China and Hong Kong, whether subjected to Forest and Countryside Ordinance, Protection of Species Ordinance.
Design Rationale: Public User Education

Brisbane Box

Scientific. Name : Lophostemon confertus (R. Br.) Peter G. Wilson & J. T. Waterh.

Alias Name : Tristania conferta R. Br.

English Description

The Taiwan Acacia and Brisbane Box can be counted as two of the most common exotic trees in Hong Kong. Native to Australia, it has dark green leaves with smooth edges; opposite when young, alternate when mature, they rotate and aggregate on branch tops. White flowers with numerous inconspicuous stamens appear in 5 feather-like bunches in summer. Fruits are born in autumn as bell-shaped woody capsules that can be 2 cm large.

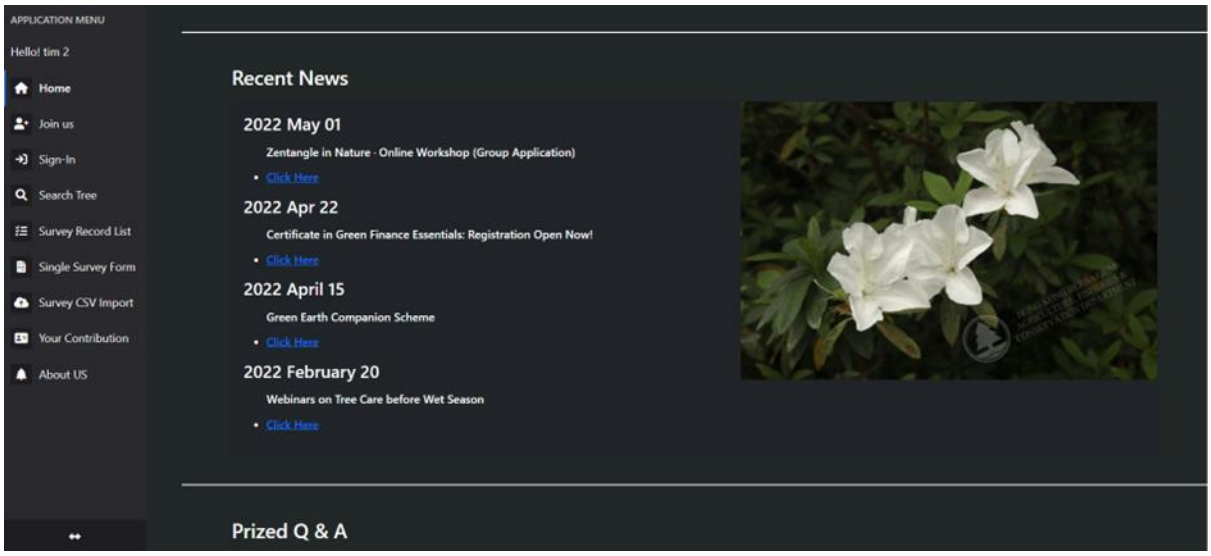
Chinese Description

香港外來引種植物 （exotic species） 最常見的兩種是台灣相思和紅膠木。 紅膠木原產澳洲，葉墨绿，邊缘平滑，幼苗時，葉對生，長大後變為互生，樹葉於分枝頂聚生近似輪狀。白花，雄蕊如白色羽毛，細小不起眼，果成鐘形，蒴果 （capsule）。

Chinese Name : 紅膠木
Ecologic : Exotic
Flowering Period : May - July
Fruiting Period : August - September
Rare in China : No
Rare in Hong Kong : No
Subject to Forests and Countryside Oridance : No
Subject Protection of Species Ordiance : No

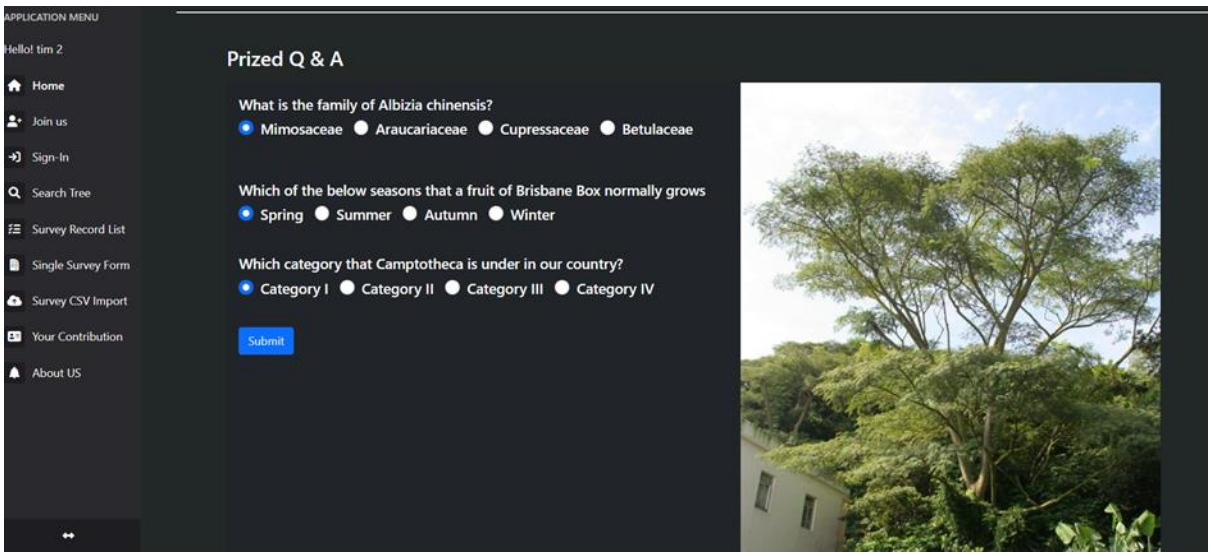
OK

ii. Recent News



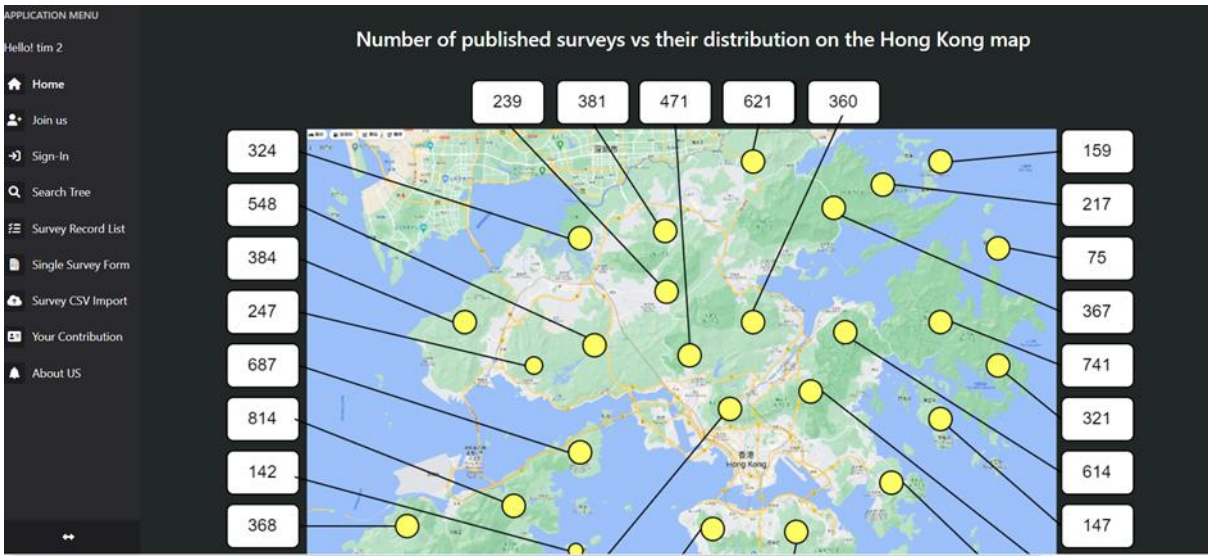
In this section, recent events include an online workshop, educational course, organization project for the public, and seminar about trees that are targeted to be listed in this section. The link is provided for users to approach the data source directly.

iii. Prized Q & A



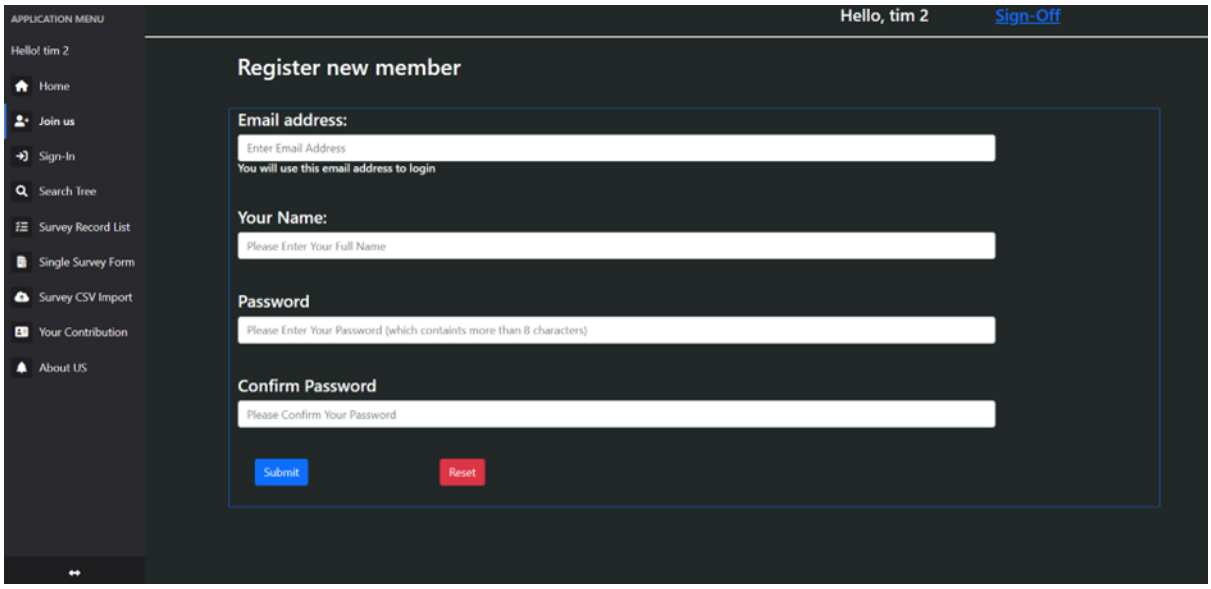
This section was designed for the organization to reward their members through some challenging questions. Our team agrees that this section can enhance the user interaction with the Apps and drive end-user's initiatives to learn more about trees.

iv. Survey Distribution Map



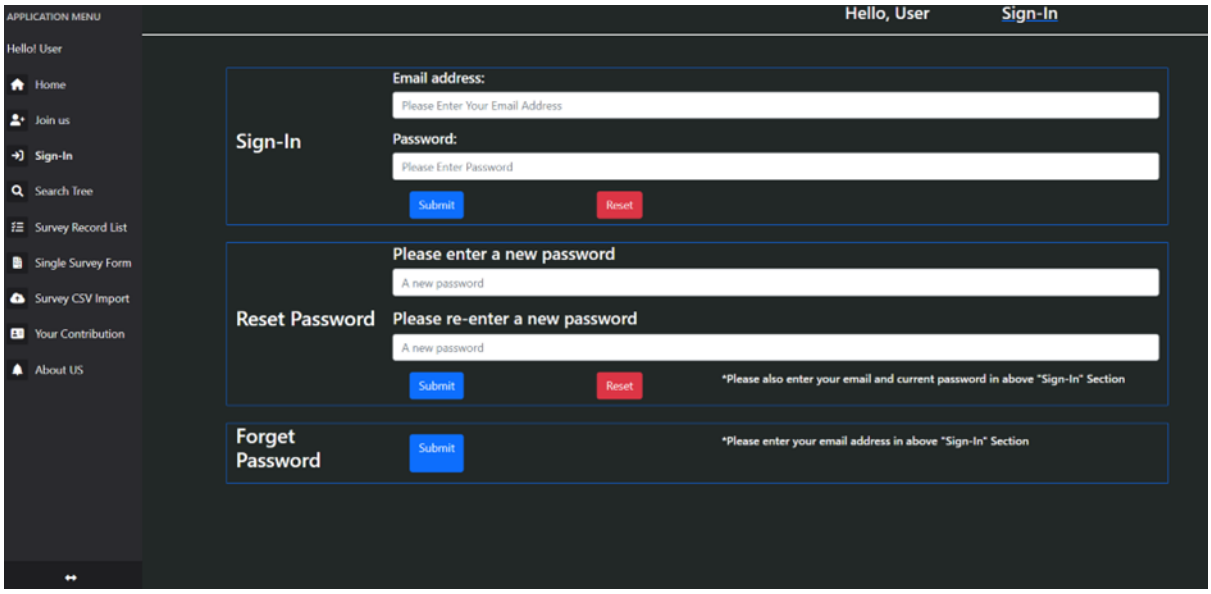
The graph is to show the number of surveys according to their locations specified on the GPS box. We will discuss it further in the chapter of innovation and future design direction.

