TraceContact

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Abstract

Pandemics are outbreaks of disease that spread quickly and affect many individuals across a wide geographic area. Such pandemics have the potential to pose a huge health and public safety hazard, owing to the lethality that some of these diseases spread by a pandemic might possess. A secondary concern would be the adverse economic effects that such a pandemic might bring – owing to quarantine and social distancing measures that countries all over the globe will have to employ in the face of such a situation – such measures have the unwanted side effects of massively hindering the economic activities of a country, negatively affecting the economy. Needless to say, it is imperative that pandemics are stopped as quickly as possible. To tackle pandemics, epidemics or any form of viral outbreak, governments employ contact tracing alongside other quarantining and social distancing measures, which are shown to be effective and hence a necessary component of any viral containment measures. However, current contact tracing methods have their effectiveness capped as they are bogged by inefficiency and blind spots owing to the manual efforts involved in the contact tracing process. Our project objective is therefore to solve and overcome this problem, hence helping to optimize pandemic containment measures. We have programmed a website that can help automate and optimize the contact tracing process, making it more efficient, and consequently, more effective in helping to tackle a pandemic. Initial testing of our website has shown that…

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Introduction

1.1 Background

Pandemics are outbreaks of disease that spread quickly and affect many individuals at the same time, characterised by its effect on a wide geographic area and afflicting a major proportion of the population. They are often a grave cause of concern, particularly if the pandemic involves a novel strain of virus, owing to the lethality that these viruses may have and consequently the huge risk to health and public safety that these pandemics may pose. There have been multiple viral outbreaks so far in the 21st century, each having claimed numerous fatalities. The Ebola outbreak, though an epidemic and not having as wide a geographical effect as a contemporary pandemic, still claimed over 11 300 lives (*2014-2016 Ebola Outbreak in West Africa., 2019*). The 2009 Swine Flu pandemic claimed about 284 000 lives. Currently, the COVID 19 coronavirus pandemic has infected over 8.69 million people and claimed 461 000 lives (*Coronavirus Cases., 2020*).

To try and mitigate as well as contain the spread of a virus during a pandemic, countries and governments employ a measure known as “contact tracing”. Contact tracing involves identifying close contacts - people who have had prolonged physical contact with those who have been confirmed to be infected - and then isolating them in order to monitor their health conditions for the incubation period of the virus, such that they can get the appropriate care and treatment if they happen to be infected as well, given that they are most at risk of infection *(NSW, 2020).* This way, the spread of the virus can be checked by disrupting the chain of transmission.

1.2 Problem Identification

Contemporary contact tracing methods usually involve physical interviews with infected patients to identify people he or she had close contact with through obtaining information on the patient’s daily activities leading up to his or her hospitalization. Contact tracers will then proceed to try and obtain contact information of the people now identified as “close contacts”, after which they will begin a manual process of tracking down these people in order to isolate them.

Contact tracing is effective in helping to curb the spread of viruses - and is an essential part of any country's efforts to tackle the spread of a pandemic - however, there are glaring flaws and drawbacks in current contact tracing measures. Firstly, the process is mostly carried out manually, and quickly becomes laborious and inefficient. The contact tracing process has been found to take up anywhere from 1 - 79 hours on average to carry out (*Mccann L, 2013).* Secondly, even with an increasing use of digital, wireless and Bluetooth technology in an effort to speed up the contact tracing process - in particular the *TraceTogether* app, as well as the *SafeEntry* web application, both of which we will later address in our literature review - gaps still exist where not all close contacts may be accounted for - a patient may still have to give a recount of his activities leading to his infection in order to pinpoint exactly all close contacts, and there may be a situation where a patient is unable to provide contact details or the activities he carried out leading to his infection. This will lead to inevitable gaps within the contact tracing process, and additional effort is needed to track down and contact those who might have had close contact with the patient. This will result in inefficiency and ineffectiveness in the contact tracing process, and consequently, inefficiency in virus containment efforts.

1.3 Objectives

Therefore, there needs to be a streamlining, refining and even further automation of the contact tracing process in order to rectify any gaps in the system, to allow contact tracing to become more effective, and hence to allow for more efficient virus containment such that the far reaching, adverse effects of a pandemic can be curtailed and contained as far as possible.

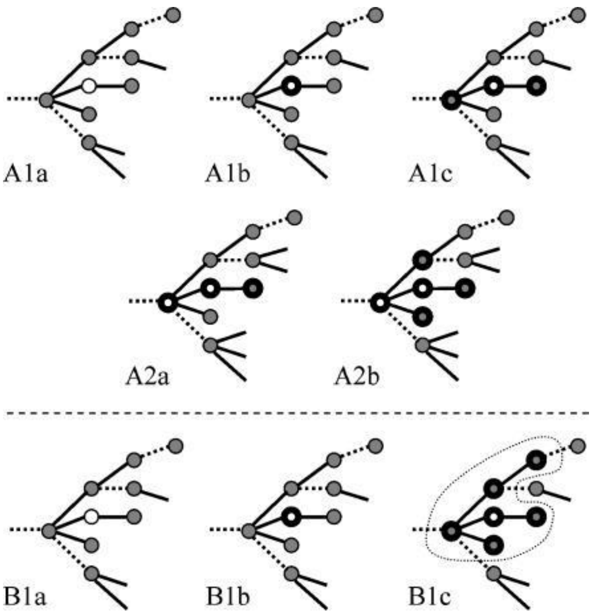
This project aims to develop a web application that can be used to track the movement of people and collate a database of human traffic in contained, closed environments, such as within an institutional complex (a school campus; an office building). By doing so, we can make contact tracing much easier, streamlined and less tedious, while rectifying the gaps in the system and making it more efficient as well as effective as a whole. Consequently, virus containment efforts can be made more efficient. Furthermore, with a database of human traffic, our web application can also be used for crowd management and regulation of human traffic flow, potentially helping in social distancing measures. We will begin by developing our product specifically for use within our school campus, before exploring possible expansionary options to be used in other places.

Literature review

2.1 Review of contact tracing

As mentioned above, contact tracing is an integral and indispensable part of any country's viral containment efforts, as it plays an important role in cutting the chain of virus transmission. There are two main types of contact tracing - Single step, and iterative contact tracing - Single step tracing refers to tracing only of direct close contacts of symptomatic patients, whereas iterative contact tracing refers to tracing of all persons who have been in direct or indirect contact with an infected person.

To study the true effectiveness of contact tracing in helping to contain a pandemic, researchers used a mathematical branching model to investigate how effective both types of contact tracing are at mitigating and containing viral spread. While taking into account external factors such as: delay in the process of contact tracing; the latent period; infectious period and detectable period of a virus, the paper found that both types of contact tracing are effective in containing viral spread regardless of the latent period of the virus. It was also found that iterative contact tracing is more effective than single step contact tracing across all latency periods and virus types (*Klinkenberg, Fraser, & Heesterbeek', 2006)*. However, this is not an issue regarding the probable inefficiency of single step contact tracing, but simply a matter of intuition as iterative contact tracing allows the immediate isolation and quarantine of all potential infected persons, compared to single step tracing. Single step tracing has still proven to be effective, and almost as effective as iterative tracing.



Contact Tracing types： As the figures "A1a; A1b; A1c; A2a and A2b" above shows, only close contacts of those who are symptomatic (represented with white dots) are contacted and isolated. (Isolated patients are represented by dots with thick borders). This is single-step contact tracing.

Iterative contact tracing is shown with the figures "B1a; B1b and B1c". Close contacts of symptomatic patients, as well as close contacts of these close contacts are contacted and isolated.

Contact tracing is also a more versatile and moderate method in dealing with a pandemic, offering an "intermediate" solution, between concentrating control measures only on observed cases (treatment, isolation, culling) and directing control to the whole population (mass vaccination, prophylactic treatment, preventive culling). Therefore, contact tracing, with its effectiveness, versatility and viability, plays an integral and indispensable role in helping to deal with a pandemic. Our project is necessary and relevant, since it aims to streamline and refine the contact tracing process, helping increase the efficiency of containing a viral outbreak.

2.2 Problems with Contact Tracing

Contact tracing is an effective method of dealing with pandemics, but there exist challenges to the contact tracing process that significantly hamper its effectiveness. Researchers, using the Ebola Virus Disease (EVD) outbreak from 2014-2016 as a case study, studied the challenges faced in current present methods of carrying out contact tracing. Interviews were conducted with United States Centers for Disease Control and Prevention staff members engaged in contact tracing activities in the affected West African countries of Sierra Leone, Guinea, Liberia, Senegal, Nigeria, and Mali from September through December 2014. It was found that there are 5 prominent challenges facing current contact tracing methods, two of which are what our project is trying to address and also happen to be the challenges of higher severity - “Contact-person identification” and “Locating contact-persons”. *(Greiner, et al., 2015)* While these challenges were indeed exacerbated by the lack of proper infrastructure in the countries in question - telecommunication unavailability, lack of proper street names, countries with no identification systems - it was highlighted that these problems are integral in current methods of contact tracing, and hence carries over to other countries employing contact tracing, the only difference being extent of severity of these problems.

Two clear problems of present contact tracing processes can be clearly seen here - the inevitable lack of contact information of close contacts, as well as the problem of identifying who the close contacts are in the first place. Through automatic logging and tracking of people’s movement in our web application, these problems can be managed, simply through access to comprehensive information on where people have been, and hence being able to identify who are close contacts of an infected patient. Our web application has the potential to overcome and transcend this problem facing current contact tracing methods, and by overcoming this problem, solve 2 of the most prominent challenges facing and inhibiting contact tracing, and subsequently - improve efforts to combat viral outbreaks.

At the time of this project’s inception, there existed little to no technological or digital aids to assist the contact tracing process. Contact tracing remained mostly manual, taking up anywhere from 1 - 79 hours with the median being just below 24 hours (*Mccann L, 2013)*. As a result, contact tracing was still rather laborious and can become inefficient, reducing its effectiveness as well as the efficiency of virus containment measures. There was more than enough room for us to develop a product that can help rectify these flaws in current methods.

