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Research Article

Improving Coronavirus Disease Tracking in Malaysian Health System

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ABSTRACT

This paper proposes coronavirus disease tracing system acts as a portal for the health center to update and track their patients' contacts and collect data for further analysis. All of the contents are handpicked, filtered, and selected to the best of our ability by assigned individuals (mostly medical staff) to ensure that sources are credible and free of hoaxes for the public's benefit. This application likewise means to assemble information for the top to the bottom investigation (for example, time arrangement to screen the development, in-house patients) and synchronization with a contact following application, for instance, MySejahtera app that was created and set up by the Malaysian government and utilized from one side of the country to the other it assumes that all patients have internet access and smartphone, to handle such delinquent, SMS driven application with ability to update status through using patient credentials through system website, and to add simplicity for clients' understanding using graphic visualizations and dashboards are incorporated.

Keywords: Coronavirus disease, e-government, e-health, Tracking system

INTRODUCTION

Coronavirus disease (COVID-19) is a newfound virus causing severe, intense respiratory disorder (coronavirus sickness COVID-19)[1] rose in Wuhan, Hubei Province, China, and quickly spread to different nations worldwide. At present, the Malaysian government and health center are trying their best to learn and stop the spread. This virus is perceived to spread through human-to-human contact, particularly those with close contact and respiratory droplets from an infected person sneezing or coughing. With the number of cases expanding each day, government departments are looking to cooperate with health centers to track down patients effectively. The health center needs a system to store patient's details, trace the patient visited places, and send the report to government agencies whenever required. Hence, this COVID-19 tracing system (CTS) was intended to assist clinical experts and medical care communities in keeping track of their COVID patients and updating the government agency regularly. This system allows the health cares to store patients' details, their last visited locations, and linked cases if there are any. These patients' profiles are then updated to the government.

The problem statement for this project is that the medical center cannot store, track, and update case details with government agencies as the number of cases grow every day. Moreover, it a challenging to trace the linkage infections between two or more cases.

Furthermore, public locations attended by the infected person are unknown. The system's scope is separated into two parts: Employee scope and system scope. The employee scope enables the employee to login to the system using their employee ID and password. The system also enables the employee to add new case details and link them to any existing past cases. The employee can put in a location to see if there were any reported cases. At the same time, the system scope shows the latest case updates of the COVID-19 cases. Moreover, it can store the new case details and link to any existing past cases. It also shows the background of the infected person, details such as last 14 days visited places, how to contact the virus, and sent the reports to government agencies through email.

This project aims to help health centers store, trace, and update the government agencies on COVID-19 case details. A web-based application to store the cloud data will be easy to integrate with many government applications such as MySejahtera. It is expected to reduce the work on government agencies to trace the contacts linked to the cases. Simultaneously, the project works with an internet connection and location enabled through the web browser, yet it collects patients information through SMS or through QR code scan by nearest smartphone. It is

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anticipated that the government will approve it and integrate it with government-linked applications to allow for seamless data transfer. The default email services for health care will be used.

LITERATURE REVIEW

Health Centre app acts as a portal for the health center staff to update and track their patients' contacts and collect data for further analysis. All of the content are handpicked, filtered, and selected by assigned medical staff to ensure that sources are credible and free of hoaxes for the public's benefit.

This app also aims to collect information for the in-depth analysis, such as time series to monitor in-house patients and monitor the growth and synchronization with a government's contact tracing. It is conveyed using graphic visualizations and dashboards to make it easier for users to learn.