(2) Join Us - Register New Member



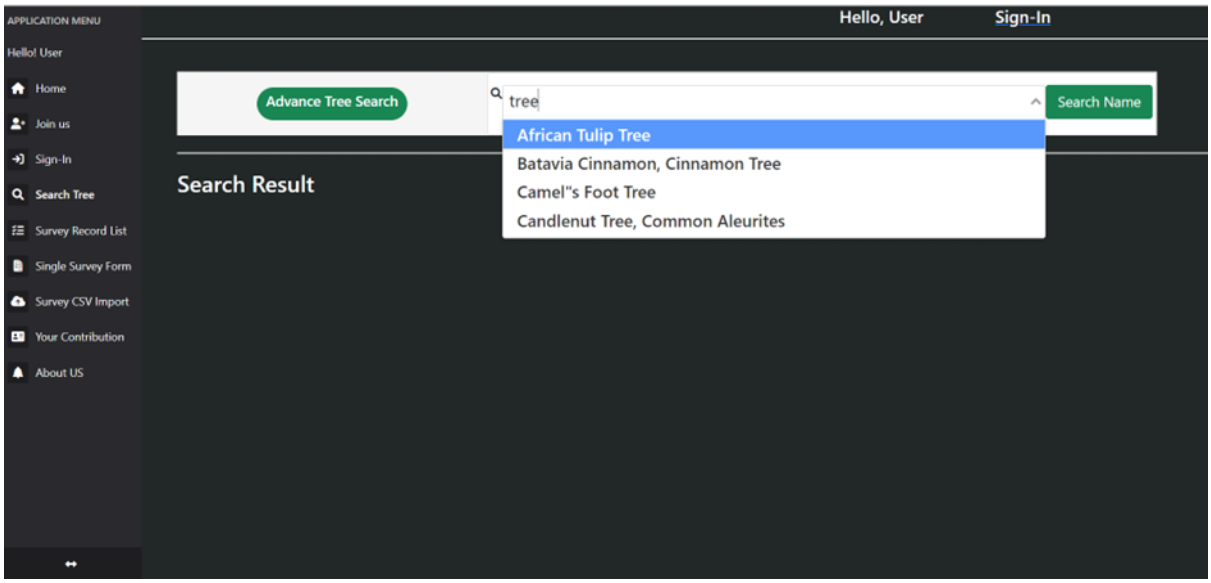
An end-user needs to submit four pieces of information to register a new member. They are Email Address, Your Name, Password and Confirm Password. Reset Button is to clear all information on all boxes.

(3) Sign-In Page



Users submit their email address and password to login the app.
Design Rationale: User Authentication

(4) Search Tree Page

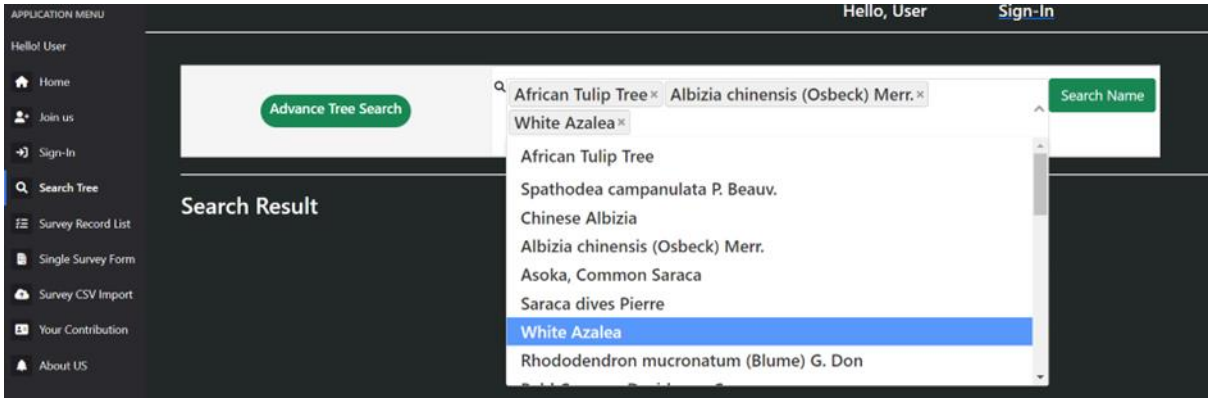


On the page, user can either input any kind of tree name (i.e. Alias, Scientific Name, General Tree Name) or by filtering some parameters of the trees to find out a list of targets.

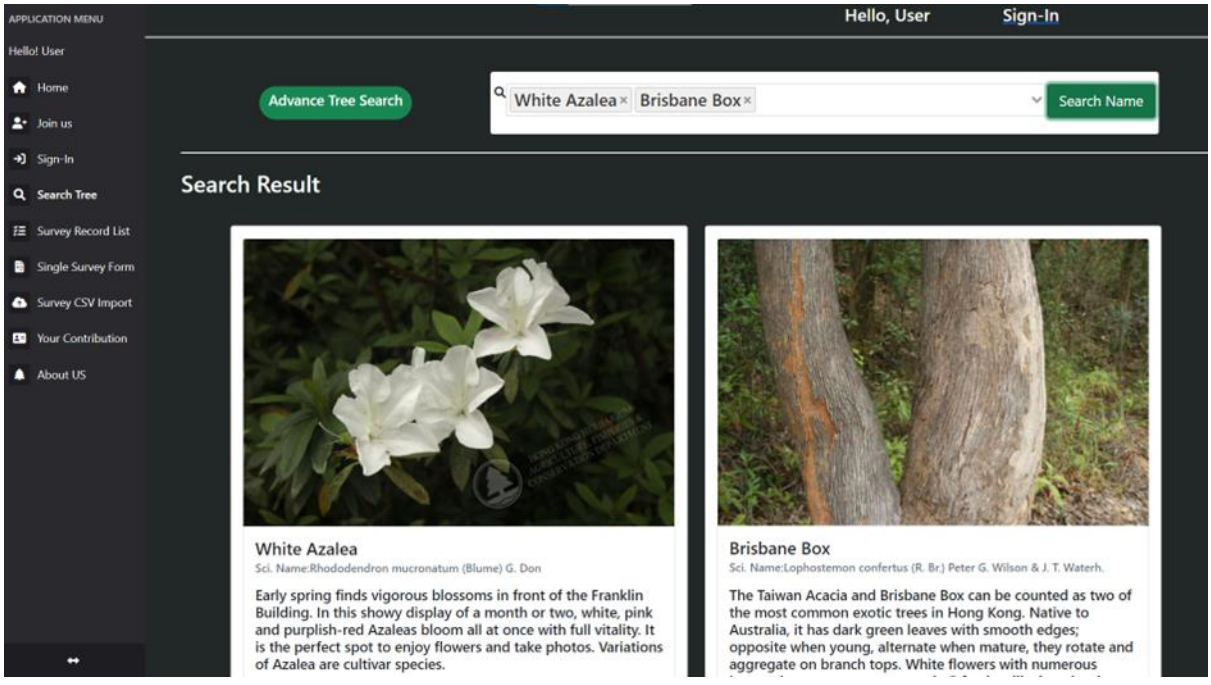
a. Two ways of searching method is provided to target a list of trees by

i. typing (i.e. tree) as above

ii. selecting in the provided list as below

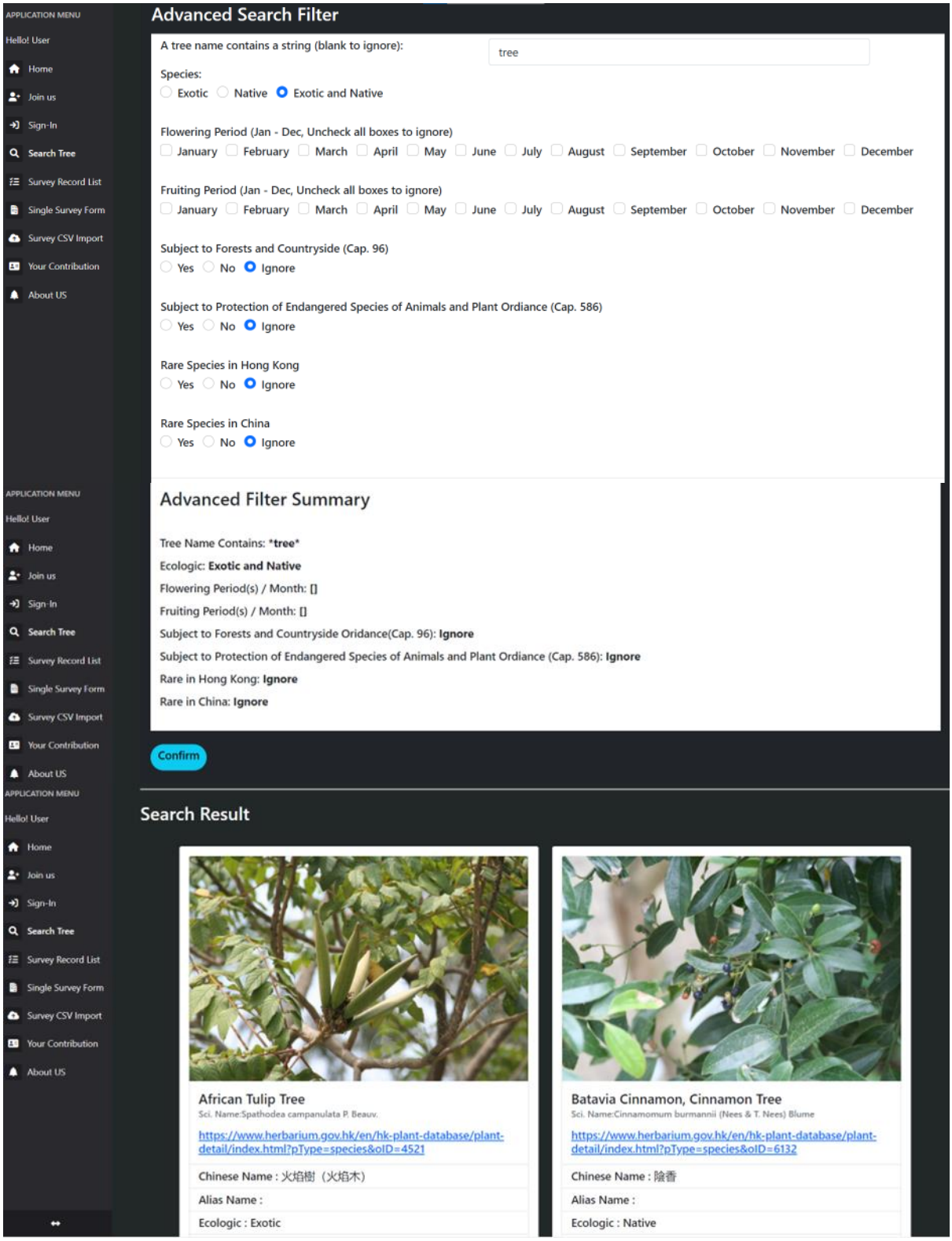


The result will be shown on the bottom search box as below.

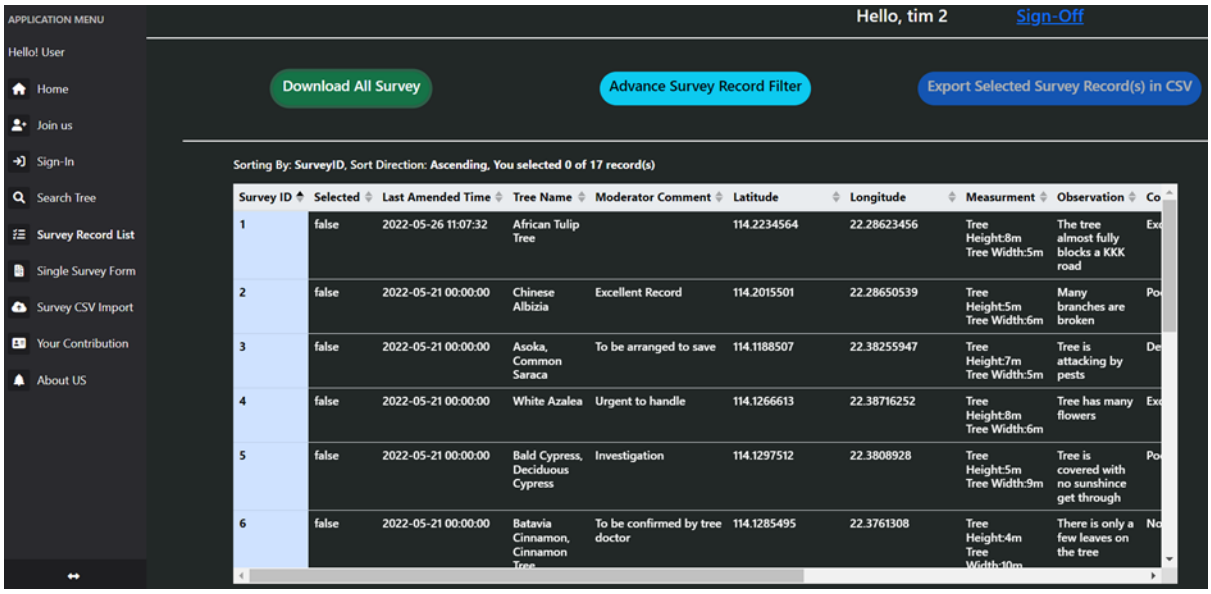


b. Advanced tree filtering.

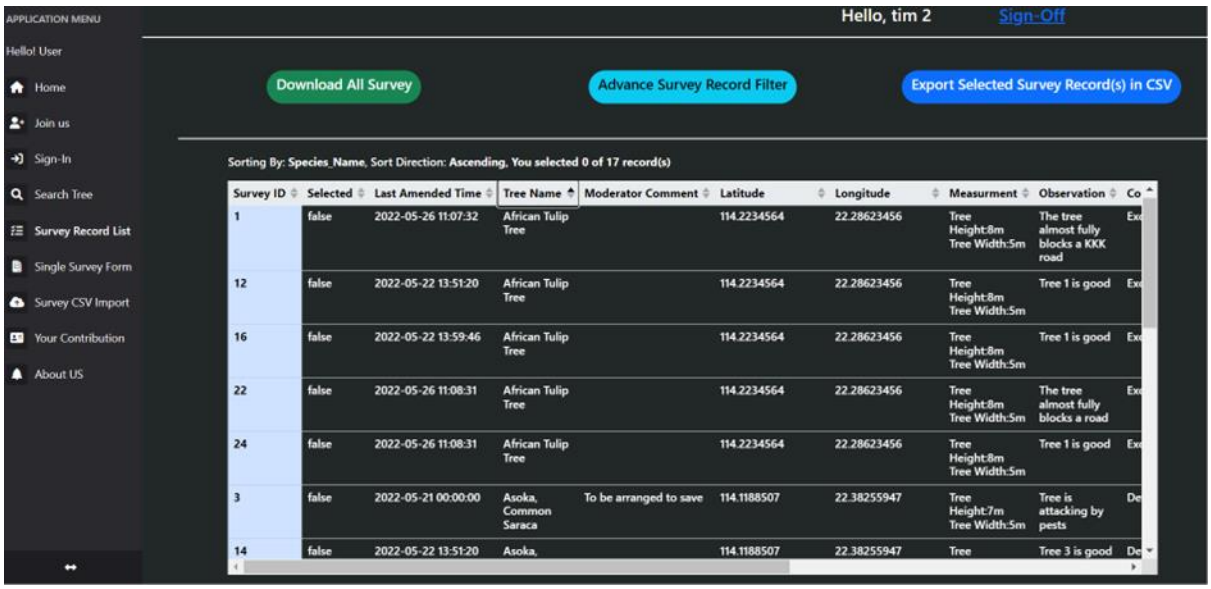
The below input form provides a place to filter some trees according to the user's preference.