2.3 Existing Solutions

However, with the presence of COVID-19 and its high rate of transmission, the Singapore government pushed out 2 technological aids rapidly to assist the contact tracing process - the *TraceTogether* app as well as the *SafeEntry* human movement tracking system. The *TraceTogether* app was commissioned on the 20th of March this year, whereas the *SafeEntry* system was rolled out on the 23rd of April to a select few hotspots, and to all venues on 12th May.

The *TraceTogether* app is a mobile app that supports Singapore's efforts to mitigate the spread of COVID-19 through community-driven contact tracing, developed jointly by SGUnited, GovTech and the Ministry of Health, and released on 20th March 2020. Through the exchange of short-distance Bluetooth signals between mobile phones with the installed app, each phone can detect other participating TraceTogether phones that are in close proximity, and then track these phones along with timestamps, such that when the need arises, these information can be used to identify close contacts based on the proximity and duration of an encounter between the two or more users. The proximity and duration data of a user are stored on a user's phone for 21 days before they are deleted, and no location data is stored in any database of any sort. This is to protect the privacy of the user and ensure that the tracking process remains un-intrusive. In the event that someone has fallen ill to COVID-19, and he/she happens to be a user of the TraceTogether app, he/she will be able to contact the Ministry of Health (MOH) and grant the MOH access to his proximity and duration data stored on the app - making it quicker for the MOH to contact people who had close contact with the infected individual, to provide timely care and guidance, in order to curb the spread of the virus.

The *SafeEntry* system consists of a series of QR codes located at the entry at exit points of places and locations with potentially high human traffic: Shopping malls, certain shops, supermarkets, transport infrastructure such as MRT stations, and schools. Persons entering these locations will then scan the codes to "check-in", while those leaving will "check-out". By logging an individual's entry or exit into a venue, the government will have a rough database on where a person has been to, and in the event that the person becomes infected, the government will be able to use entry and exit data of a particular venue to determine the possible close contacts of that infected patient. Given that *SafeEntry* also asks for a person's contact information, the government will then be able to easily contact the identified close contacts, bringing him/her in for quarantine and isolation.

With the presence of these 2 apps, most of the drawbacks and challenges facing current contact tracing has been rectified. The proximity and duration data provided by the *TraceTogether* app, as well as the entry and exit data provided by the *SafeEntry* system, removes the issue of not being able to locate or identify close contacts. The contact information stored by the *SafeEntry* system removes the issue of not being able to contact these identified close contacts. The overall digitization and automation of the process also allows contact tracing to become less laborious.

It would seem like the web application we are developing shares extremely similar properties and functions to these 2 systems, and this raises the possible issue of redundancy regarding our project. However, upon closer inspection, it can be seen that our product does have some intricate differences, making it an asymmetrical counterpart to the 2 systems rolled out by the government.

Firstly, compared to the *TraceTogether* app, there are a few important differences:

1. The TraceTogether app does not store location information to protect the privacy of users, whereas our product stores location information and therefore is able to generate a database on human traffic.
2. The TraceTogether app does not have functions outside of contact tracing, whereas Could be used for other functions, such as crowd management and human traffic flow regulation.
3. The TraceTogether app works real time and continuously detects and tracks the presence of another phone with the app, whereas our website does not track users concurrently and in real time, but rather tracks the movement of a user based on location - whenever he logs his movement throughout an institutional complex
4. The TraceTogether app requires the user to input their mobile numbers for identification and contact purposes, whereas our website does not. This is because our website is not intended to be used as a platform for direct contact tracing by the government, but rather to help the school (or an institution) identify potential close contacts if one of the students of the school happens to have been infected, using location information that has been tracked and stored. From here, the school can then aid the government in contact tracing. Contact numbers are not required to be inputted, since the school (or any institution) should already have the contact information of students and staff.

Secondly, compared to the *SafeEntry* system:

1. The *SafeEntry* system is mainly designed to be used purely for contact tracing through identification of persons that were in a common venue with the use of their Entry and Exit data - specifically the timing of their entry and exit. On the other hand, besides contact tracing, our website can also be used for crowd management and human traffic flow regulation. Our website also has the ability to flag “overcrowded” locations, based on thresholds set by admin
2. The human traffic database generated by our website is able to be accessed by administrators, whereas any such database generated by the *SafeEntry* system (if any, as no information on such features have been available) is only accessible to the government.
3. The *SafeEntry* system requires users to input their contact information, whereas our website does not, for the same reasons listed above.

From here, it can be seen that our product's capabilities and functions are asymmetrical to that of the systems pushed out by the government. Hence, it still has relevance and can still be developed.

Methodology

Our solution is a website coded by HTML, CSS and JavaScript, together with a MySQL database to store the information and generate a human traffic database.

The website is hosted on InfinityFree, a free web hosting site. This is to enable those with internet access to be able to visit the site anytime. It is also ad-free and has unlimited storage space, which enables more logs to be stored in the database.

CSS is used to make the site to be as user-friendly as possible, with the interface kept simple. The fields the user needs to interact with, are enclosed in a box, to draw their attention there. This design is kept consistent throughout the pages. There is a collapsible menu to access different pages, to keep the screen less cluttered.

User input is kept as minimum as possible, i.e. time is automatically recorded. Searching logs is also kept simple, and the user only has to enter any relevant information they want to find. Furthermore, the welcome page once users sign in reminds users to log their movement, and has a button to bring them to the page to log their movement. Admins can also easily download the logs in a .csv file.

MySQL is used alongside PHP, to facilitate the searching of logs. There are 2 MySQL databases, one for user accounts, and the other for their movement logs.

For the user database, usernames are stored in plaintext along with a unique userID, and passwords are stored as bcrypt hashes to provide security in the unlikely event that the database is compromised.

For the movement database, the respective userID of the user, the location, entry time, exit time, and date of movement of the user is stored. This allows users to be able to search for specific locations, timings, and users easily.

When a user performs an action, JavaScript is used to get their input from the site. These inputs are sent to PHP, which strings the inputs into a SQL query. The SQL query is run, and MySQL returns the output to PHP. The output is encoded to JSON and sent back to the JavaScript file, and if necessary, presents the output to the user by creating elements with the result and appending it to the current page.

Design

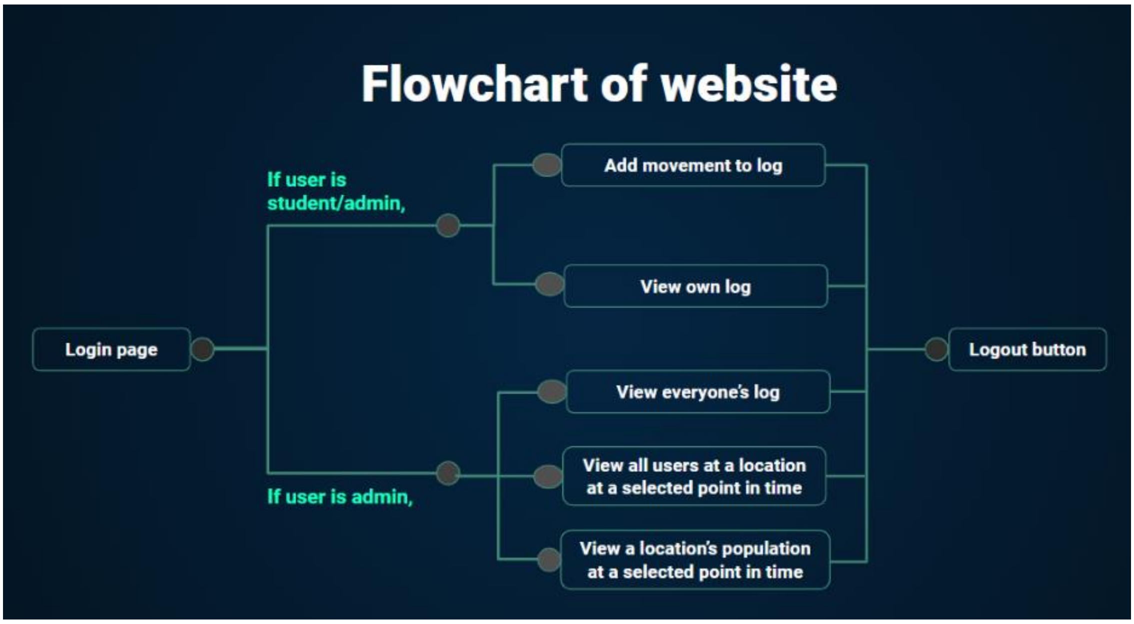
Our website will consist of the following pages:

Pages of website:

1. Registration
- Allows new users to be registered.
2. Index
- Page for user to sign in.
3. AddLog
- Page where user can add their movement log according to the venues, they are in.
4. LogArchive
- User can select and view their previous logs.
5. CheckLog
- Only users logged in as admin have access
- Able to select and view other user's movement logs.
6. LocationLog
- Only users logged in as admin have access.
- Able to select and view who has been to a specified location.
7. Statistics
- Only users logged in as admin have access.
- Shows population at a place (based on logs)

There will be 2 types of user roles: users and administrators. Users will make up the majority of the people using our website inside the school campus (students, teachers, non-teaching staff). Users only have access to pages 1 to 4. The administrator will have access to all pages, and this role will only be granted to a select few higher up in the school's (or any other institution's) administration, who may need the peripheral data (such as movement data of all people; the list of people that have been to a specific location, or the population of a certain location) to aid in their management of social distancing/crowd control. They could also be those whom are entrusted with the authority to initiate first-hand contact with possible close-contact persons of an already infected individual within an institution itself, though not associated with government contact tracers (governmental based contact tracers, at least in Singapore, may not have access to human movement data inside larger compounds – in our school campus for example, SafeEntry have only been deployed in the capacity where authorities would know whether a person, and when a person has entered or exited our school, but will not have access to finer details such as the exact location within our school a person has been. **This will inevitably give rise to blind spots in the contact tracing process**, as well as inefficiency.) We aim for our website to be able to rectify this gap. Specially appointed persons in our school could be entrusted with duties of contact tracers themselves, using our website to gain coverage of human traffic within our school itself (or any other institutions, for the matter), potentially helping actual authorities if the need for this type of microscopic contact tracing arises, hence removing this blind spot in contact tracing.