Review of Foreign Countries Tracing Applications New York H1N1 Surveillance System

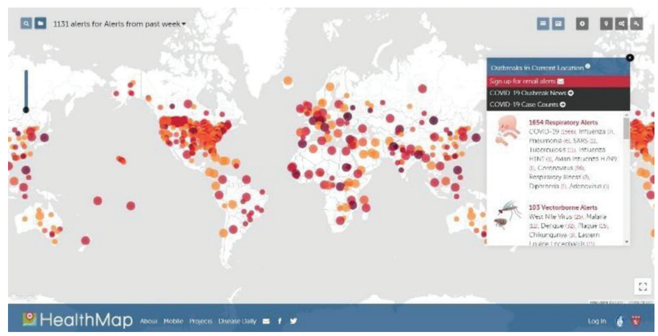
On April 23, 2009, a medical attendant from a secondary school in New York City (NYC) called the Department of Health and Mental Hygiene (DOHMH) to report a flare-up of respiratory disease[2]. The reason for the episode was quickly affirmed to be flu A pandemic (H1N1) 2009 infection. Only a few days after initial reports of mild illness caused by pandemic (H1N1) 2009 infection in California and Texas[3,4], this episode was identified as a flare-up of a significant respiratory condition linked to pandemic (H1N1) 2009 infection in Mexico[5]. The clinical severity and transmission characteristics of this new flu infection were kept a secret. DOHMH launched a wide-ranging public health response in response to initial media reports about the Mexican flare-up and concerns that NYC could also be hit by unending severe infection.

Before the spring of 2009, DOHMH routine observation frameworks for flu included (1) syndromic reconnaissance for medicine deals, school non-attendance, and crisis office visits for flu-like ailment (ILI)[5,6]; (2) electronic research facility announcing of affirmed cases from business and emergency clinic laboratories; (3) dynamic observation of all NYC virology laboratories to decide the week after week number of examples submitted for flu testing and the level of those positive; (4) composing tests of flu disconnects acquired from patients in NYC emergency clinics at the DOHMH Public Health Laboratory; (5) upgraded latent observation for pediatric flu passing; (6) checking patterns in flu and pneumonia-related mortality through the DOHMH Vital Registry; and (7) observing outpatient ILI through the Centers for Disease Control and Prevention (CDC; Atlanta, GA, USA) Influenza-like Illness Surveillance Network [6], a sentinel arrange through which suppliers revealed week after week on the extent of ILI in their works on during flu season.

The DOHMH had also arranged a nearby reaction to a potential flu pandemic, remembering upgraded observation to control general well-being authorities to decide how to organize the utilization of antiviral specialists and antibodies[7]. Reconnaissance information could likewise advise network control measures, for example, school terminations. Proposed observation methodologies in this arrangement concentrated on systems for checking patterns in hospitalizations and passing, yet not attempting to tally each severe case. Techniques were additionally proposed for acquiring more definite clinical and epidemiologic information for an example of cases.

The DOHMH also has an incident command system (ICS), which is different from the standard DOHMH structure in that it is an office wide structure for dealing with and responding to crises. The ICS is divided into 10 sectors and is led by an episode officer who reports directly to the Commissioner of Health[1]. DOHMH workers are allocated to an area inside the ICS and can be approached to help their endless supply of the framework. In a general well-being crisis, the Surveillance and Epidemiology Section builds up and directs observation to evaluate the sickness and passing related to the occasion and leads any required epidemiologic examinations to manage the general well-being reaction. ICS actuation gives flood limit by expanding the workforce accessible to lead observation or epidemiologic exercises past the staff individuals who are regularly liable for the particular infection or general medical problems associated with the crisis.

HealthMap – H1N1 Surveillance system.



H1N1 Swine Flu pandemic: 2009–2010. The 2009 swine flu pandemic was caused by a new H1N1 strain that started in Mexico in the spring of 2009 and quickly spread worldwide. The virus infected up to 1.4 billion people worldwide in a year, killing between 151,700 and 575,400 people. According to the CDC, the 2009 flu pandemic primarily affected children and young adults, with 80% of deaths occurring in people under 65. Considering that most flu virus strains, including those that cause seasonal flu, kill people aged 65 and up, this was important. In the case of the swine flu, however, older individuals seemed to have built up enough immunity to the virus family that H1N1 belongs to, so they were less affected. The annual flu vaccine also includes vaccination for the H1N1 virus that caused swine flu.

HealthMap is an example of a new initiative in public health surveillance that is open and global.