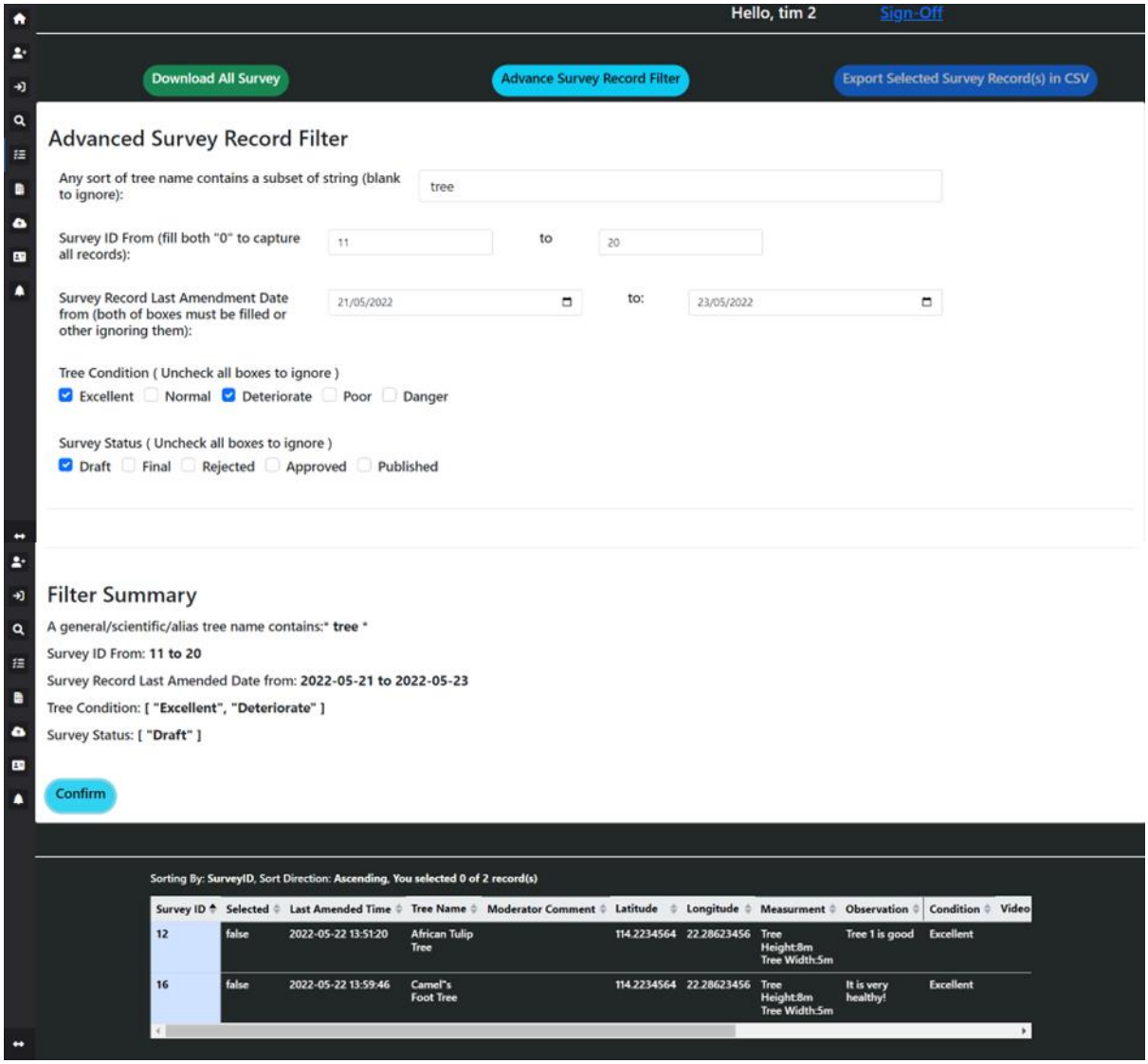
(5) Survey Record List



This page is to let users download all submitted historical survey records either in “Draft”, “Final”, “Approved”, “Rejected” and “Published” survey stages. The column and the survey ID is fixed while other columns can be moving along on a rolling scroll bar.



User can do the sorting on this table (i.e. Tree Name).

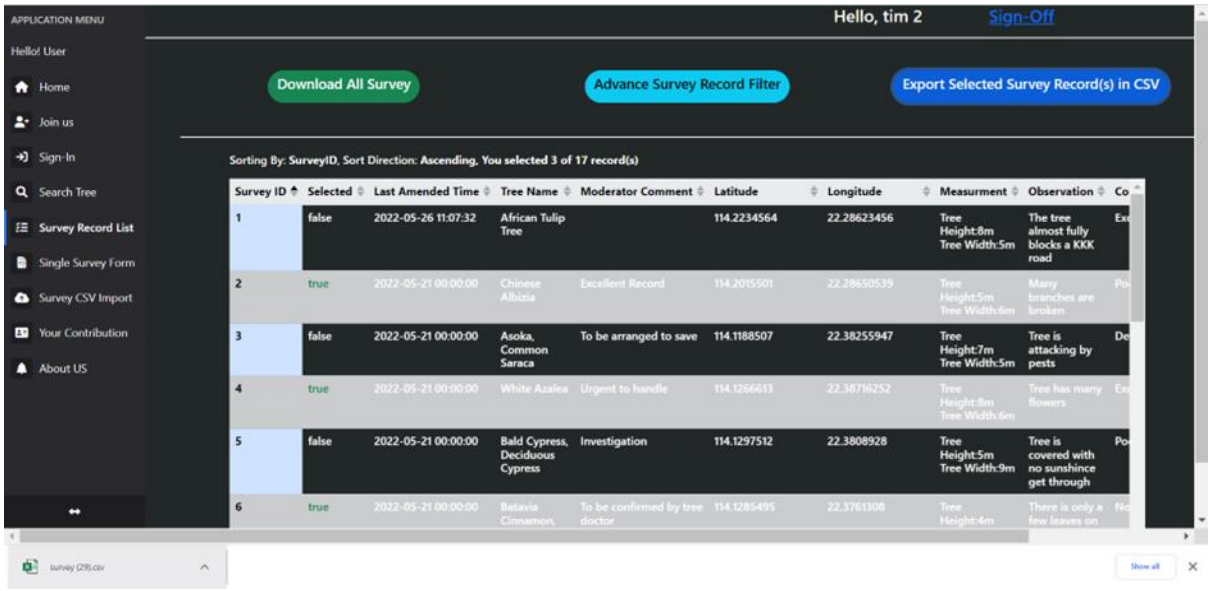


On the other hand, users can filter a list of survey records on the “Advance Survey Record Page” (by pressing the “Advance Survey Record Filter” Button.

When users can click on the targeted rows, “Selected” column will be changed from false to true

A sorting method with the number of selected surveys is shown on the top of the table. (i.e Sorting By: Survey ID, Sort Direction: Ascending, You selected 3 of 17 record(s) in below pictures)

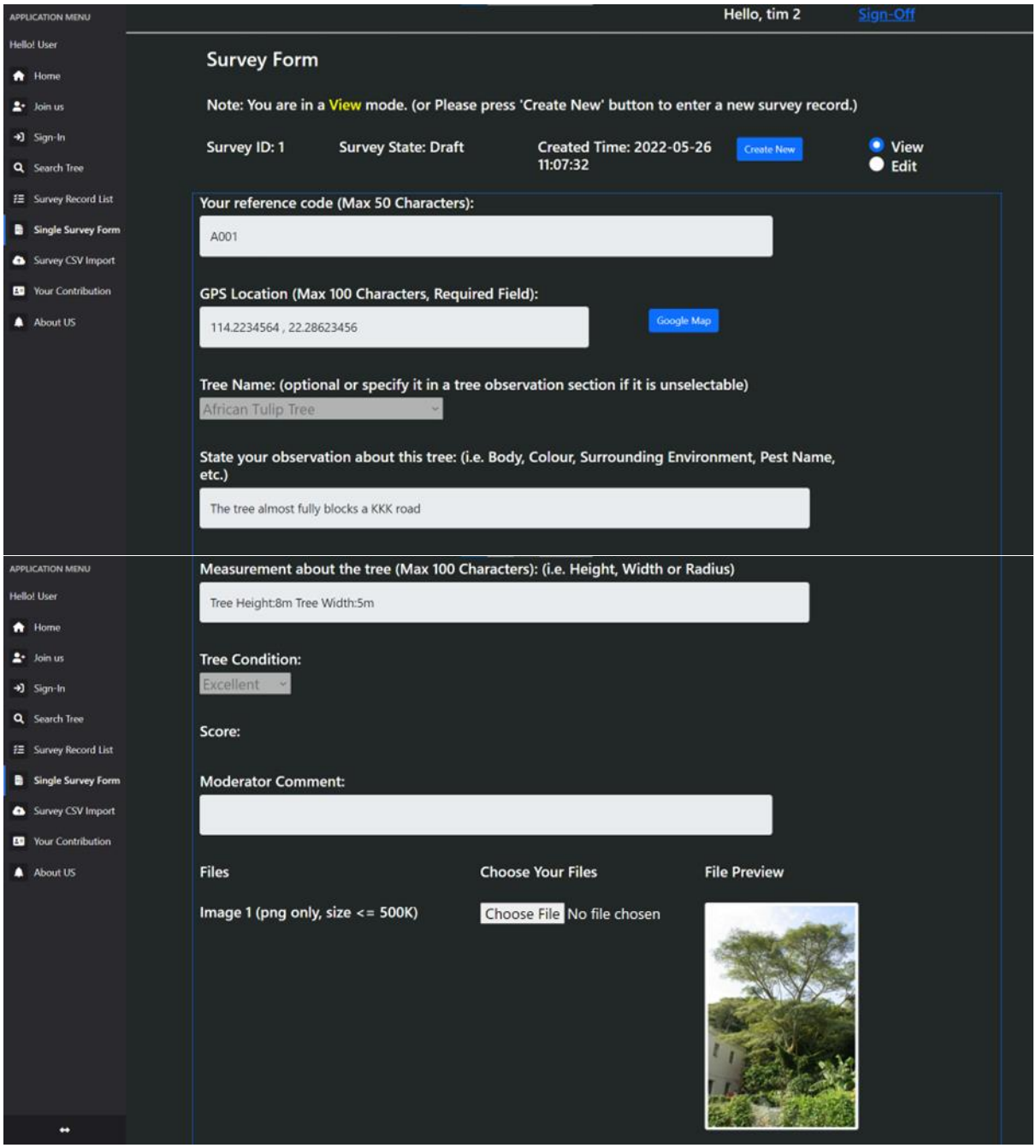
The selected row can be exported in a CSV file by pressing the “Export Selected Survey Records(s) “button. A download box is prompted at the bottom of the left-hand corner for the user to download the file.

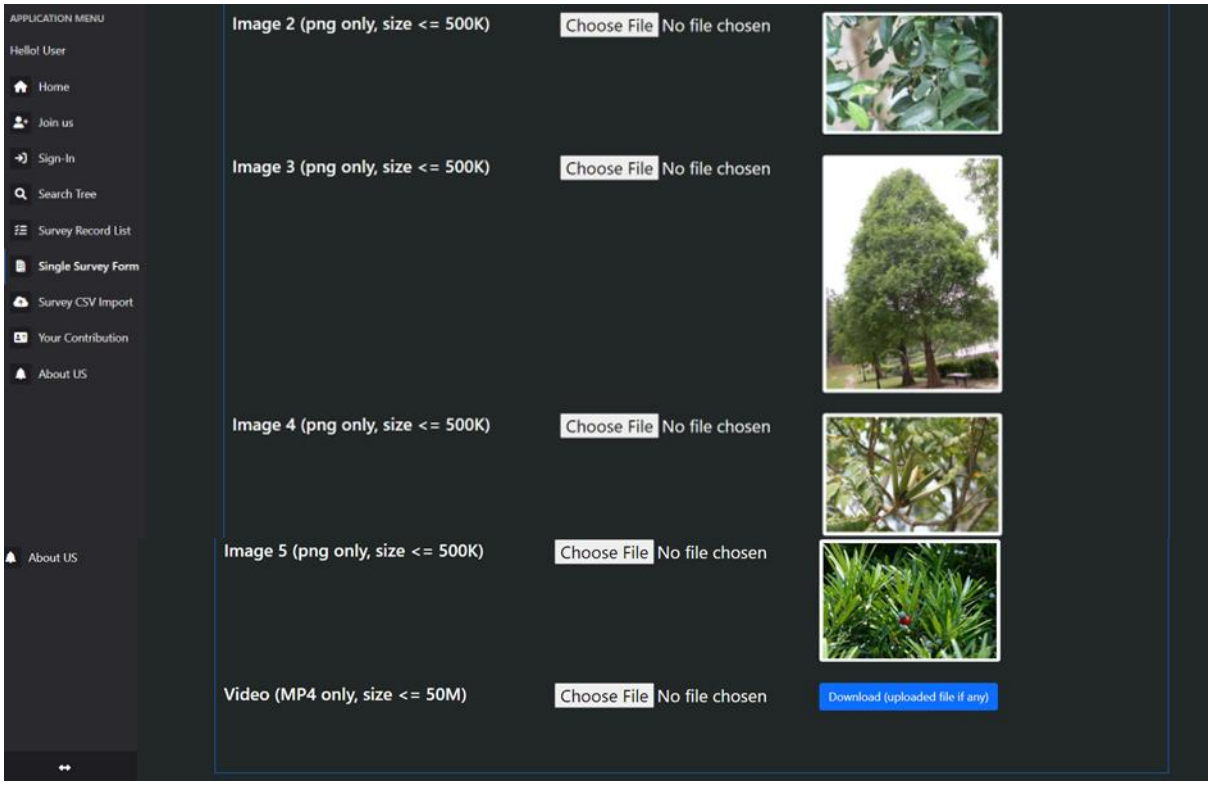


Users can delete a draft of the survey in the table by pressing the “Delete” button located at the most right-hand side. User can also view the details by pressing the “View” button and will be directed to “Single Survey Form”