General flowchart of users'/admins' actions when he uses the website



Index

This will be the first page of the website where all users will have access to. Users/admins enter their login details and login.

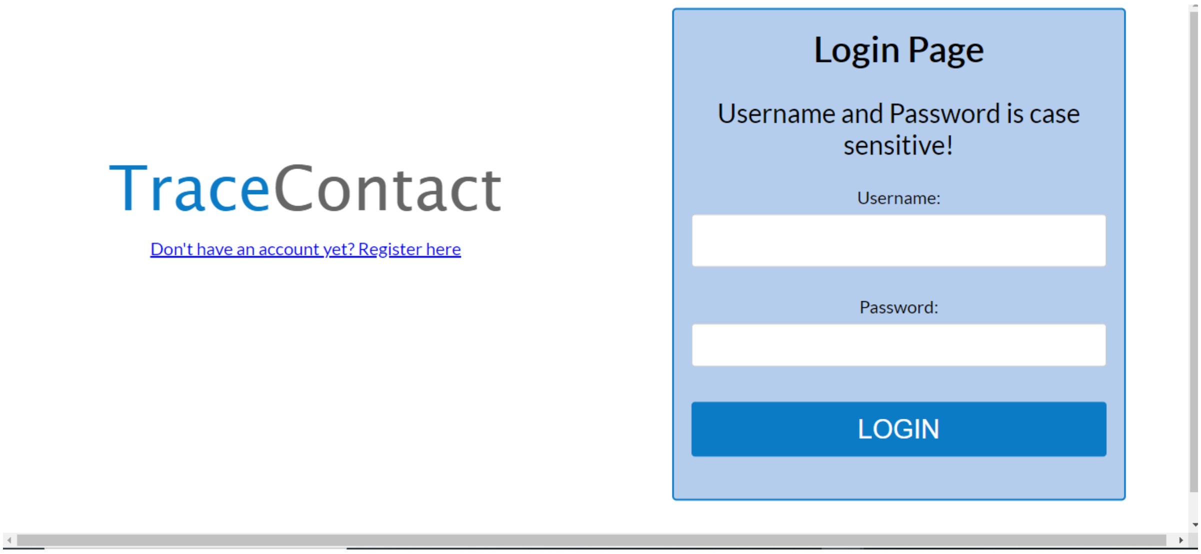


Figure 1: Login page of website

Registration

In the event where the user is a new user, he/she will have to register himself /herself first. The school could preempt this by issuing everyone a specific username to register themselves as (allowing for quicker identification and a streamlined contact tracing process)

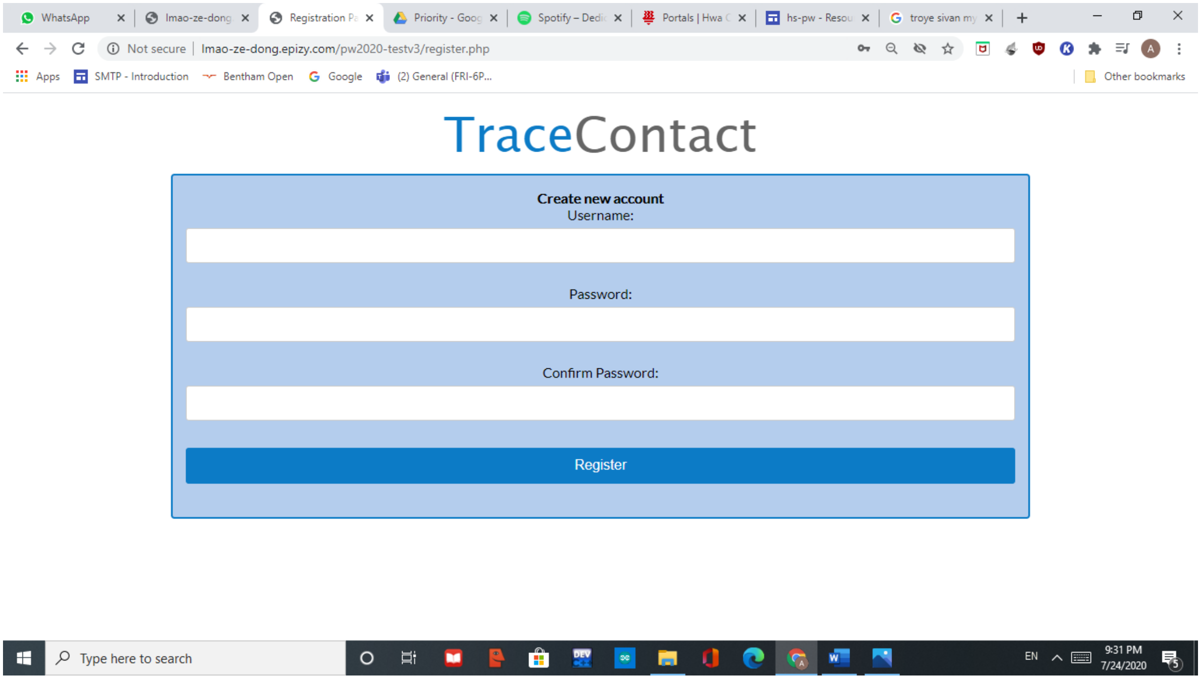


Figure 2: Registration page of website

AddLog

Upon registration or logging in, users will be presented with the AddLog page. This is where the main action of entering the movement logs take place. Adding a movement log is a 2-step process, requiring a user to "log-in" of a location when he/she enters, and "log-out" of the location when he/she exits.

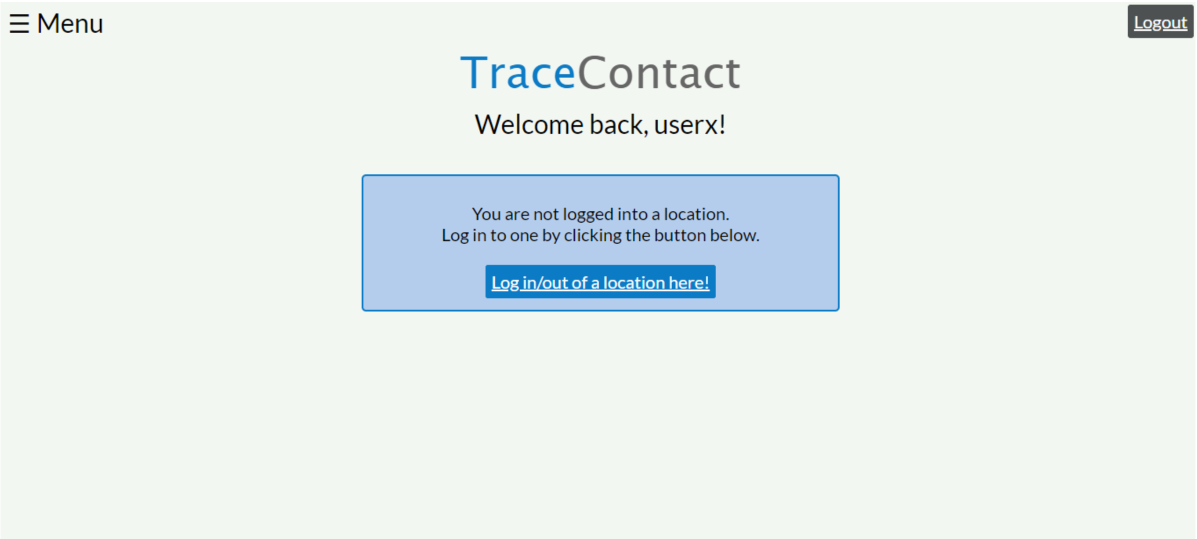


Figure 3

1. Users will first be presented with this page. For users to login when they enter a location, they first have to click *Log in/out of a location here!*

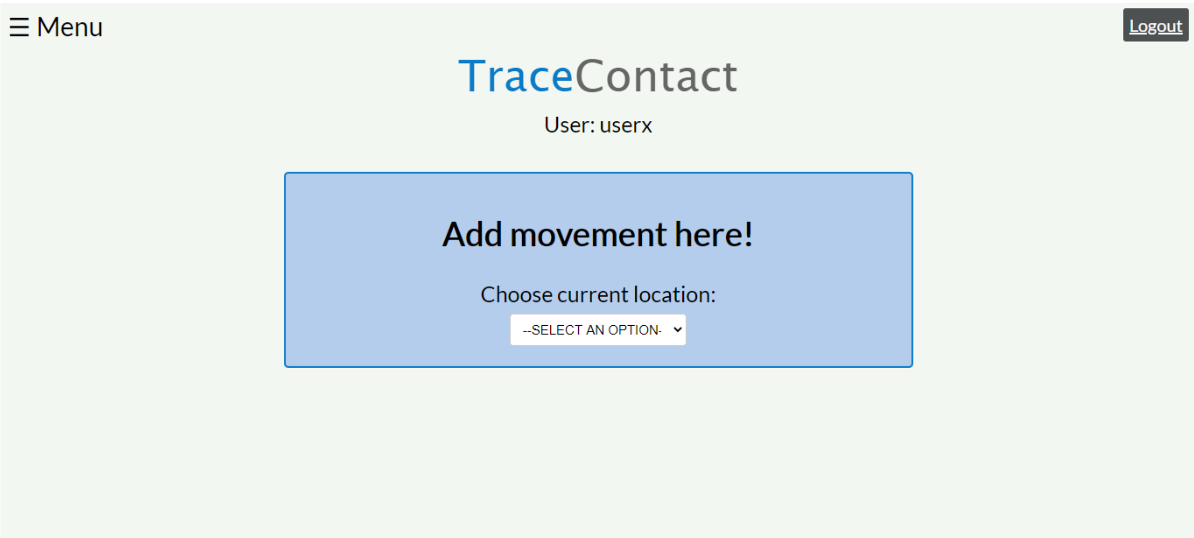


Figure 4

2. Users will be brought to this page next. To complete the log in, users will first have to select the location they are in via the dropdown bar.