The HealthMap system integrates automated, around-the-clock data collection and processing with expert review, and analysis to aggregate reports by type of illness and geographic location. Through a freely accessible web site, HealthMap sifts through vast amounts of event information acquired from various online sources in multiple languages to provide a detailed view of ongoing global disease activity. HealthMap collaborated with the journal to develop the H1N1 interactive map (as part of the Journal's H1N1 Influenza Center) to improve situational awareness of public health practitioners, clinicians, and the general public regarding the worldwide spread of 2009 H1N1 influenza infection. The HealthMap infrastructure was used to provide information about outbreaks on this interactive map. It used Informal sources (e.g., the news media, mailing lists, and contributions from individual users) and formal announcements to compile the data.

(mainly from the World Health Organization [WHO], the CDC, and the Canadian Public Health Agency) Visitors to the site might sort reports by alleged or confirmed cases or deaths and view reports over time to see how the disease spread.

During the two most giant waves of the H1N1 pandemic, HealthMap gathered over 87,000 reports from both informal and official sources (43,738 reported during the first wave of infection, from April 1 to August 29, 2009, and 43,366 reported during the second wave, from September 1 to December 31, 2009) (between August 30 and December 31, 2009, during the second wave of infection).

All reports submitted into the HealthMap system had their geographic location documented, allowing for easy monitoring of H1N1 influenza's regional and global spread.

According to the WHO regions and pandemic stages, HealthMap also detected a growing number of countries with informal reports of suspected or confirmed cases overtime. There had already been reports of suspected or confirmed cases in 32 countries by the end of the WHO pandemic Phase 4 (April 28).

The spread of the virus to new countries was most rapid in Europe and the Americas during the pandemic's early stages. Because of the implementation of containment measures and the early involvement of countries with a high amount of air travel, this spreading steadily slowed to about one country per day by the end of Phase 5 (June 10). It further decreased to one country per 2 days in Phase 6, potentially due to the implementation of containment measures and countries' early involvement with a high volume of air travel. Although air travel may have aided the virus's intercontinental spread, other migration patterns are likely to have shaped the virus's spread within continents. Regions that are foreign travel hubs (e.g., France and the United Kingdom) in Europe, for example, identified infections earlier than areas with fewer commercial flights (e.g., Eastern European nations). Public health capability and ability to report cases influenced this trajectory as well.

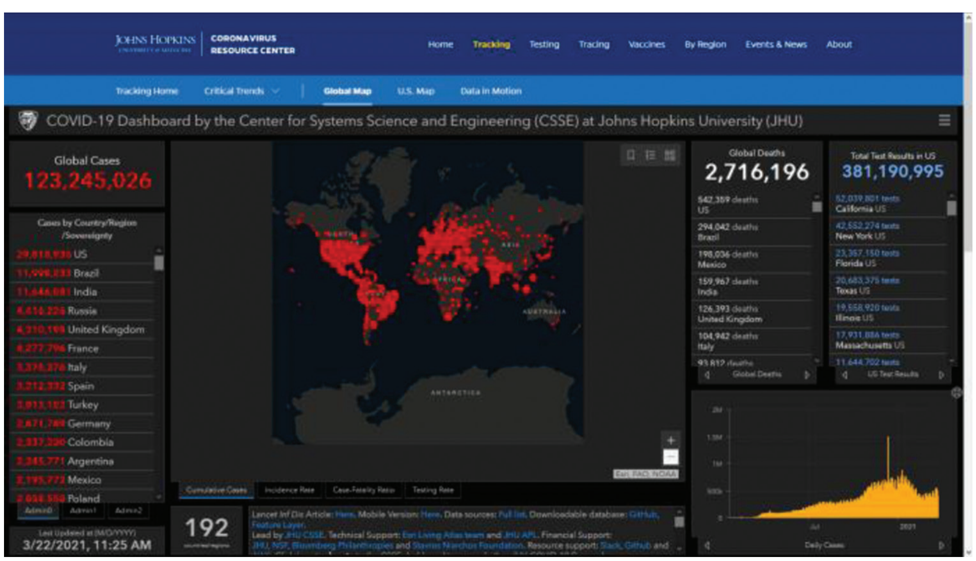
Johns Hopkins University CSSE Dashboard

When a disease can spread so quickly, data must move at a much faster pace; thus, map-based dashboards become extremely useful. Seven coronavirus dashboards are among the top 10 cited applications from Esri ArcGIS Online assistance at the time of this writing in mid-February 2020, with more than 160 million views. In light of the rising pandemic, this was first issued on January 22, 2020[4].