(6) Single Survey Form

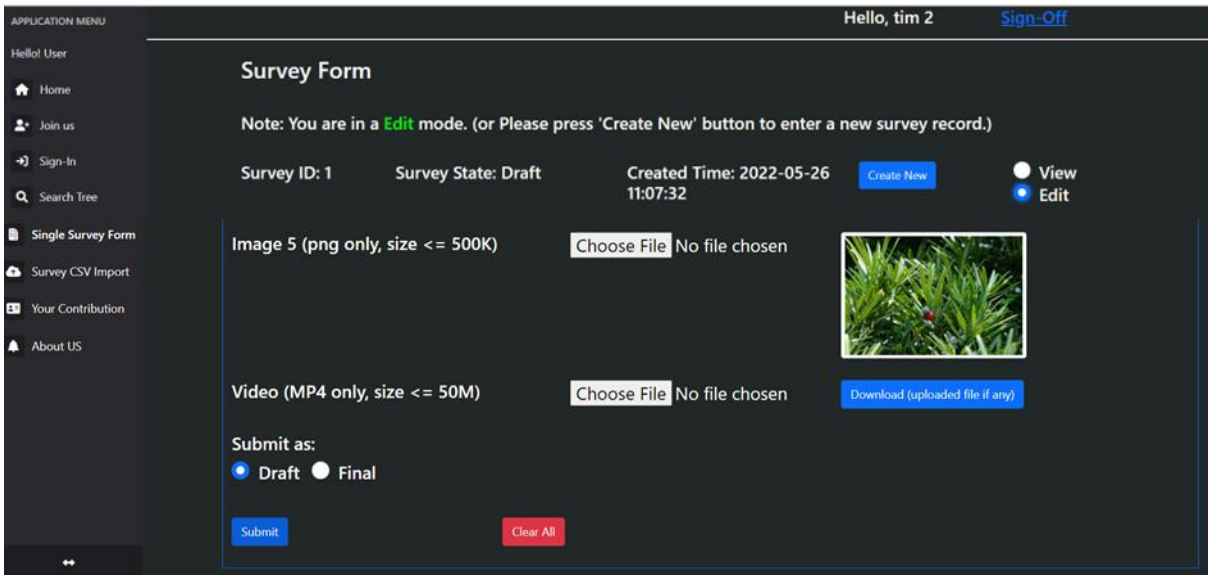
The form is showing details of the tree, images, and video file. When the form is in a “View” mode, all input boxes cannot be edited. If a survey is a “Draft”, he can switch this page to “Edit” mode by clicking the “Edit” radio button.


APPLICATION MENU
Hello! User
Home
Join us
Sign-In
Search Tree
Survey Record List
Single Survey Form
Survey CSV Import
Your Contribution
About US
Hello, tim 2
Sign-Off
Survey Form
Note: You are in a View mode. (or Please press 'Create New' button to enter a new survey record.)
Survey ID: 1
Survey State: Draft
Created Time: 2022-05-26 11:07:32
Create New
View
Edit
Your reference code (Max 50 Characters):
A001
GPS Location (Max 100 Characters, Required Field):
114.2234564 , 22.28623456
Google Map
Tree Name: (optional or specify it in a tree observation section if it is unselectable)
African Tulip Tree
State your observation about this tree: (i.e. Body, Colour, Surrounding Environment, Pest Name, etc.)
The tree almost fully blocks a KKK road
Measurement about the tree (Max 100 Characters): (i.e. Height, Width or Radius)
Tree Height:8m Tree Width:5m
Tree Condition:
Excellent
Score:
Moderator Comment:
Files
Choose Your Files
File Preview
Image 1 (png only, size <= 500K)
Choose File
No file chosen

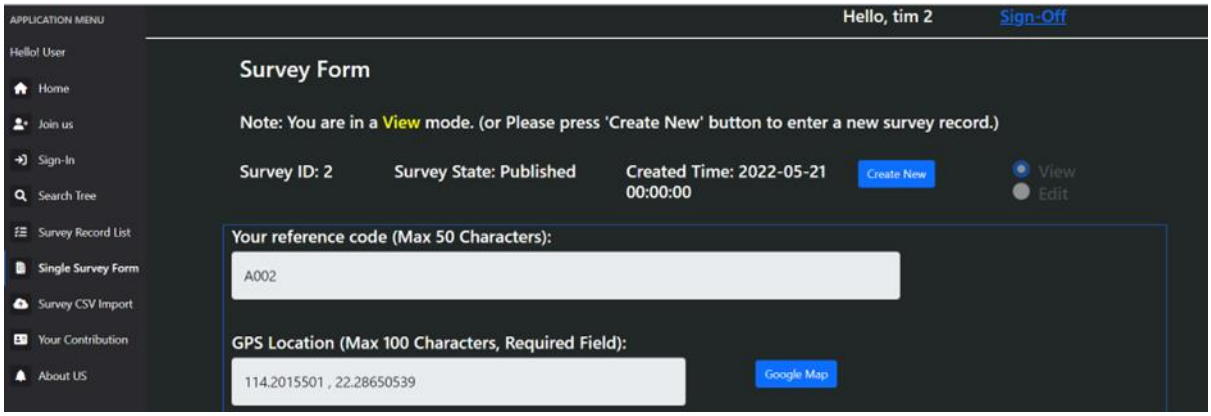


On this survey form, the end-user can input reference code, GPS Location, given Tree Name, statement about observation of the tree and measurements, given tree condition. The Moderator Comment box is not editable and for reference only. Users can submit 5 Images and 1 video file on this page.

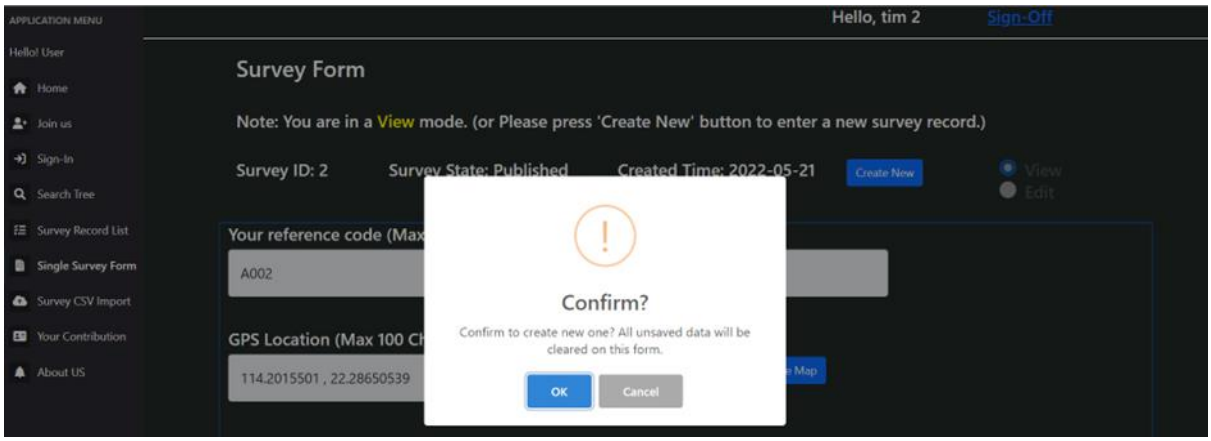
When the user changes to “Edit” mode, the “Submit” and “Clear” button appeared at the bottom.



If a survey is not in a “Draft” state (i.e. “Published”), “View” and “Edit” radio buttons are disabled as below.

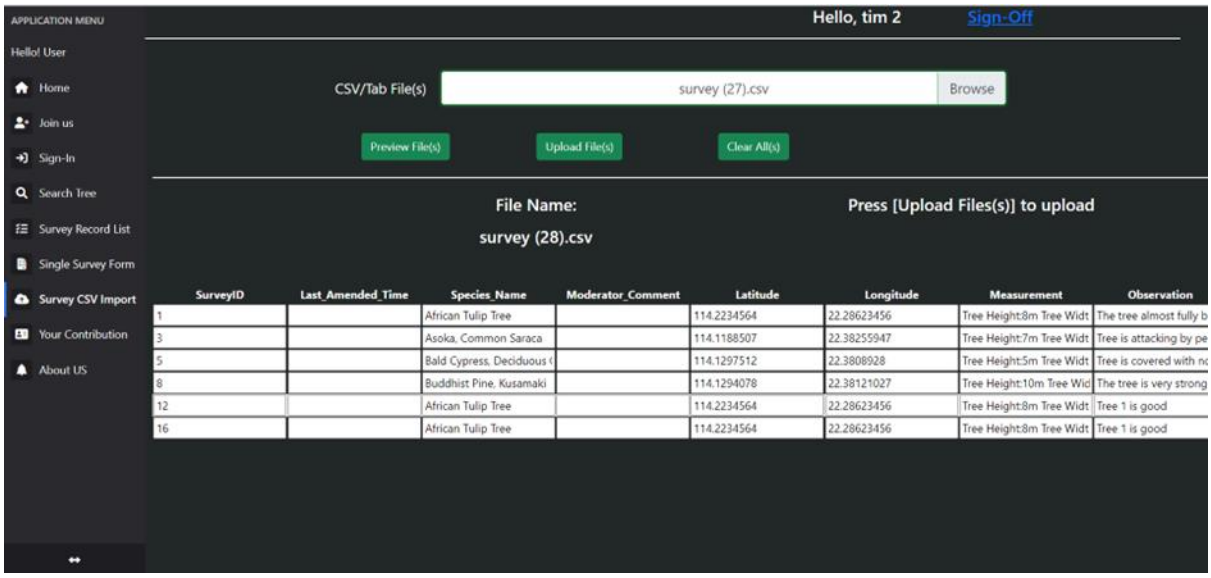


Finally, users can create a survey record by pressing the “Create New” button. All boxes on the form will be cleaned.



(7) Survey CSV Import

A list of survey records can be imported into the back-end database on the page. Select a file by pressing the “Browse” button and click the “Preview” button to preview. When everything looks fine, the file can then be uploaded by pressing the “pressing upload files” button. Users can clear everything to start another import by pressing the “Clear All” button.



(8) Your Contribution

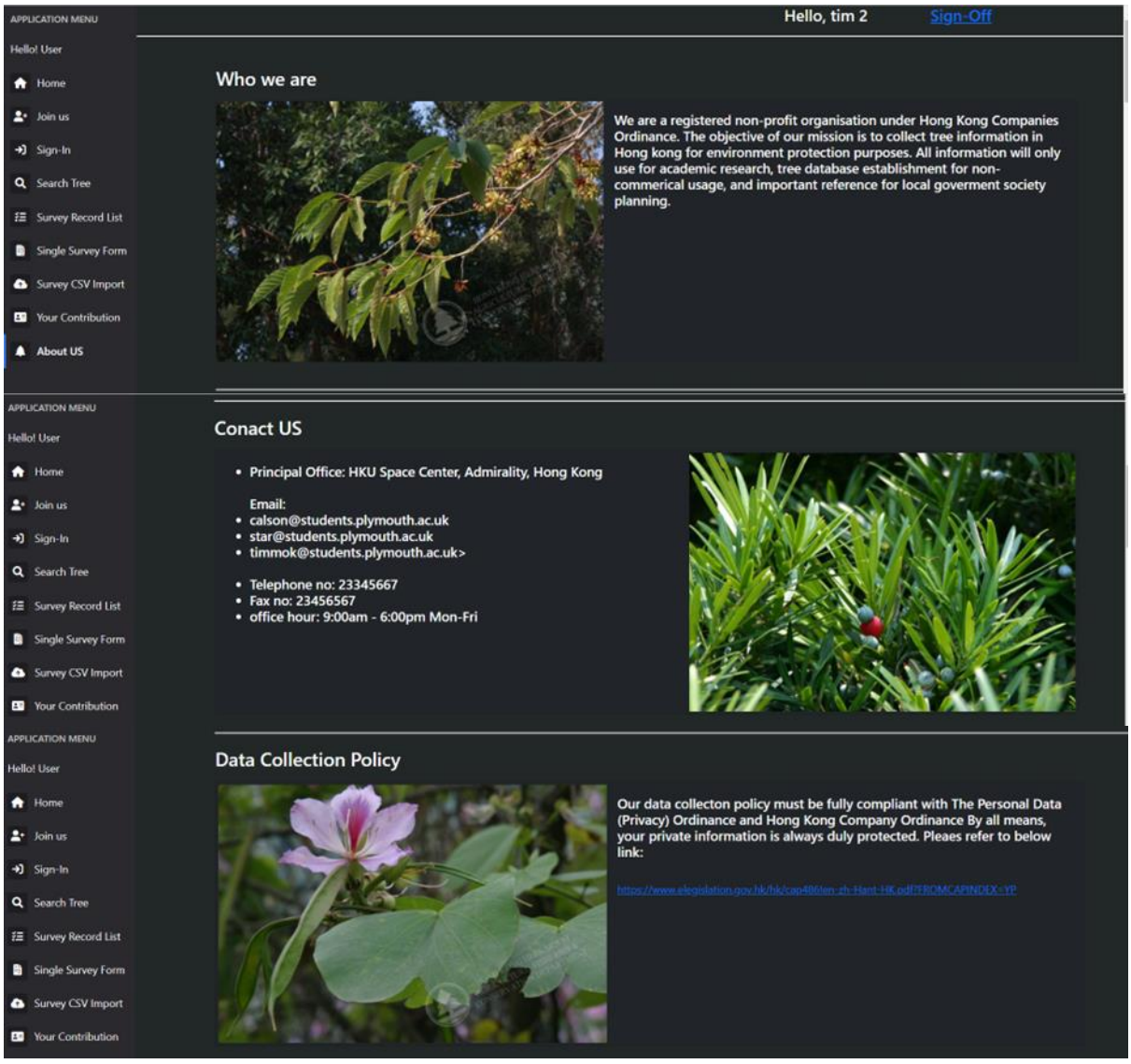
Every end-user will be given a score when their survey is approved. It is one of possible ways to let them know how well they are doing and express our appreciation for their contribution.

A graph is provided for end-users to compare with other member's performance.