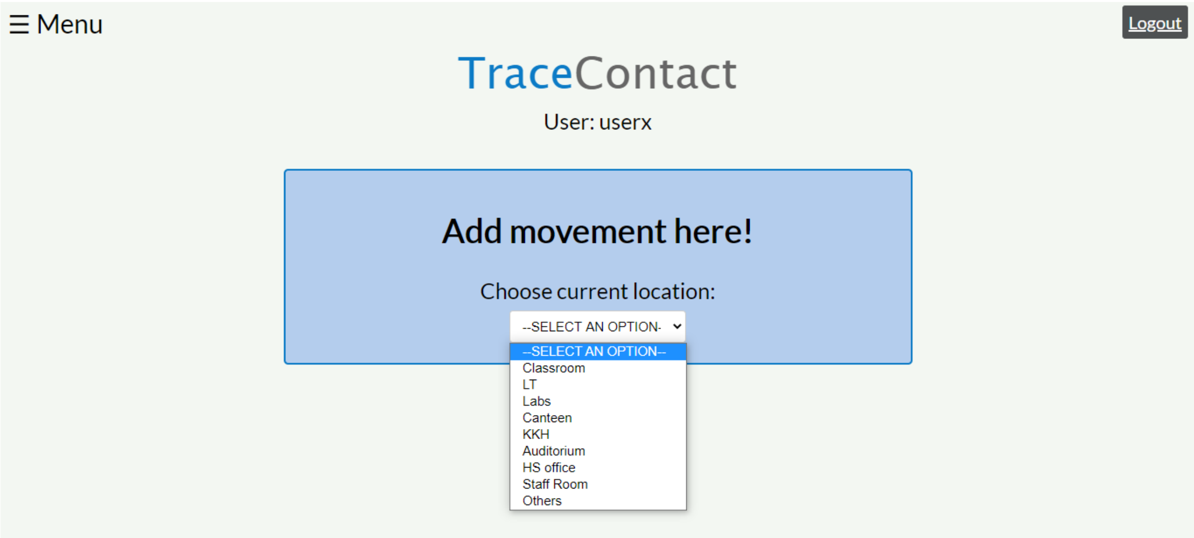


Figure 5: AddLog page of website: users choose location via a dropdown bar. Locations can be changed from ground to ground up to the discretion of the personnel in charge of managing contact tracing within their ground through the use of our website. However, this will require some recoding.

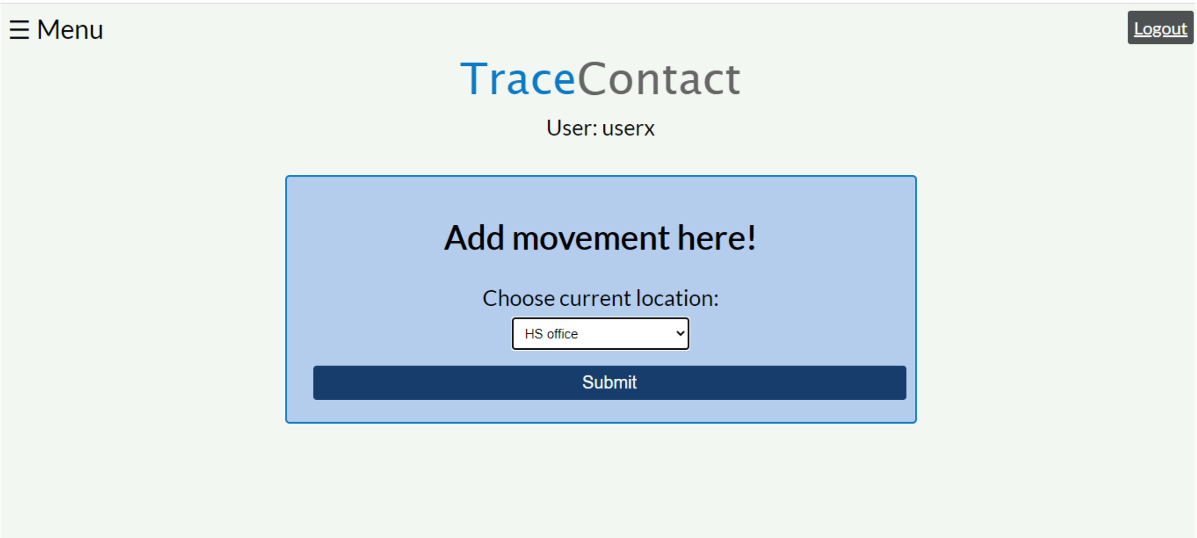


Figure 6: AddLog page of website

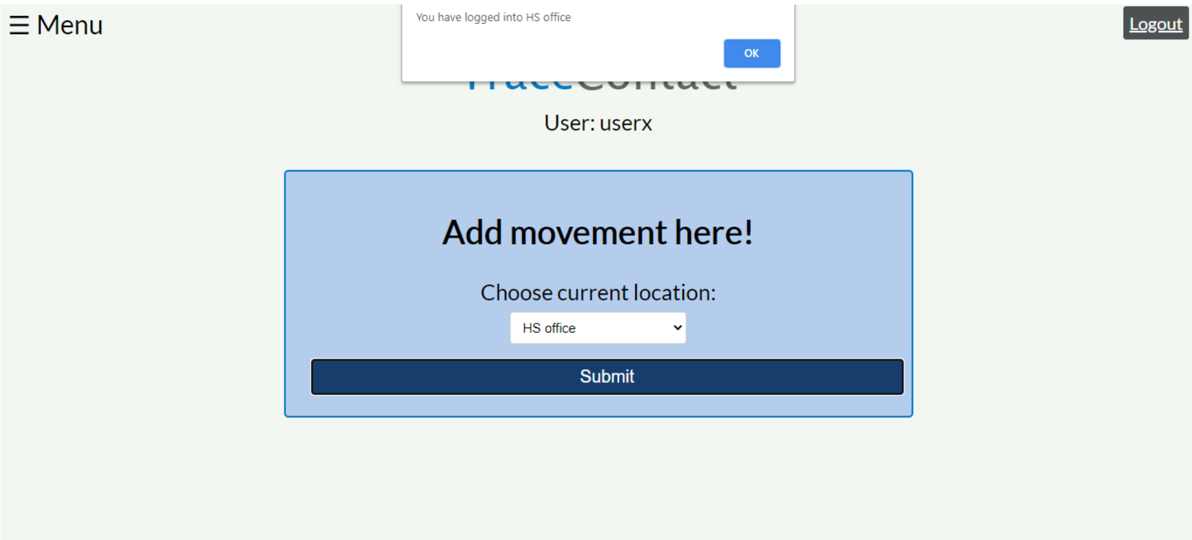


Figure 7: Dialogue box shows that user has completed logging in to the location.

3. To complete the addition of the movement log, users must "log out" of their location as they exit. By accessing the website again, they will be presented with this page:

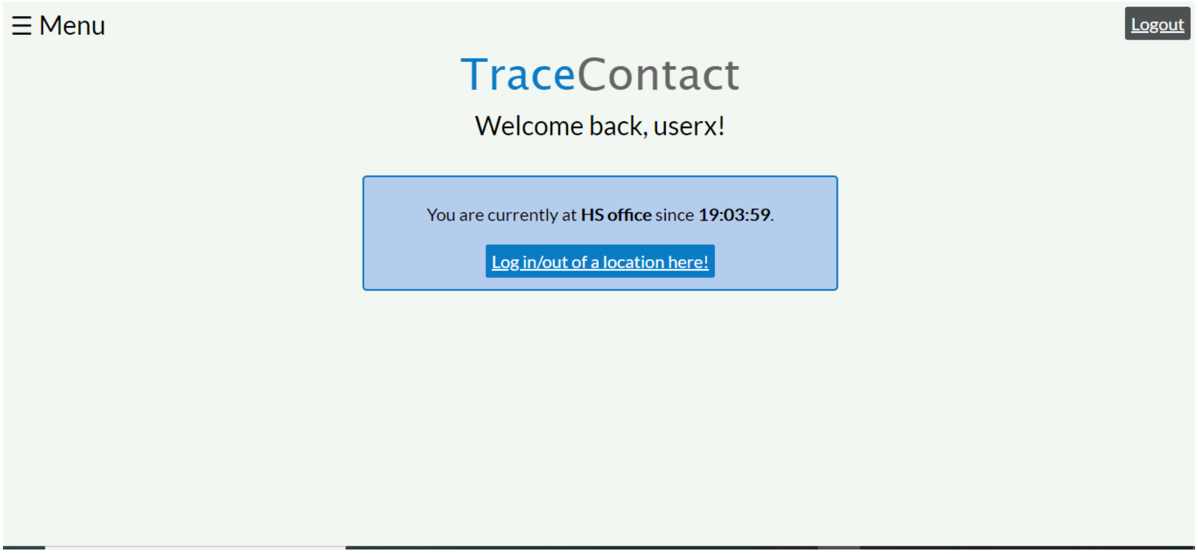


Figure 8: This page now differs from that shown in figure 3, with the text "You are not logged into a location" replaced by "You are currently at _____ since ______". This allows the users to know that they have completed phase 1 of the addition of the movement log, that is, logging into a location. They will now have to log out to proceed.

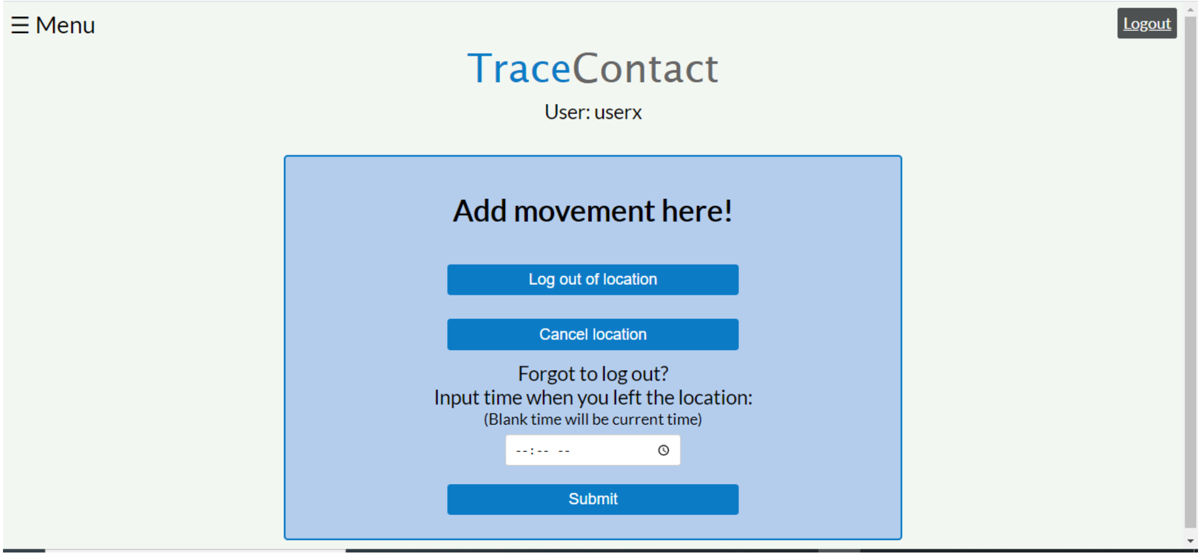


Figure 9: AddLog page of website: users logout when they are leaving a location – entry time is automatically logged when user logs in; exit time is automatically logged when user logs out. Time information (i.e. how long a user spent at location; the time he spent at a location) is grabbed this way

Once they are leaving the location, users access the webpage again, then select the "log out of location using current time" option. This will complete the process of making a movement log, and will automatically result in the creation of a log in the LogsArchive page, as shown below.

In the event the user forgets to log out of location earlier, an option is available for them to manually input their "exit from location" time. Submitting it will complete the process of making a movement log, and will automatically result in the creation of a log in the LogsArchive page, as shown below.

Entry time is automatically logged when user logs in; exit time is automatically logged when user logs out. **User identification data and time data can be automatically obtained this way, without a need for manual input.**

If the user realized that he has created a log wrongly, there is an option for the user to cancel his log.

LogsArchive

Users can view their own previous logs under the ViewLog page, which can be accessed through the use of the sidebar and clicking on “View own logs”. Users cannot check or access other users’ data. (This function will only be accessible to administrators)

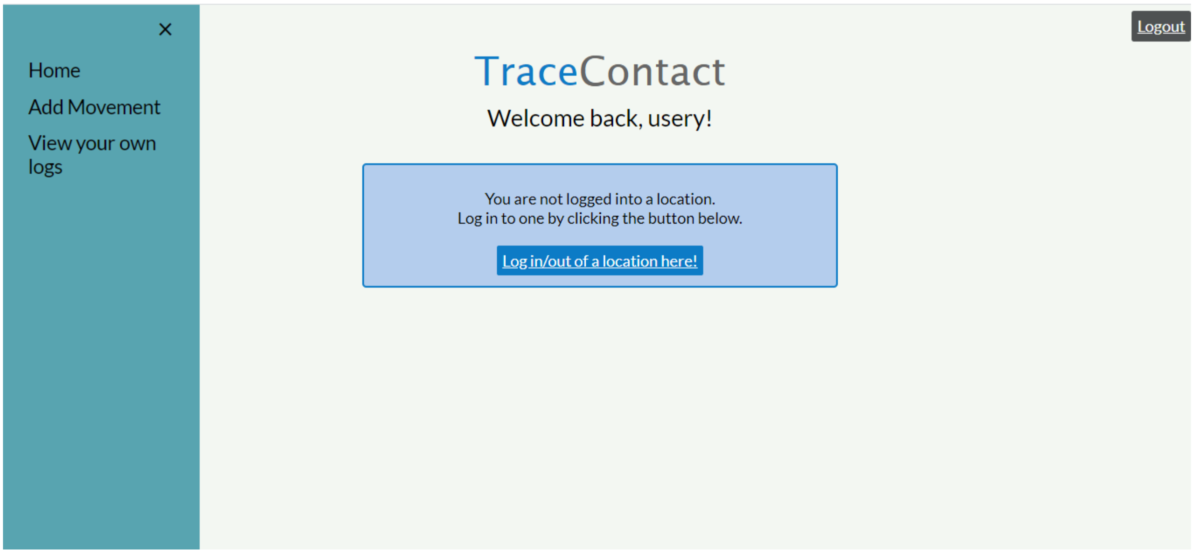


Figure 10: Side bar accessible to users in order for them to access the ViewLog page.

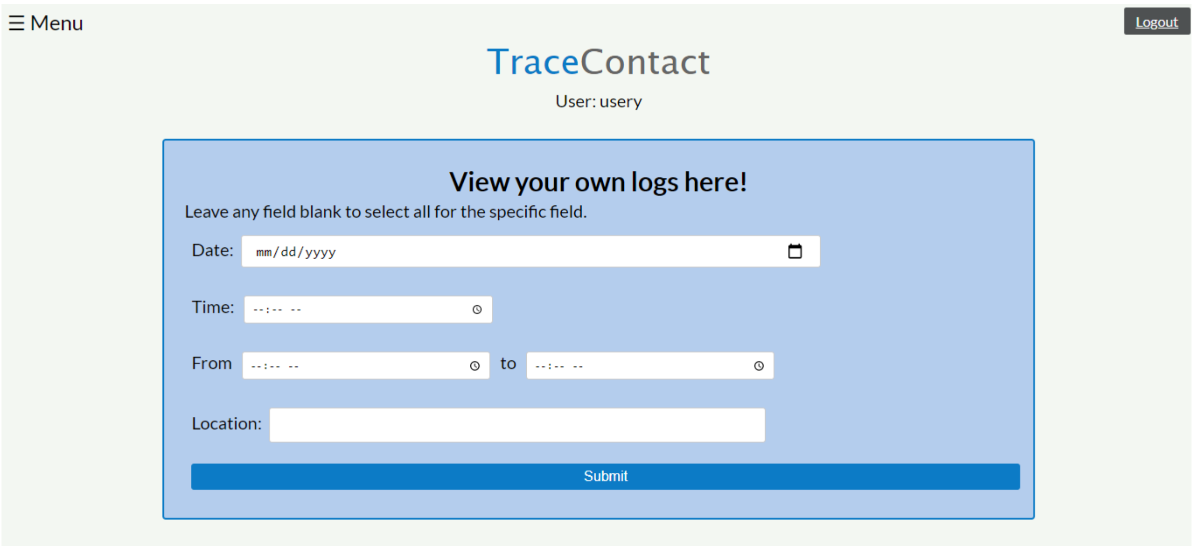


Figure 11: ViewLog page of users. Users can select and view their logs based on date/time, a range of time, or based on location. This way, they can quickly access their movement logs of any particular date; time; or to any particular location without having to scour through an unfiltered list

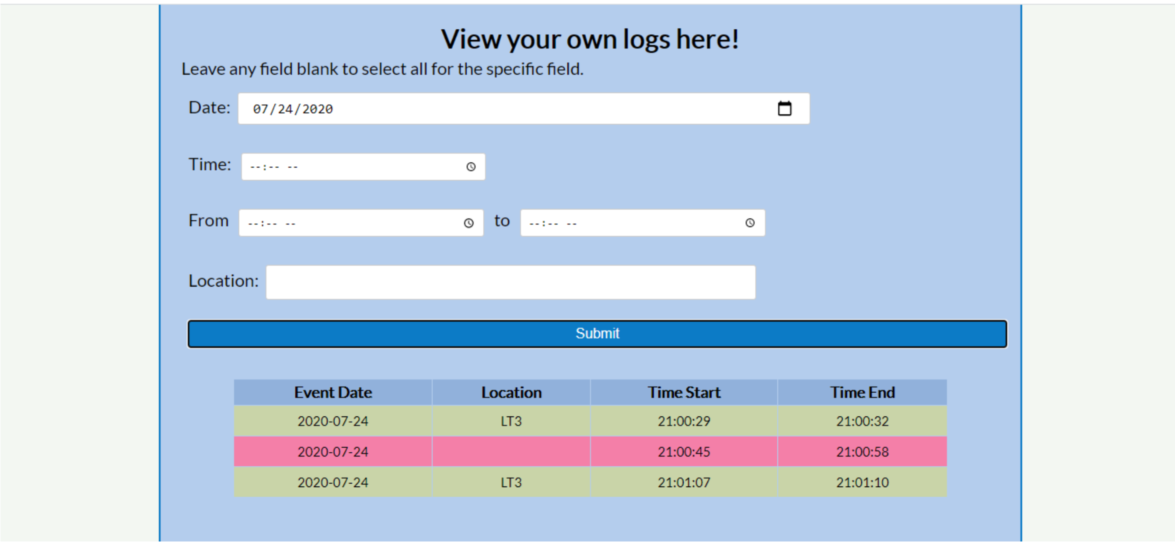


Figure 12: Page layout after user has filled in required fields to narrow field of search for a particular log. Here, the criteria selected is any log created on the 27/04/2020. Logs are displayed in a table as shown above.

Movement log of a person includes:

1. Location
2. Time information (date/time of stay at a location)
3. User ID

CheckLog and LocationLog

As mentioned above, administrators will have access to 3 additional pages compared to normal users. The first of these 2 are the *CheckLog* and *LocationLog* pages.