A scoring schema, specifies how a survey is scored based on some criteria, is provided for reference.

(9) About US

"About US" page is placed at the end of the bar menu. It is an important data source for KYC purposes which is common in any industry. This page provides "Who we are", "Contact US", "Data Collection Policy", "The acceptance of your submitted survey records", "Handing of your data collection", "Guidelines and Technical Constraints", "Further Development of the App", "Link for study of trees".



APPLICATION MENU

Hello! User

- Home
- Join us
- Sign-In
- Search Tree
- Survey Record List
- Single Survey Form
- Survey CSV Import
- Your Contribution
- About US

The acceptance of your submitted survey records

Rules of use of our web site/mobile application

In order to minimize the possbility of survey case being rejected

Please Don't:

- Input irrelevant information which will be removed without notice in advance
- Repeatly input same tree information.
- Input the information that you are not fully confirmed (i.e. tree name) or is lack of supporting evidence.
- Abuse of our property (i.e. data, software, rights granted to you) for other purposes.

Please Do:

- Ensure all information is accurate and relevant.
- Submit your draft as a final version as soon as possible. Draft which stores in the database over 1 year will be erased or rejected without notice in advance.
- Provide sufficient information as much as possible for our professional judgement especially the genue of tree is very rare or it is in a danger situation (i.e. likely to collapse shortly on a pedestrian).
- Avoid these characters likes "'", ".", "/", "--", "?", "#", "$", "*", "|". They will be removed in your data when submitting.
- Contact us when you encounter any difficulties.

APPLICATION MENU

Hello! User

- Home
- Join us
- Sign-In
- Search Tree
- Survey Record List
- Single Survey Form
- Survey CSV Import
- Your Contribution
- About US

Handling of your data collection

1. Submit your data as a draft or a final version for moderator's approval. A draft can be amended many times before sumbitting your data while a final version cannot.

2. A moderator is assigned to examine each survey case. Normally, it takes 3 months to complete the whole process.

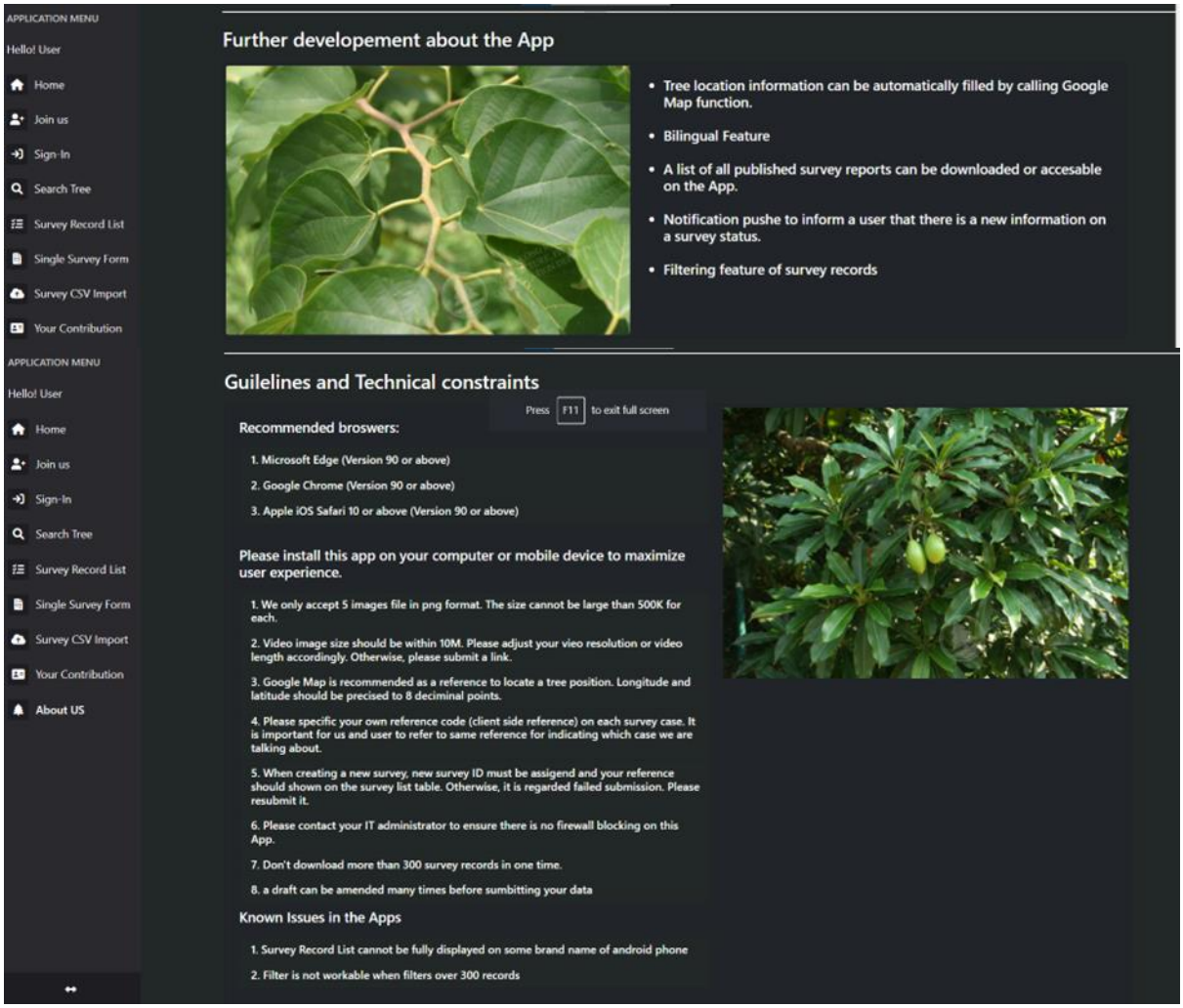
3. The status of your survey will be classified as:
   - Draft
   - Final
   - Approved
   - Rejected
   - Published

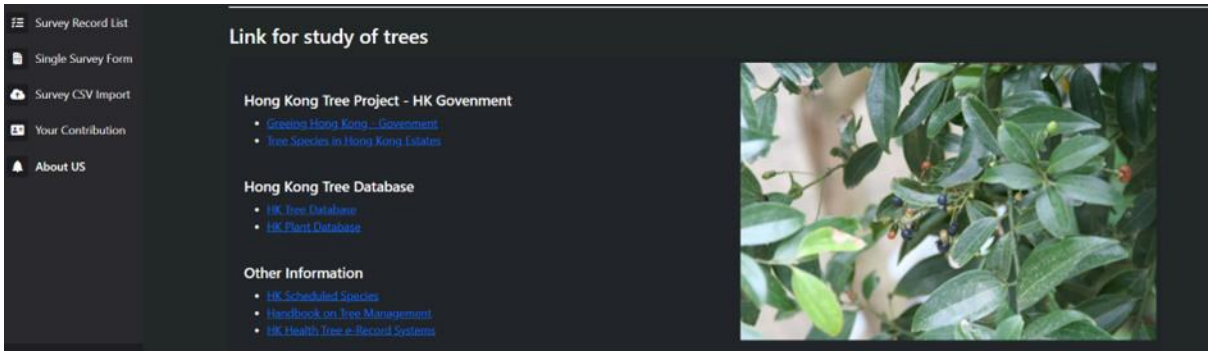
4. You will be notified by email when a survey case changes status. Our moderators may not provide a reason for rejected survey at their discretion.

5. Only published survey can be accessible to the public.

6. Obsolete draft (i.e. over more than 1 year old) or improper content in a survey will be removed without notification. We have the final rights to handle your data after a survey is submitted.

7. All data will only be kept for 7 years.





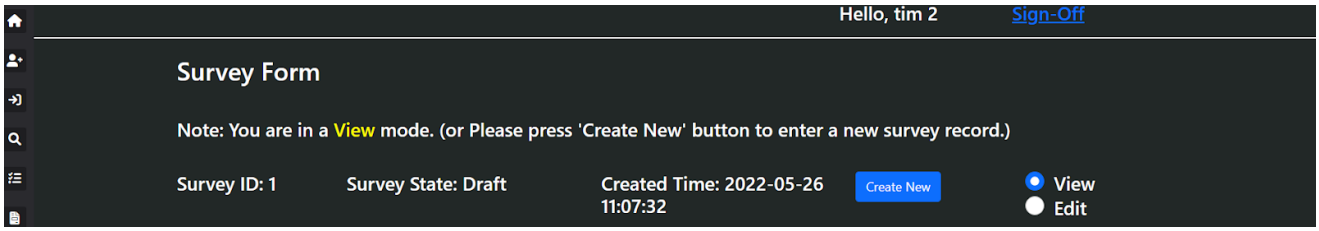
Usability Guidelines – HCI Principles

HCI Principles were followed. Some of them are listed below for our UI design guidelines.

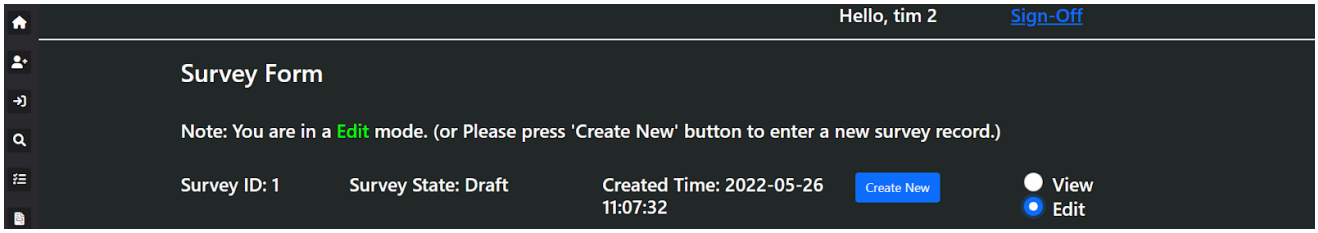
(A) Special colours as an important indictor

Mostly the App serves the end-user outdoors. Since the black color can reflect the least amount of sunlight to the eyes, it has become the main background color at the front-end for all working areas. Some special colors are adopted to let users be aware of the state change.

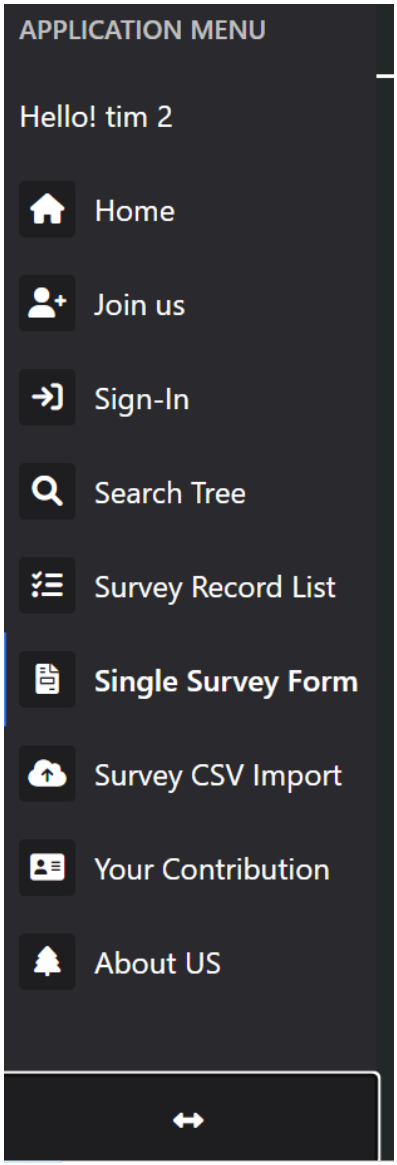
View Mode in yellow



Edit Mode in green



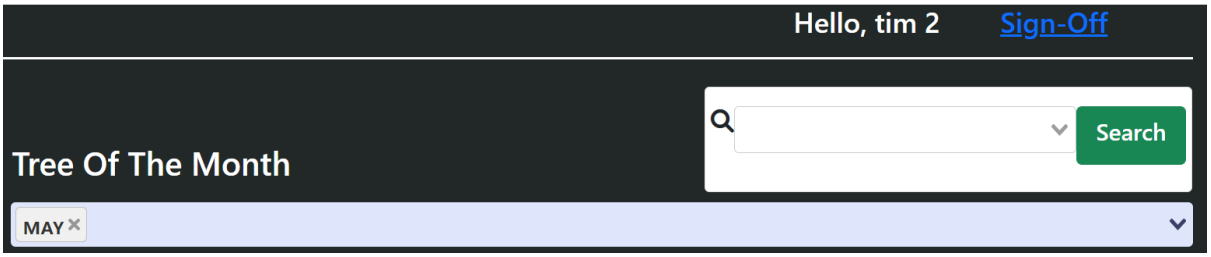
(B) Icon



Specific icons were selected to let users easily associate with its appearance and corresponding function.

Icons on the Menu bar were arranged in a working sequence so that users can get used to the procedure flow of survey submission in a short time.