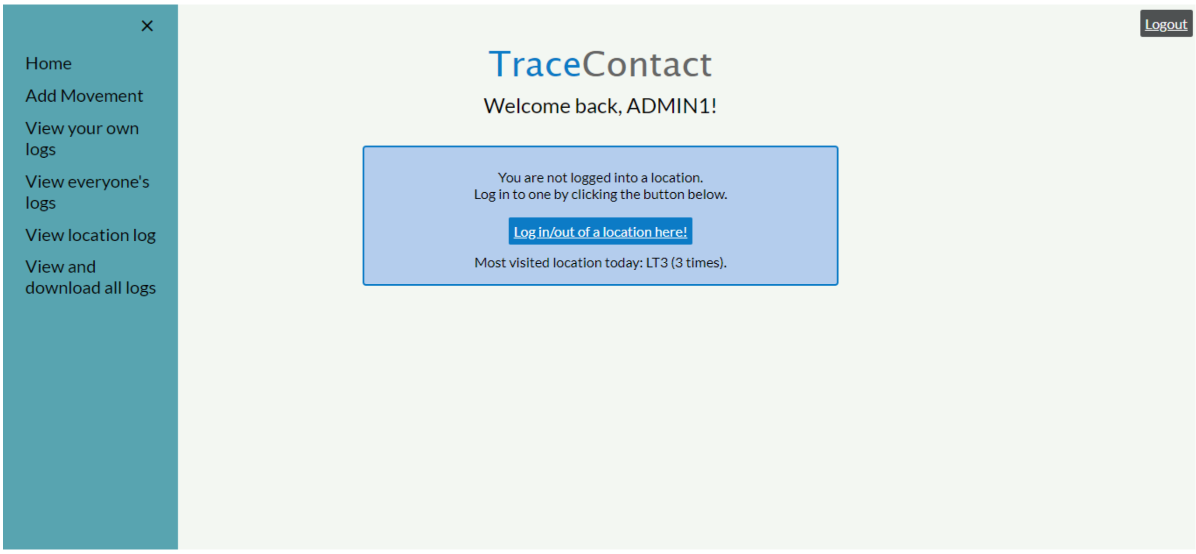


Figure 13: Sidebar of pages accessible to administrators.

The CheckLog page is similar to the user's LogsArchive page, except that here, the administrator can view the log of anyone.

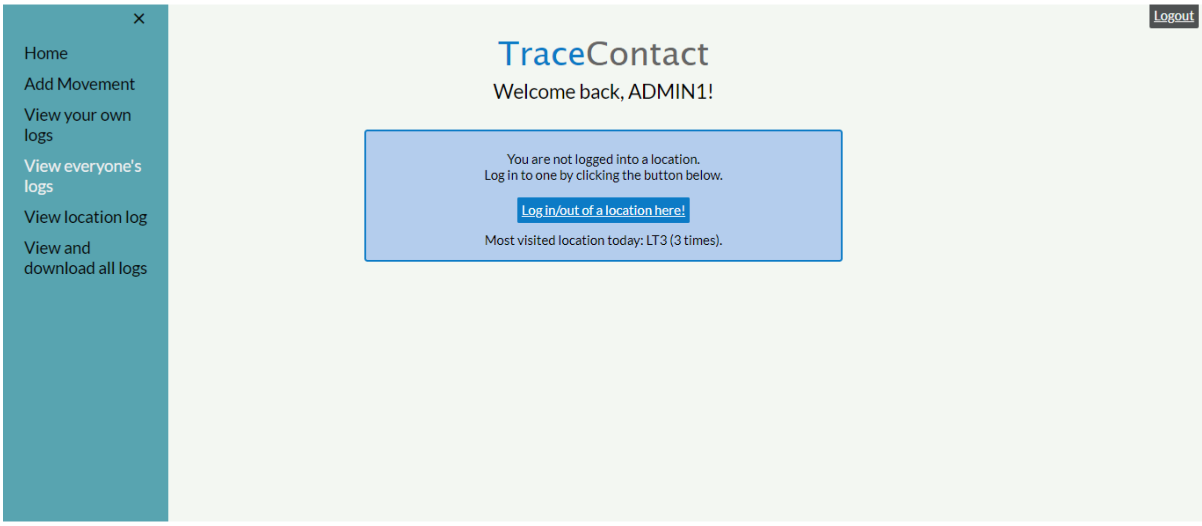


*Figure 14: The CheckLog page is accessed by clicking on **View Everyone's logs***

The administrator can access the logs of any particular user by simply typing the username of that user into a search bar. The administrator can further narrow his search by filling in fields related to time, date and location (similar to the *LogsArchive* page in figure 11)

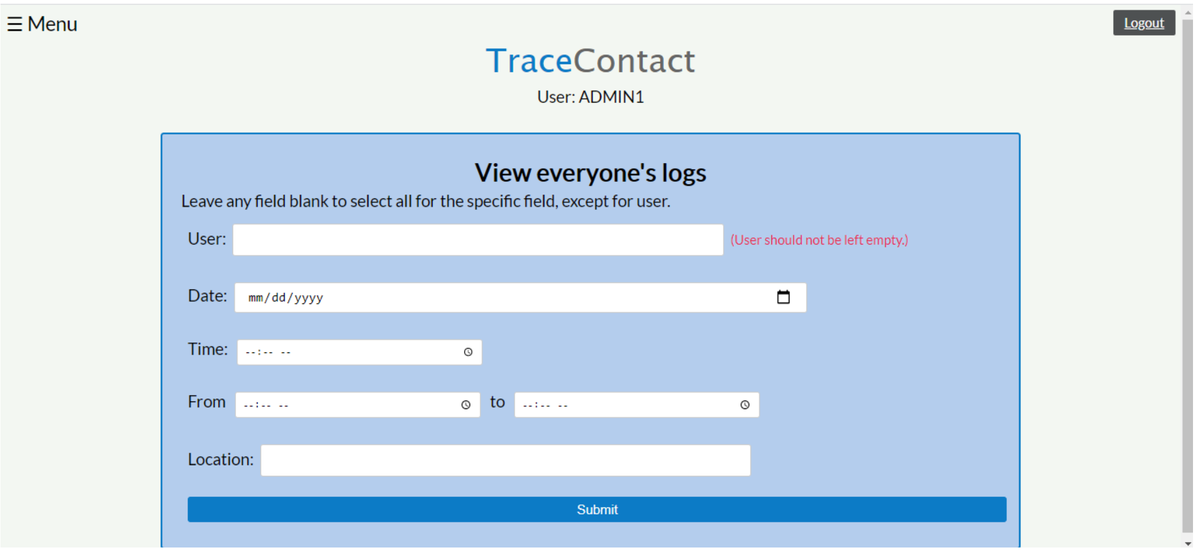


Figure 15

Besides from just simply viewing the movement logs user by user, administrators can also view the movement logs location by location. This can be done by accessing the LocationLog page. By displaying the data in this form, administrators can gain a clearer picture of how human traffic is like in any particular location. This can also help administrators in identifying potential close contacts – by looking at who may be in the same location at roughly the same time.

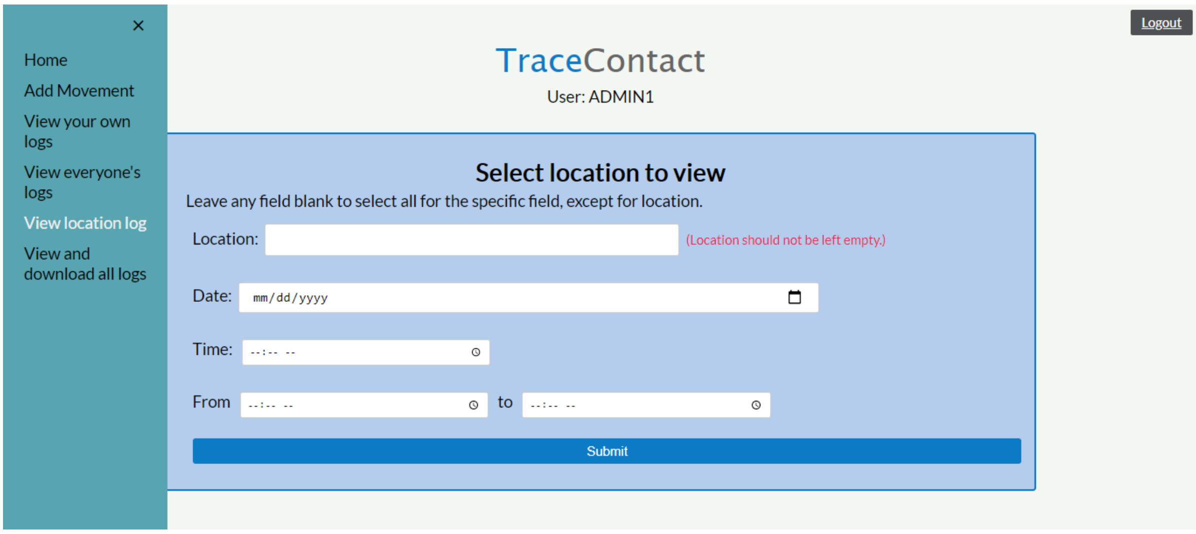


Figure 16: LocationLog page is accessed by clicking on ***View location log***

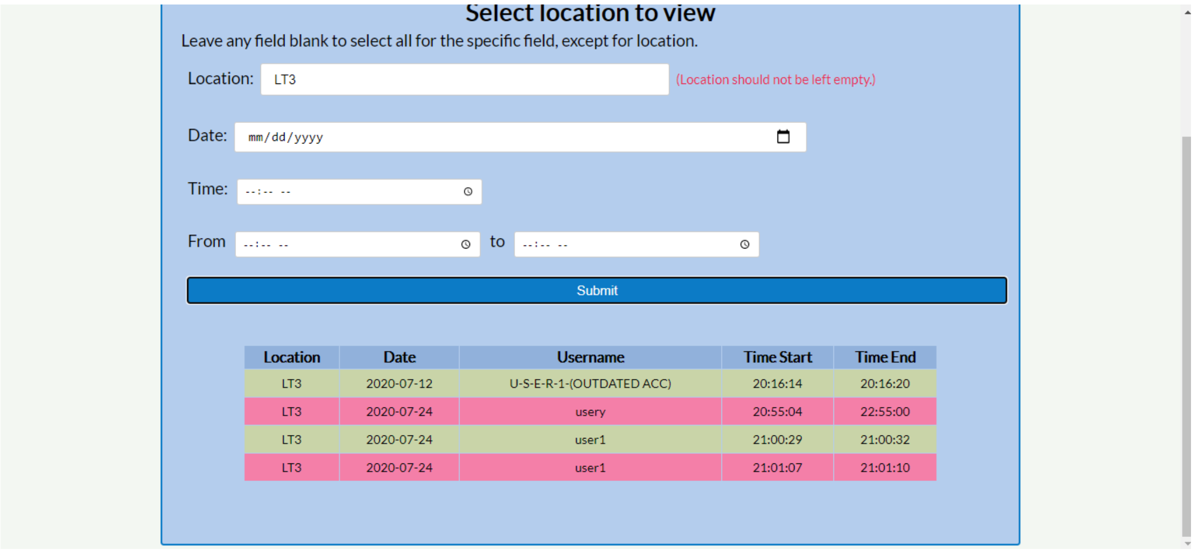


Figure 17: Administrators can bring up logs on a location by location basis. Here, the location inputted is "LT3". Movement logs of those who entered/exited LT3 will be brought up. The search can be further narrowed by filing in the date and time fields

Statistics

A human traffic database is generated here through a compilation of all the location data based on the individual movement logs that are inputted by the users.

Administrators will be able to download the movement logs and database in the form of a .csv file. Administrators will be able to download the logs based on location or based on time. By downloading the logs based on location, the movement logs will be displayed in the .csv file in a location by location fashion. Similarly, to the LocationLog page, this format of displaying data allows administrators to glean information of human movement at a particular location at a glance, as well as aid administrators in identifying close contacts of an infected person. Administrators can also download a file which shows the timings where users/administrators have logged in. The website will also be able to flag the venues or locations which show repeated occurrences of overcrowding - based on thresholds set by the administrators. This way, human traffic can be monitored, and if need be, regulated, and social distancing measures can also be enforced. Contact tracing will also be made easier given the movement logs that will be generated, and close contacts can be identified by viewing movement data by location and time.

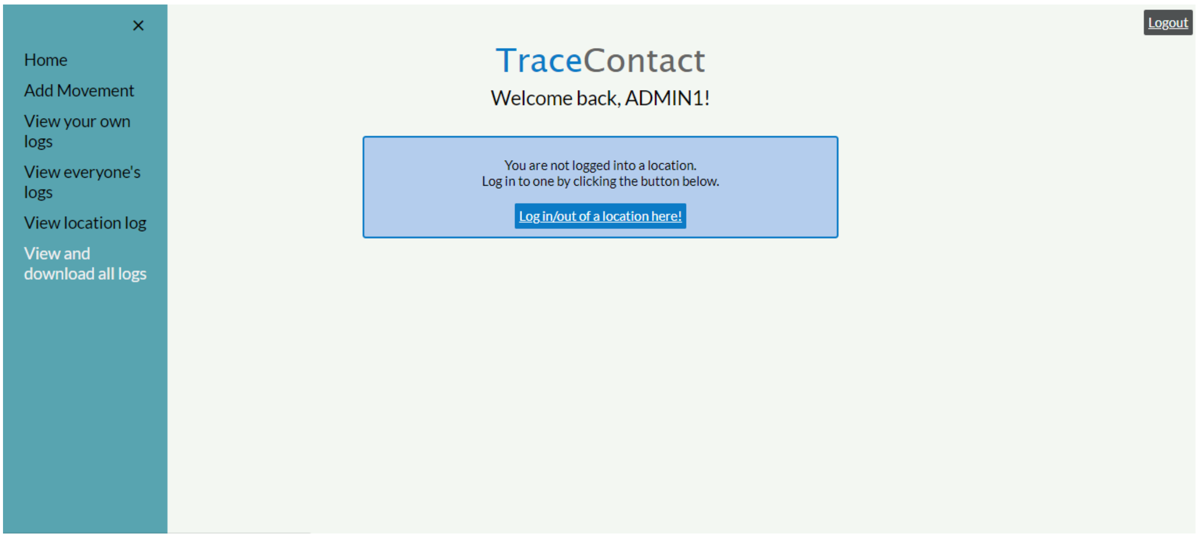


Figure 18: The statistics page can be accessed by clicking on ***View and download all logs.***

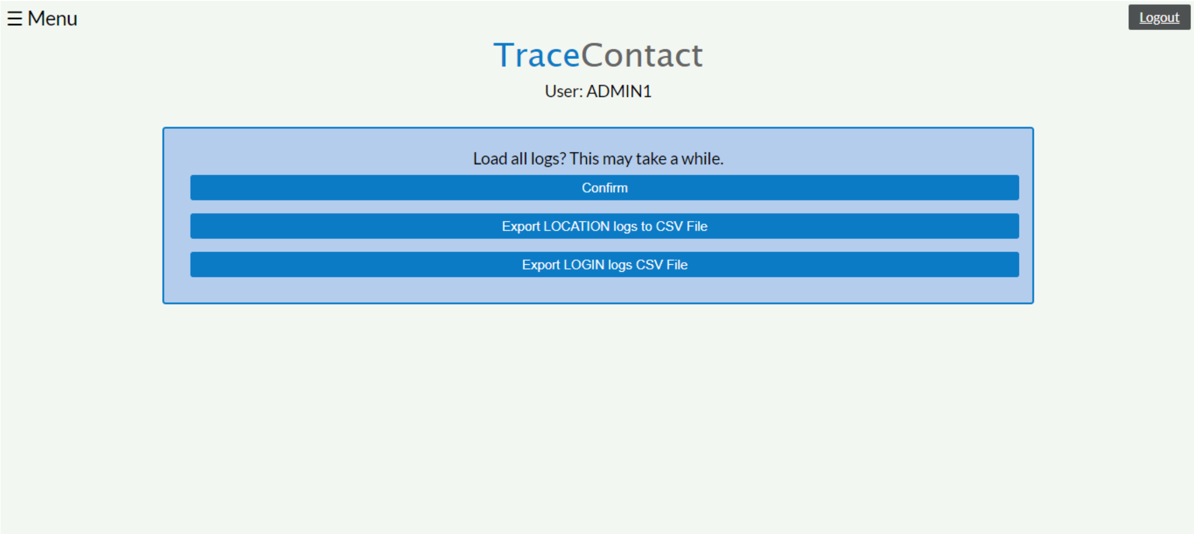


Figure 19: Statistics page

Here, the administrator can do one of three things. Firstly, he can choose to display all logs on the website itself by clicking on "Confirm"

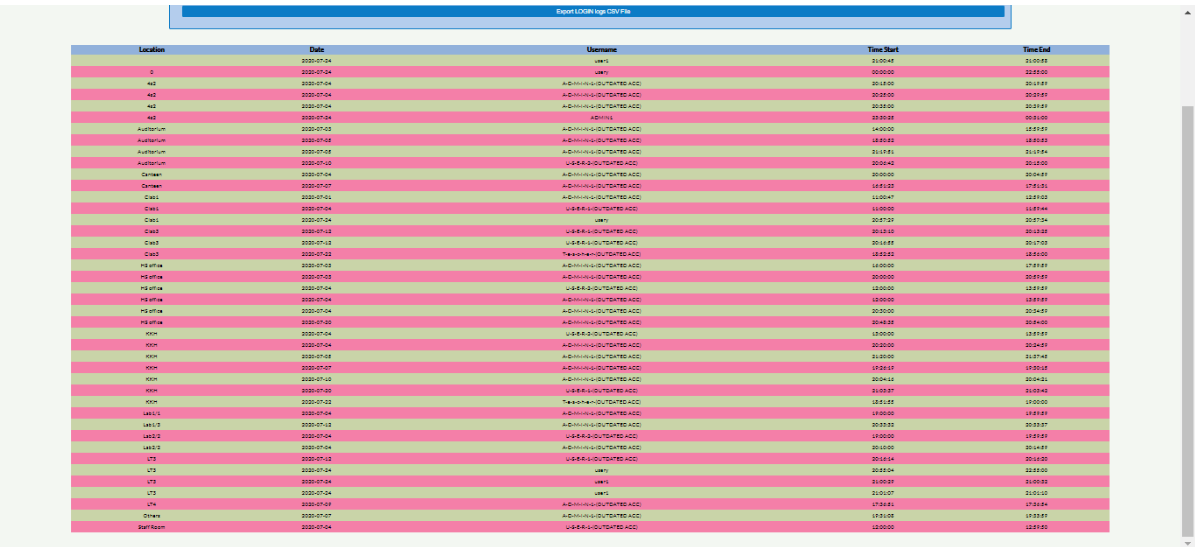


Figure 20: All logs displayed on the website

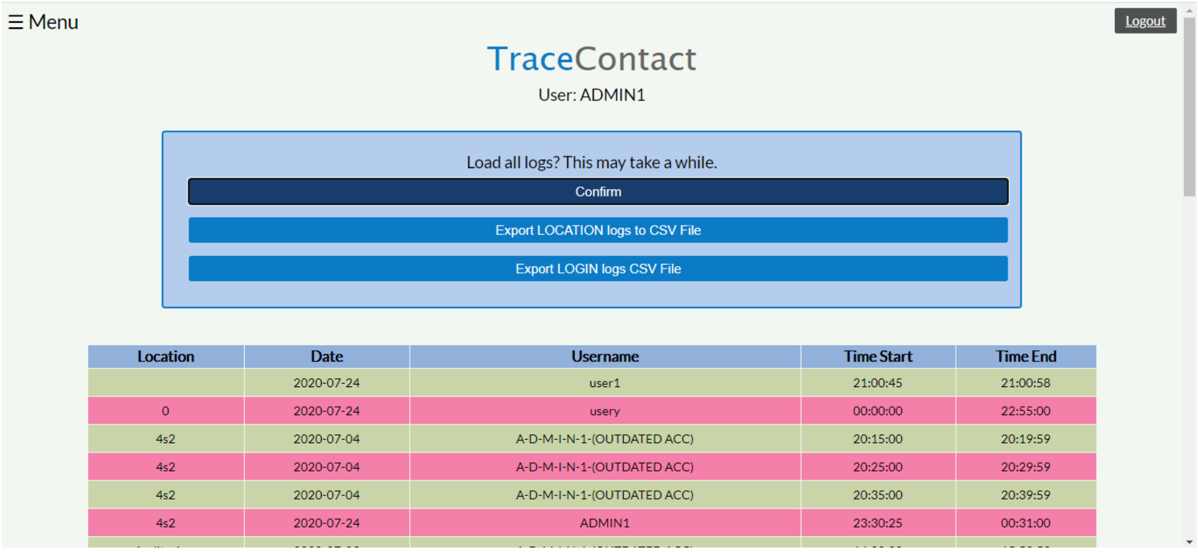


Figure 21: Logs on website are displayed in a location-based format

The other 2 actions will involve downloading of the logs into the .csv file itself. To download the .csv file where the movement logs are displayed on a location-based format, the administrator should click on **Export LOCATION logs to CSV.** Upon doing so, the logs will be downloaded in a CSV file.