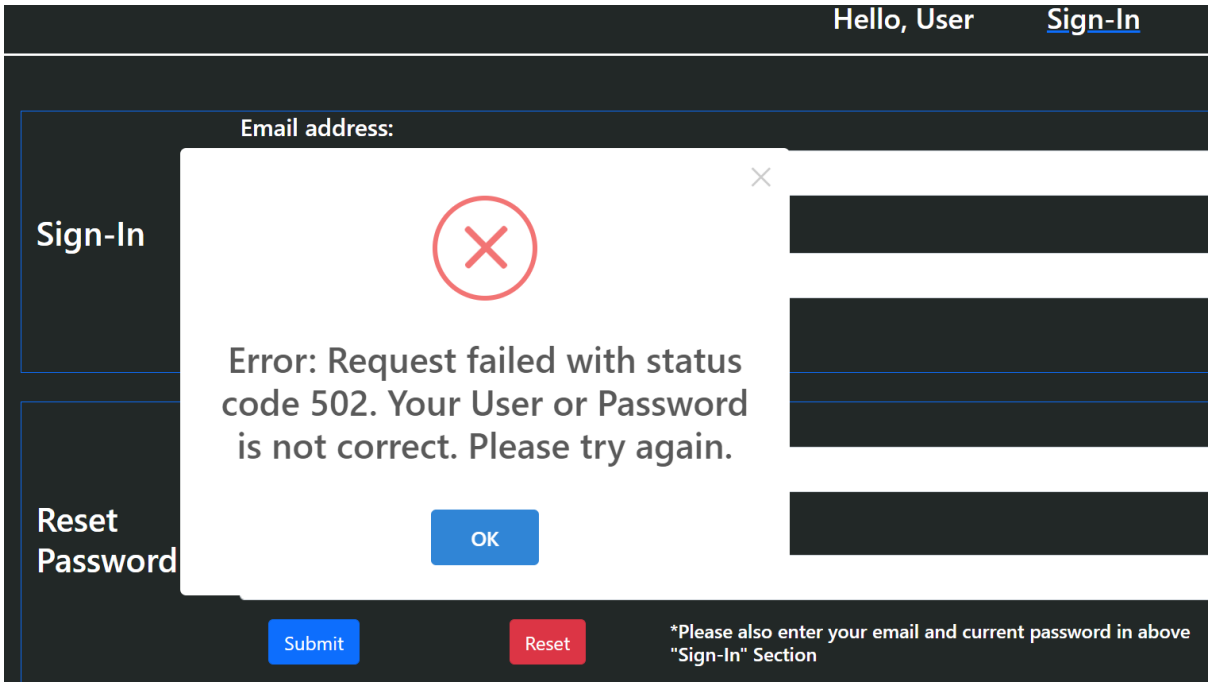
(C) Current Status



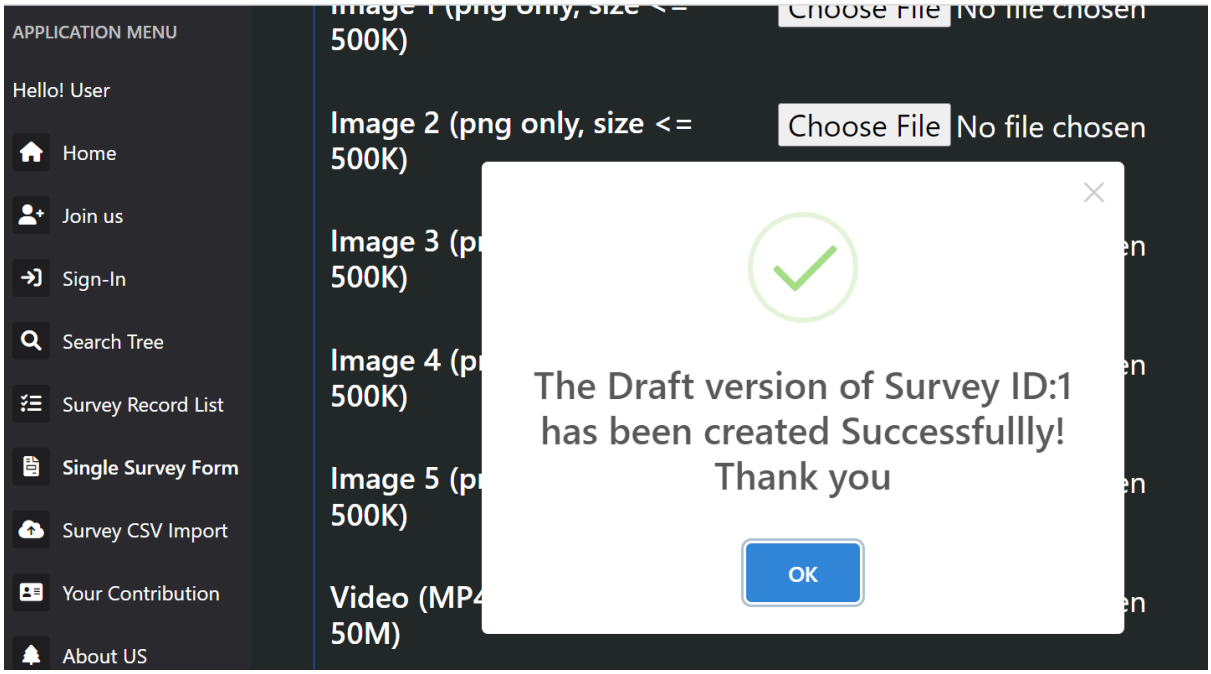
Whether a user is currently working in a login session was cleared by the “Sign-Off” and “Sign-In” indicator at the top of all pages.

(D) Feedback of any action.

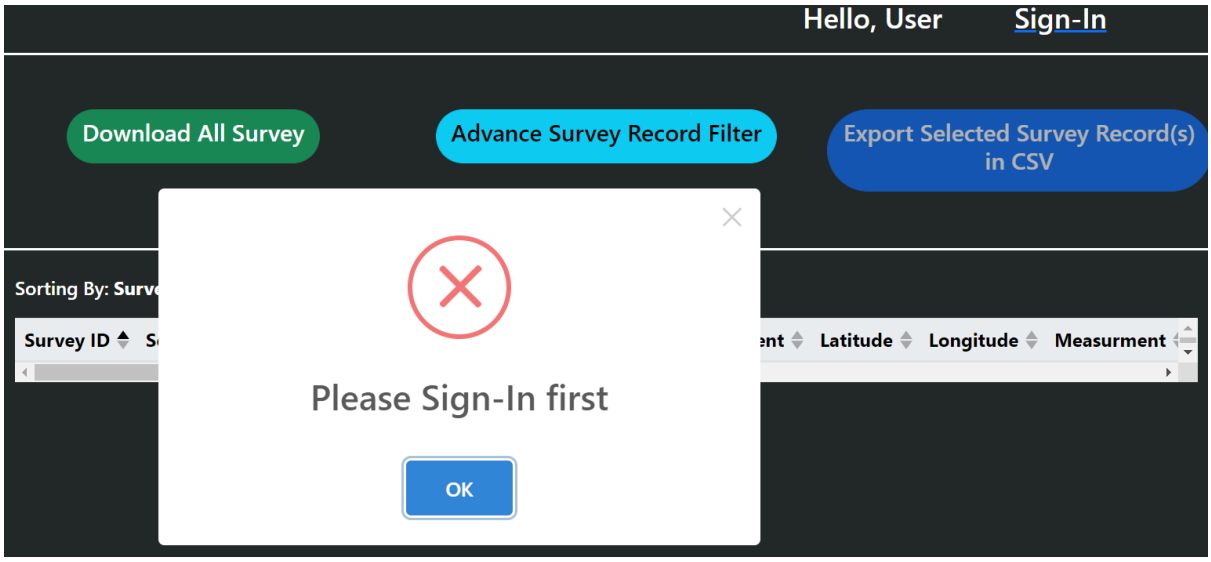
i. user error.



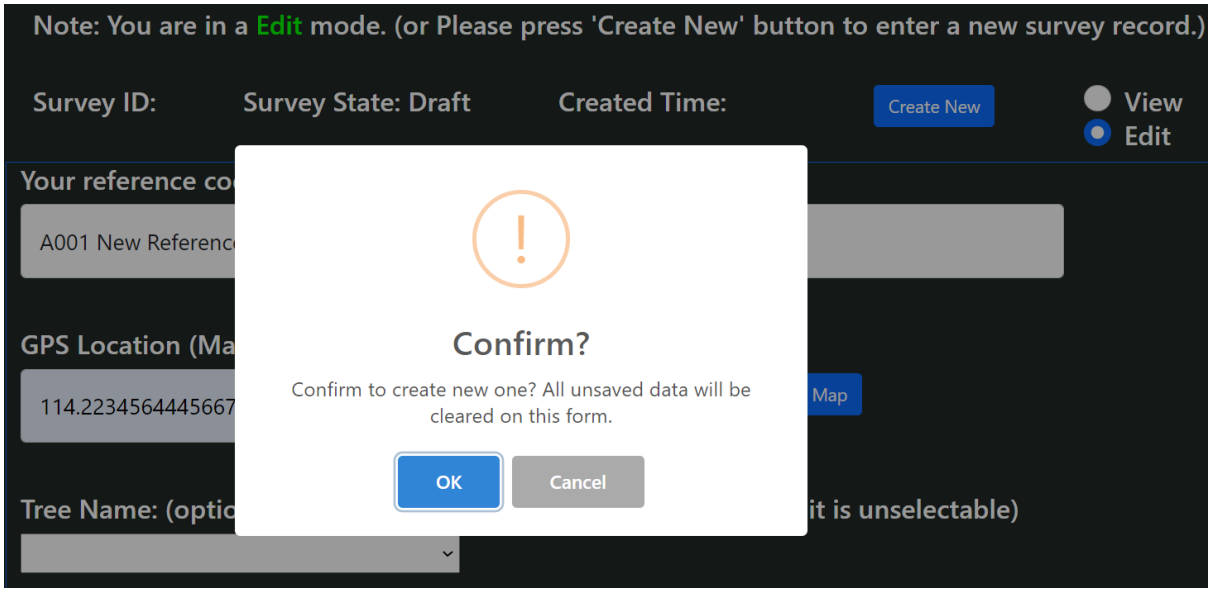
ii. successful action



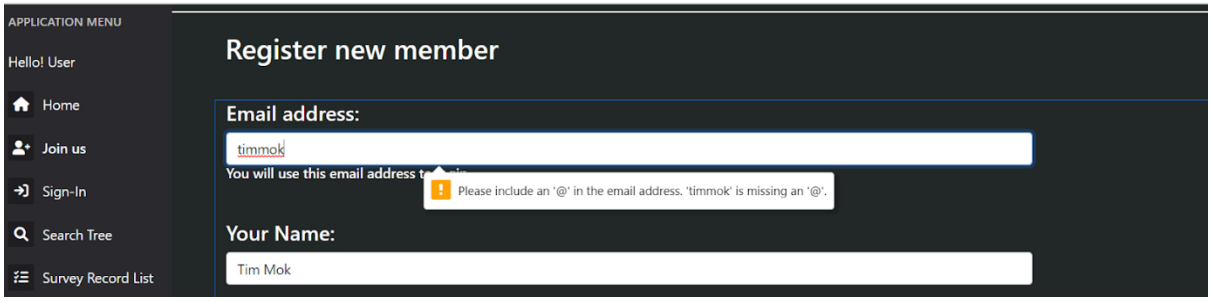
iii. missed action



iv. warning message



v. Preventive alert message



There is no “@” in the email input box

Cognitive Walkthrough and Usability Test

Cognitive walkthroughs were adopted on our usability testing. Our client was invited to use our product and 2 tasks were carried out in the first demo presentation meeting.

(A) Cognitive Walkthrough by Our Client

(1) Tree search function

A tree can be searched in a very short time (less than 30 seconds) by the client. However our client did not satisfy:

1. Outcome of the search was not informative. There is very little information for users to learn about trees. Therefore, the application, which is to be an effective education tool in future, is definitely not achievable.

2. Image sizes are not consistent. It strikes the user's impression that the layout arrangement is very not professional.

3. The colour scheme is very outdated on the search page. It seriously hit the attraction.

(2) GPS Location Input

Since GPS location is not supported on the web-based application, the information of latitude and longitude is not able to be captured automatically on the survey form. The client feels that it is not convenient.

The client opened a Google map and copied the location randomly. However, due to technical issues, the whole application was hung. It was suspected of the Zoom application screwing up this “copy and paste” process. The whole usability testing was inevitably stopped.

(B) Usability Test

It was executed by our members (Not in charge of Front-end UI development and design) and other users.

1. As a user, I wish to log in quickly when go to the web page

Functionality:

the sign-in function displays at the top of screen in the home page and main menu.

2. **As a user, I wish the View / Delete button to easy to find without searching the location in Survey Record List page**

Functionality:

View / Delete buttons revised the location, and it is easy to find it after re-designing the UI

3. **As a user, I wish to edit location of Google Map Functionality:**

Just click Survey Record List and then click Download All Survey, choose the row of record which you want, click radio button, click Google Map, the Google Map will be automatically displayed, search the correct location in the Google Map, right click the mouse button and then choose the Map location which is displayed at the top of right click menu, back to the Hong Kong Tree Survey page, paste the Google Map location in the GPS location input box.

4. **As a user, I wish to upload a csv file as a set of survey record**

Functionality: click the Survey CSV Import in menu bar, then click Browse button, choose a csv file. Click the Preview File(s) to view the information, if the record is correct, you may click upload File(s) button. Go to the Survey Record List page and click “Download All Survey” to confirm whether the upload is success.

5. **As a user, it is difficult to find the button which expand / contract menu bar is located at the bottom when using mobile phone. it is not handy for user to use it.**

A suggestion of improvement:

If the button is located at the top of the menu bar, it should be much better.

6. **As a user, I wish to see the previous page from the current web page but it will get page not found. For instance, it always shows the page not found when getting back from recent news or by clicking refresh web page**

A suggestion of improvement:

It is a known bug and it needs time to bug fix. By the time being, it is recommended to input the webpage again.

7. **As a user, I wish to express opinion / discussion. The web page can enhance interaction such as provides help function / enquiry box to enquire questions with moderator or administrator.**

A suggestion of improvement:

It will provide the function in future. User may email to us.

8. **As a user, I wish to see more colourful text instead of white / black text in web page**

A suggestion of improvement:

The next version of web page will provide more colourful text / title.

9. **As a user, I wish to add some videos to introduce tree information for reference. It will be more attractive. Moreover, a short video is allowed to user upload to the web page.**

Difficulties encountered:

As the limited storage of web site is insufficient for saving video. However, it can refer to a video link function is considerable.

Security

Implemented Security Measures

The personal information of the users in the web application was considered the priority of the security measure.

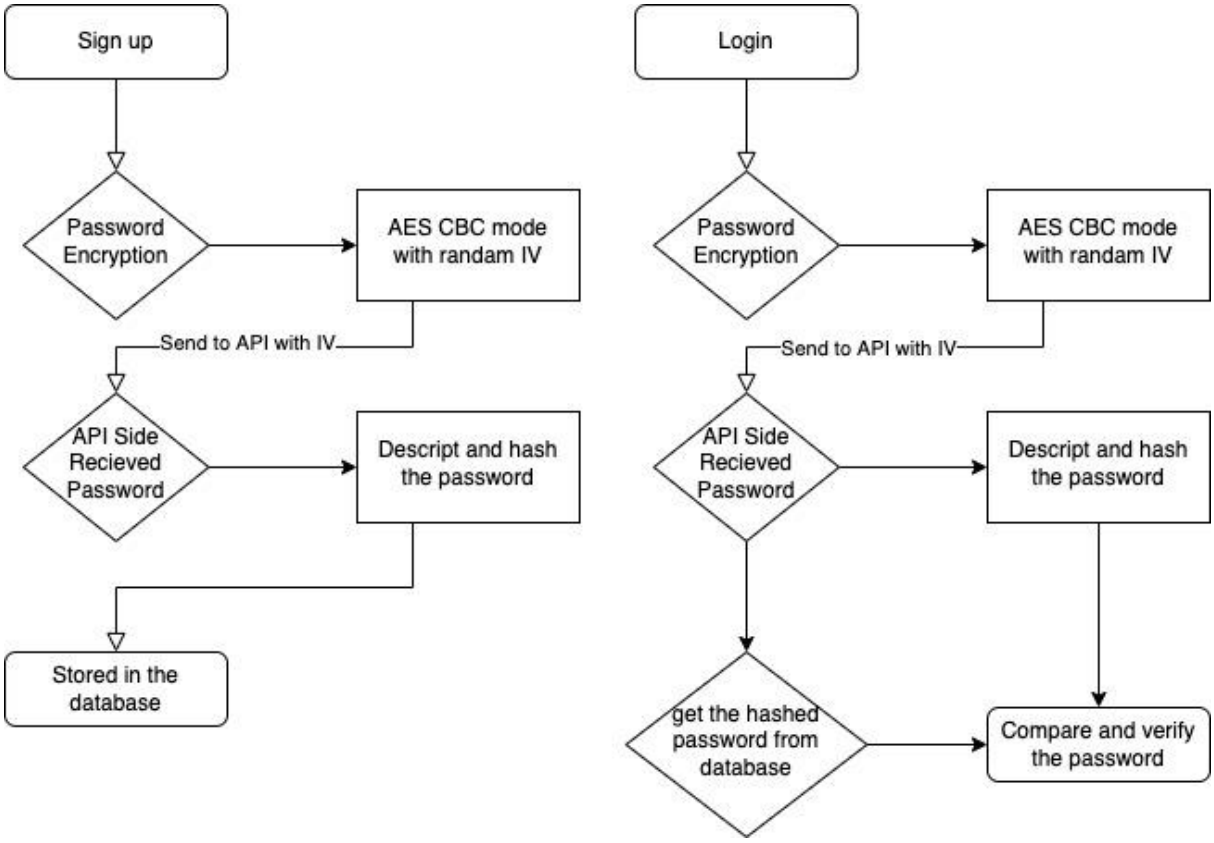
By the benefit of AWS cloud hosting, some of the cyber-security control has been provided.

1. The different roles would be created in the AWS to separate different levels of users to access different parts of the system. The access control security has been provided.

2. The SQL injection attack could be highly protected by the separation between the external network and database by the API gateway and lambda. All the communication of the RESTful API must be verified by the gateway and lambda to protect the database from the malicious injection code.

3. The database and API system are automatically updated by the AWS to protect the vulnerability from the outdated software.

4. The DDOS risks would be borne by AWS rather than the in-house server.



The broken authentication concerns are handled by the web application and the API side. All the passwords of authentications including sign up and login are encrypted by the web application and decrypted by the API side with AES 256 CBC mode with random IV (initialization vector). When the users sign up an account with the encrypted password, the decrypted password is stored after hashing it. When the corresponding user login to the account, the API side does the same thing - decrypt the password and hash it, then compare with the hashed password from the database to get the verification.

To prevent the cross-site scripting, all the http methods should be set the “Access-Control-Allow-Origin” to be the trusted websites which are the tree web application and admin panel.

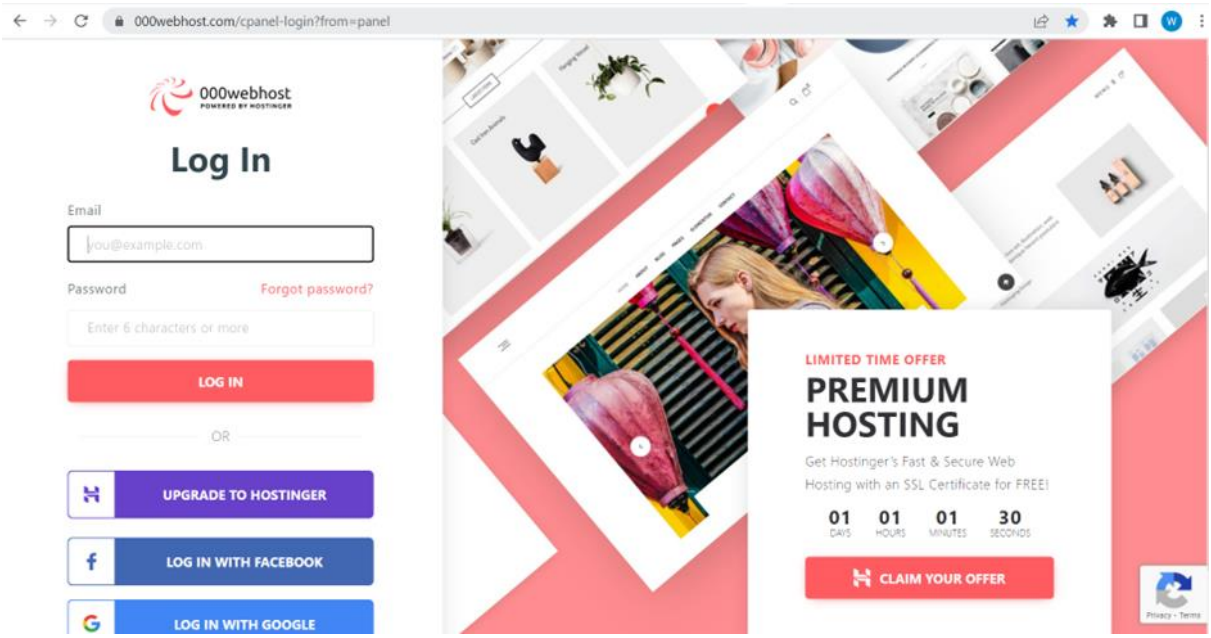
For now, it is set to be all websites accepted as the development stage.

```
return {
    'statusCode': statusCode,
    'headers': {
        'Content-Type': 'application/json',
        'Access-Control-Allow-Headers': 'Content-Type',
        'Access-Control-Allow-Origin': '*',
        'Access-Control-Allow-Methods': 'OPTIONS,POST'
    },
    'body': message
}
```

Deployment

To let our end-user and members perform usability evaluation, the Front-End part of the application was deployed on the web hosting company. The testing web page is then created on this link: https://treesurveyproject.000webhostapp.com.

The login page of the web site hosting company for our application usability evaluation is https://www.000webhost.com

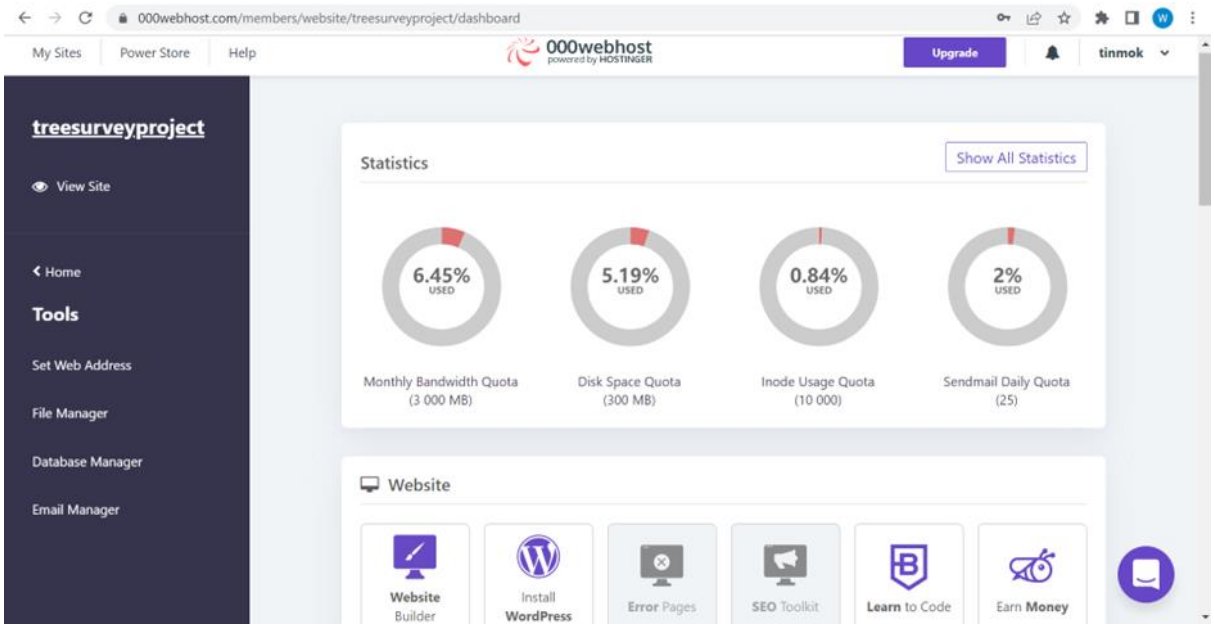


This web hosting company was selected because:

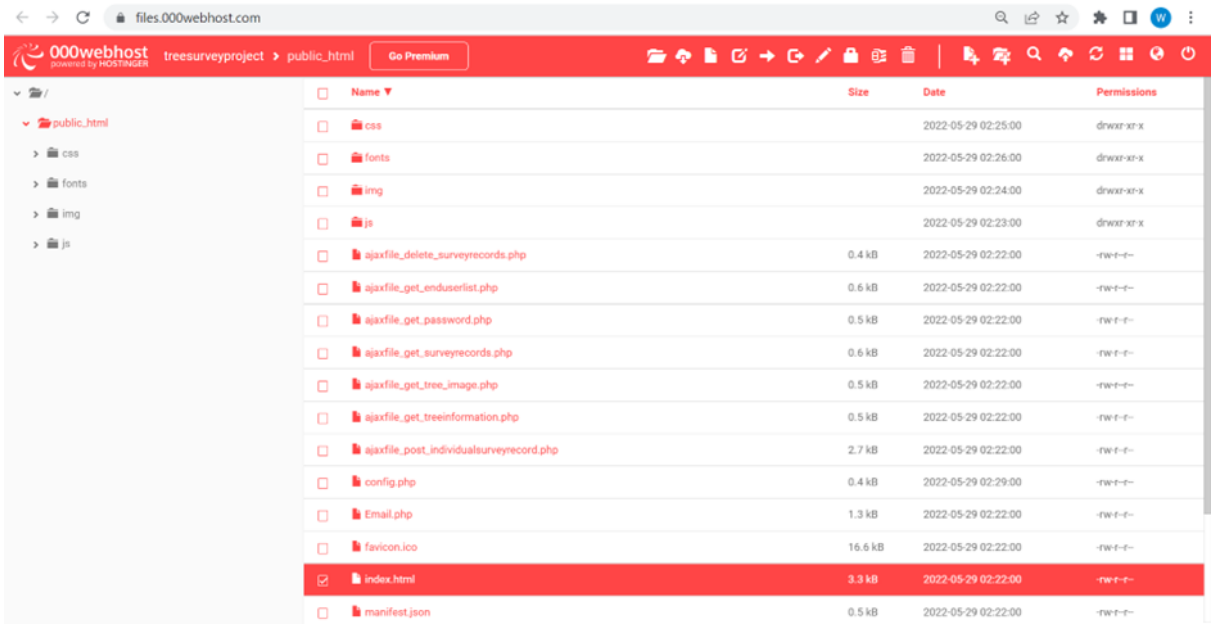
1. Free of charge
2. It supports PHP and Mysql
3. Deployment procedures are very easy and simple

However, the connection of their database provided is not always available. Therefore, it was not satisfactory as it often impacted our testing schedule.

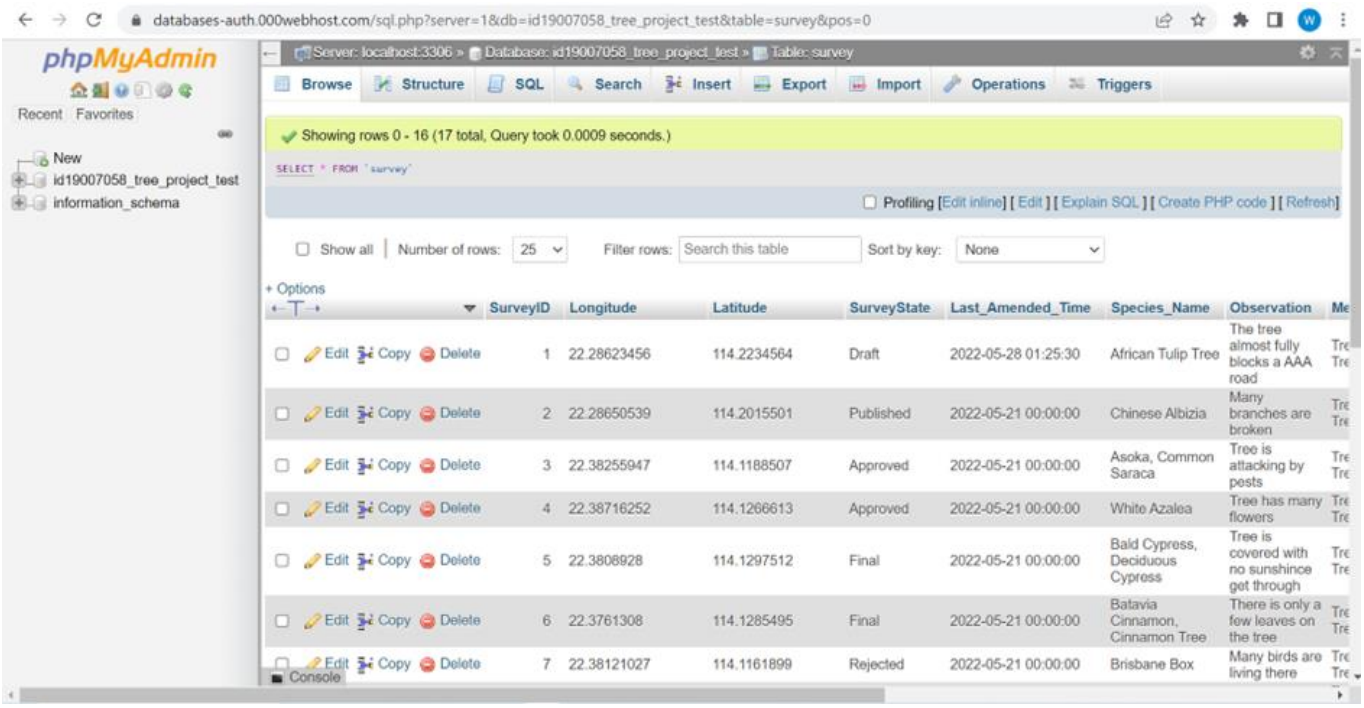
Our web site infrastructure is managed by the below web-based control panel provided by the web hosting company.