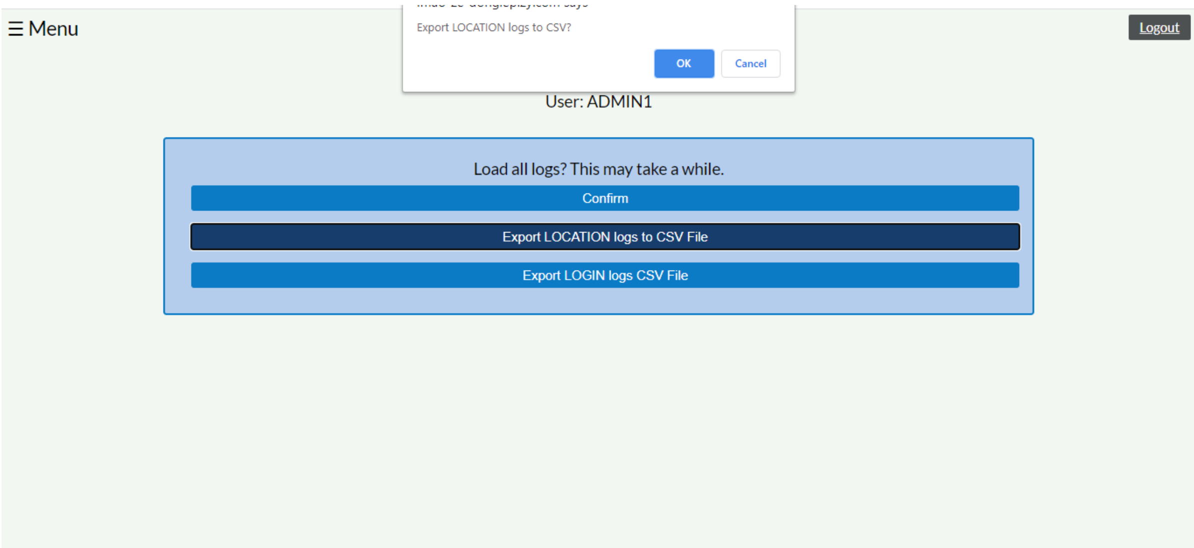


Figure 22: Dialogue box upon clicking the ***Export LOCATION logs to CSV*** *option*

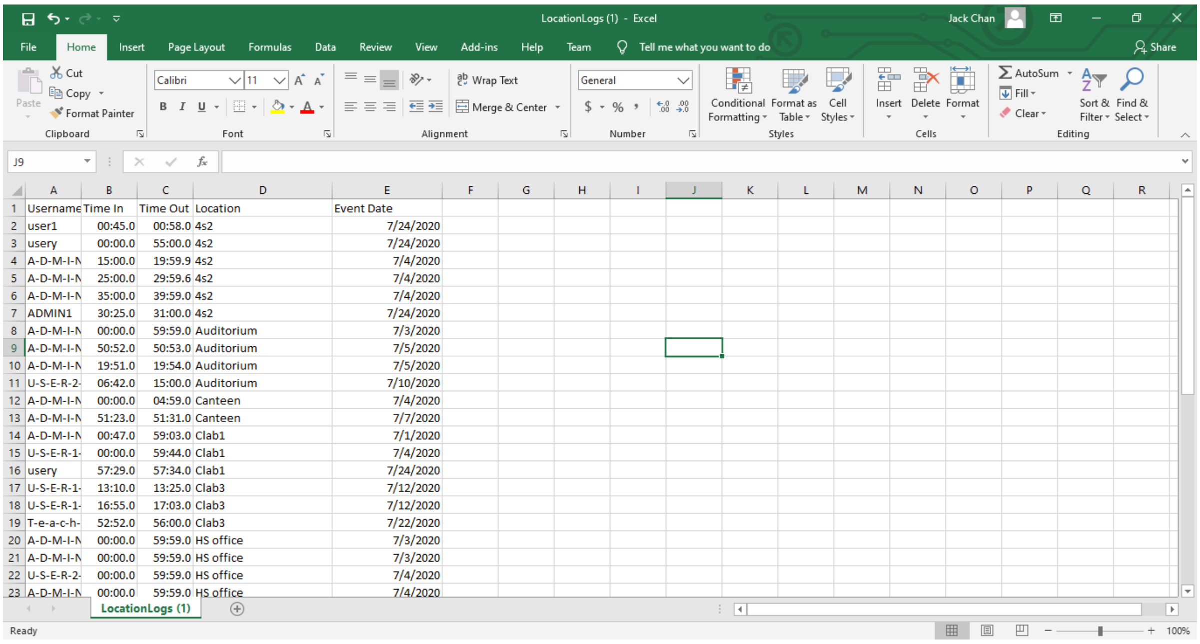


Figure 23: Logs displayed based on location in the csv file.

To download the .csv file which shows the timings where users/administrators have logged, the administrator should click on **Export LOGIN logs to CSV.** Upon doing so, the logs will be downloaded in a CSV file.

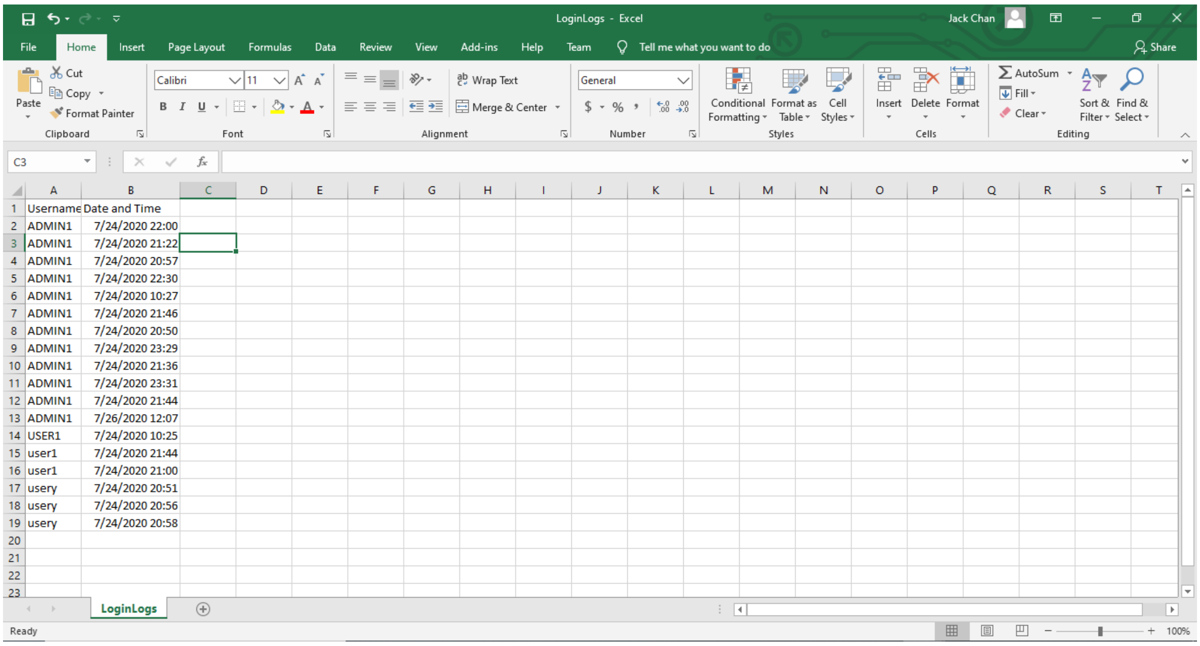


Figure 24: When the ***Export LOGIN logs to CSV*** *is selected, the csv file shows the timings where users/administrators have logged in*

Testing

Alpha testing of the website was carried out by the members of this project group, and preliminary testing procedures began during the Term 3 mid-term break as the website was nearing the end of its development, to test for the presence of bugs and issues in the website.

Certain bugs involving the dysfunctionality of certain buttons in the website were unravelled and fixed quickly. No reliability issues were found within the website.

As school reopened, preliminary Beta testing was commenced to further test the reliability of the website, to collect feedback on the website's UI and functionality from the users, as well as to further weed out any other subtle bugs and issues that may have been overlooked despite comprehensive testing during the Alpha Phase.

Preliminary Beta testing was initiated on the 30th July through to the 11th of August. The website link was distributed to a few students who were requested to use the website to enter logs as they moved throughout the school for that day. They were also instructed to report any bugs present, as well as give feedback on the website's functionality at the end of the day. Meanwhile, the project group members were tasked to act as administrators and test the functionality of the *LogsArchive, CheckLog and LocationLog* pages

No bugs were reported by the users. Some comments were, however, made with regard to the website's functionality:

Area for Improvements:

- "Instead of typing in class name, type class address e.g. A102 instead of "4S2".
- "Include SRC areas."
- "Not all science labs included yet."

Well-done areas:

- Option for choosing time of check out is a good feature.
- Website feels refined. Navigation between pages is smooth.
- Interface is intuitive and easy to use.
- There are no bugs present.

As we can see from the feedback given, most of the Area of Improvement feedback given for the website were unrelated to actual functionality or User Interface. The main improvement feedback given, however, allowed us to become aware of certain aspects which we have overlooked – namely the locations in school where users can log their movements in. All AFI comments above were quickly addressed and rectified.

With regards to administrative functions, all functions were found to be working smoothly during testing. We were easily able to locate users, identify users, and gain an idea of the movement of a user throughout the school

Conclusion

We have been successful in developing a website that captures and stores the movement of persons within a large compound, through letting users log their movements as they move about major venues within the compound.

All features of the website worked as intended, and smoothly as well. Users were able to log their movements, the website was able to store these movements, and we were able to access and view these movement data in a variety of formats.

Users have also expressed praise for our User Interface and functionality, showing that our website is user friendly, easy to use and can be easily implemented.

One limitation to our project will be the inability to test its exact performance when it comes to seeking out close contacts of an infected individual – while we were able to reliably find movement data information regarding users using our website, we are unable to get actual feedback in terms of using the website to help find potential contact tracers.

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