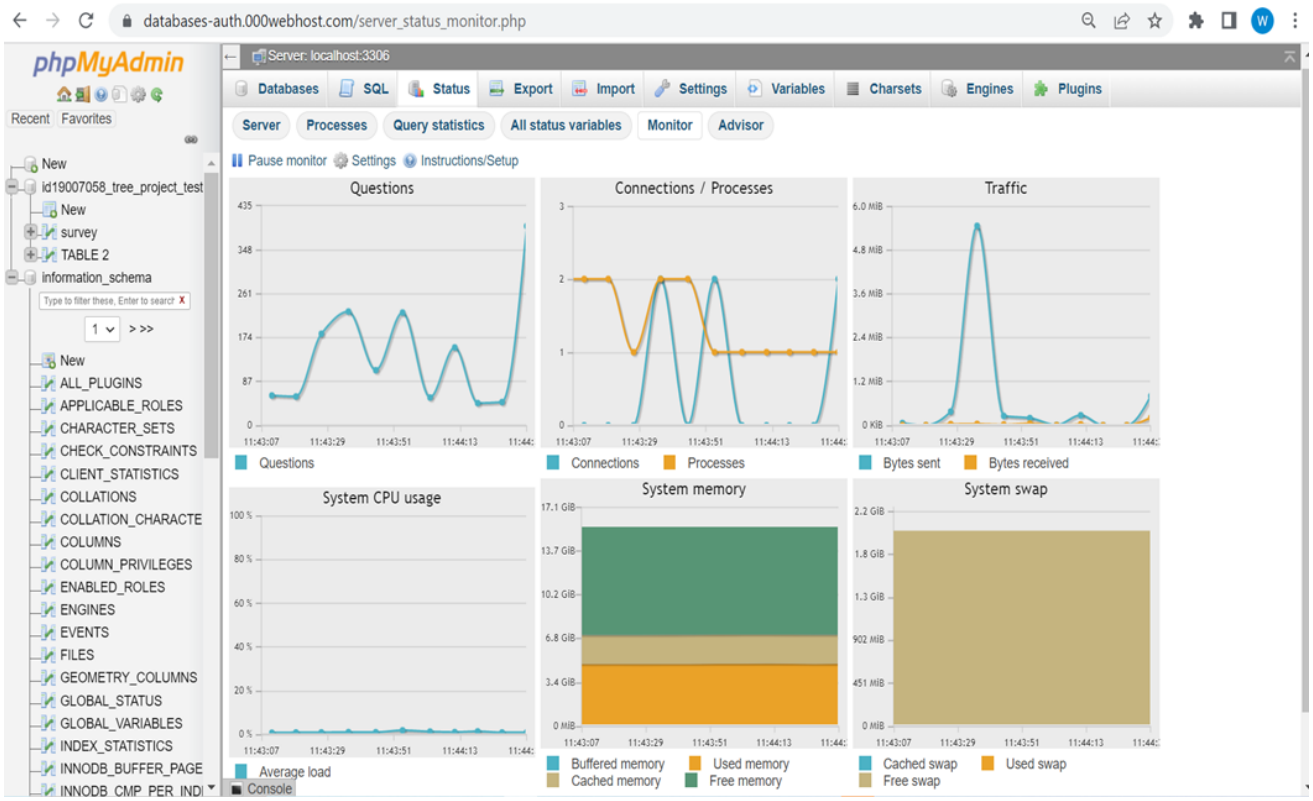
File Management Panel for our project



Database Management for our project



The real-time health condition of database operation can be shown clearly from the below graphs which helped us to evaluate whether the interaction between our database, tree survey application and end-user action can be smoothly collocated in an acceptable threshold in terms of performance.



Legal, Social, Ethical, And Professional

(A) Legal

(1) Copy Right Issue

Whether violating a copyright of a photo published from our website is a question. Authority of usage has never been granted from a data source owner. Therefore, our project may be under a legal risk to violate property intelligence although the location of image source is specified on a web site.

(2) Client Data Protection

A terms and condition agreement has not been provided for the end user to accept our client data protection policy at the first time of member registration. If the user does not agree with our data policy, it should not allow them to register our application.

(3) Data Accuracy Problem

Although the tree information, published on the web application, is sourced from other professional third parties, validation of that data cannot be gotten rid of for any reason (i.e. lack of human resource). The trustiness establishment between our application and end-user is based on the accuracy and integrity of data on which they depend for their survey information submission.

(B) Ethical

How to make the application more attractive enough to draw end-user attention is always the challenge to be overcome continuously. Scoring the submitted record to let users know how well they did without further reward, seems to be insignificant to keep their initiative using the App in the long term. On the other hand, whether it is appropriate to pay for the members who devote their knowledge, time, and effort to provide useful tree information in our place for the public interest is controversial. It involves interest conflict, format of sponsorship, financial management, benefit disclosure etc.

(C) Social

The goal of our project is to develop an application for the tree information collection and education. This application will benefit our society as follows.

1. Local tree knowledge database, those information approved by the experts, will be established for academic purposes including environment protection, reference for tree biodiversity research and development, and city facilities and infrastructure build-up.

2. Provide a channel for citizen to execute their social responsibility and thus enhance the quality of our citizenship.

3. Attract some youth, who may be a competent person in future, to join and contribute themselves in the tree industry (i.e. Ngo, Charity Organisation, Social, Volunteer, Environment Ambassador, etc)

4. By the public power, the App can indirectly discover, save, and protect some trees which are rare or in danger condition. And it can also let pedestrians aware of some trees which may potentially making harm on them (published tree report).

(D) Professional

(1) Accuracy and Integrity of our tree data.

Tree data is not enough to be present on our App for our user to reference. Lack of valuable and qualified tree data will decrease an user's initiative and passion to submit the data via our application.

(2) Appropriate input format and choose of wording

Input format of data may not be professional enough or appropriate to let general users or experts accurately describe the trees everything. For example, a tree condition which can be selectable on the App but limited to "Excellent", "Normal", "Deteriorate", "Poor" and "Bad" is very ambiguous to describe a real condition in terms of academic perspective. Without standard and comparison for general user to refer to (i.e. Image), they become a very subjective answer that needs a lot of human resources to confirm their accuracy. It can consequently in some level can misdirect a moderator to conduct an accurate assessment result and finally waste the resource.

On the other hand, the tree industry is a very professional subject. Our application should be evaluated by a third party which has professional qualifications in this industry.

(3) Every tree should have only one survey record

How to ensure every tree has only one submitted survey record is technically very challenging. Support two users type a GPS information as below.

24.125365892, 112.25358748

24.125365895, 112.25358748

If they refer to the same tree, it will waste the human resources for moderators to examine the same material. Therefore, accuracy of data reported on the App is highly dependent on the third-party software quality. If their quality is poor, it will totally fail our project.

On the other hand, the App cannot provide a function for users to indicate whether a tree (they are going to submit) is already recorded in the system. Except that the tree has indicator (i.e., QR code printed on the label) and the App has capability to recognise this code, it will waste the human resources at the end-user side.

Conclusion

Conclusion overall, the project has achieved its objectives. The project has provided a client/server application for the tree survey system. It provides a more convenient way for the public to search the trees they found in Hong Kong. People can view the monthly flowering and fruiting trees. The registered users can create the survey reports. Administrators can approve or reject the survey reports. The application was developed by focusing on the user experience. It can be run on both desktop browsers and mobile devices.

Although the main features are almost finished, there are quite a lot of details that need to be added back into the system in the future such as database of survey report, multiple languages, UI update and debugs, etc.

As the system was developed by agile development, all the sprint and stage were in the right direction by communicating closely with the client. And the system will be future enhanced to achieve the product visions.

Appendix

Marks Allocation

Student Name: Ao Wai Pong, Calson

Hours spent	Description	Evidence
12	Product UI design	Signal
36	Product testing	Signal
8	Meeting mintus	Report
5	Usability test	Report
9	Photos collection	photo in web page

Student Name: Mok Wai Tin, Tim

Hours spent	Description	Evidence
6	Requirement Analysis	Signal, Discussion on Zoom, Classroom
6	Workflow Design	Signal, Discussion on Zoom, Classroom
140	Technical Feasibility Study	Please see reference
2	UI Icon Collection	Git-Hub
10	Front End UI Layout Sample Study	Please see reference
40	Front End Layout Adjustment	Git-Hub
150	Front End Implementation (Prototypes + Final Portfolio)	Git-Hub
2	Front End BackLog Filing	Report
50	Front End Bug Fixing	Git-Hub
2	Front End Deployment	Member Registration

Student Name: Check Yiu Hung, Star

Hours spent	Description	Evidence
12	Work up requirement, Team meeting	Project plan record

12	Initial Planning	
12	Sprint Planning	
24	Prototyping	
36	Project Plan	
36	AWS RDS	Github
36	AWS Lambda and API gateway	
36	Cross-Origin Resource Sharing (CORS) problem solving	
24	Image handling approach research	
24	Image handling approach update	
24	Database of Tree	
24	Database of users	
24	Security Control	
12	Backend/API/Admin Panel Bug Fix	
36	Final Profolio	Final profolio

References

Jory, M. (2020). 7 Steps to Write a Risk Management Plan For Your Next Project (With Free Template!) [Blog post]. Retrieved from https://plan.io/blog/risk-management/

Jory, M. (2020). The Essential Guide to Writing a Project Communication Plan: What It Is and Why You (Actually) Need One [Blog post]. Retrieved from https://plan.io/blog/communication-plan/

Tree Image and Information Data Source:
http://www.hktree.com/tree/Ficus%20virens.htm

http://www.hktree.com/tree/Mallotus%20peltatus.htm

http://www.hktree.com/tree/Elaeocarpus%20hainanensis1.htm

http://www.hktree.com/tree/Manilkara%20achras.htm

http://www.hktree.com/tree/

https://en.wikipedia.org/wiki/Ficus_virens

https://dbpedia.org/page/Manilkara_zapota

https://en.wikipedia.org/wiki/Eriobotrya

https://www.easyatm.com.tw/wiki/%E5%A4%A7%E7%BE%85%E5%82%98%E6%A8%B9

Third-party web page template reference

https://nicepage.com/website-templates

https://www.lcsd.gov.hk/tc/green/butterfly/index.html

Home Page Tree Icon
https://www.freeiconspng.com/img/7690

Other Icons
https://vuejs.org/

Technical Feasibility Study
https://bootstrap-vue.org

https://stackoverflow.com/

https://www.geeksforgeeks.org/

https://mdbootstrap.com/

https://www.php.net/

https://nodejs.org/dist/latest-v18.x/docs/api/

https://www.javascript.com/learn/strings

https://vuejs.org/

https://www.w3schools.com/html/default.asp

https://codepen.io/

https://vuejsexamples.com/

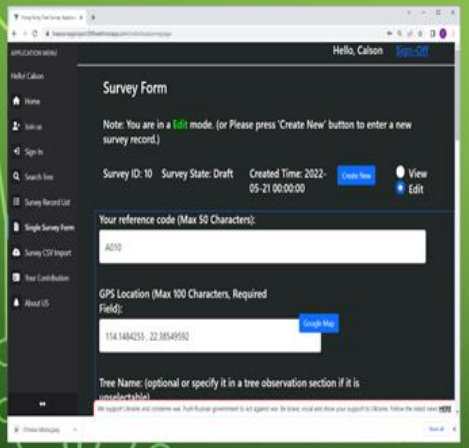
https://www.npmjs.com/package/vue-sidebar-menu

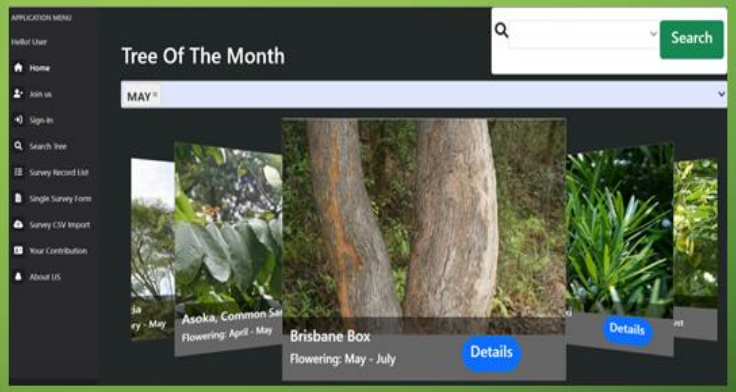
https://www.tutorialspoint.com/php/index.htm

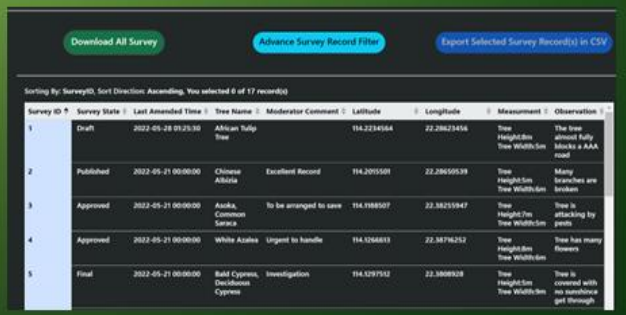
Poster

Tree Survey Application Launched! Join Now!

Whether an end-user is an amateur, expert, or a tree-lover who wants to share their observations about trees in the Public, our application is an excellent on-line tool to submit those tree information and provide the latest tree knowledge for citizen education purposes. Unlike other applications, all information, before publishing in the Public, will be reviewed and approved by our qualified experts.







Your survey will be scored to win a prize