The Johns Hopkins University's Center for Systems Science and Engineering (JHU CSSE) dashboard stands out in late January 2020, gathering 140 million viewpoints. Lauren Gardner (a disease transmission specialist) and her team from the JHU CSSE came up with the idea. The dashboard was shared widely on the internet, along with numerous news stories and offers.

This enthusiastic reaction to the JHU CSSE and other dashboards reveals the public's interest in health risks. Anyone with internet access will learn a massive amount of information about the COVID-19 infection in a few short clicks from these resources. The intuitive guide on the JHU CSSE dashboard detects and counts confirmed contaminations, deaths, and recoveries. The diagrams show the progression of the infection overtime. The day and season of the most recent information update and the information sources are visible to viewers. The WHO, the US Centers for Disease Control and Prevention, the National Health Commission of the People's Republic of China, the European Center for Disease Prevention and Control, and the Chinese online clinical asset DXY.cn are among the dashboard's five valid information sources. The dashboard provides links to these and other sources. This work is subtly described in a blog entry. The related data are stored in GitHub as Google Sheets.

Web administrations enable GIS customers to use and display various information contributions without the need for centralized facilitating or handling, facilitating information sharing, and speeding data collection. The Hopkins group physically refreshed information twice a day from January 22 to January 31, 2020, as part of the dashboard focusing.



Esri ArcGIS Living Atlas team helped them adopt a semi-computerized living information stream approach to refresh the dashboard in February 2020. It is primarily reliant on the DXY.cn information asset, which updates case reports at the standard and national levels every 15 min.

Nonetheless, Lauren Gardner's blog points out that other information assets were faster to refresh than DXY.cn for countries outside of China, so those case checks are physically renewed for the day. The ArcGIS Living Atlas currently has no restrictions on element layers.

WHO Dashboard

The WHO coordinates and organizes global health, combating infectious diseases through surveillance, preparation, response, and incorporating GIS technology into its work. On January 26, 2020, the WHO released its ArcGIS Operations Dashboard for COVID-19, which also tracks and records coronavirus cases as well as the total number of cases in each country and Chinese territory, as well as educational boards about the guide and its data assets.

The WHO and JHU CSSE dashboards made them curious comparisons before February 18, 2020. As shown in Figures 1 and 2, each had an endlessly particular all-out case (both taken on February 16, 2020).

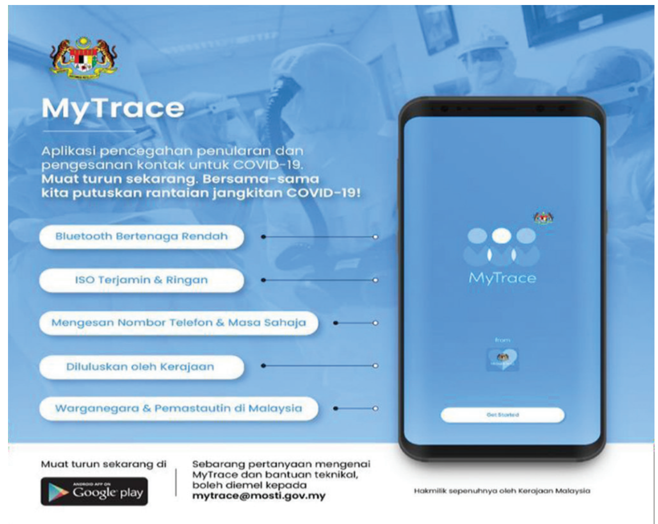
The WHO dashboard only included laboratory-confirmed cases, while the JHU CSSE included cases that were examined using a side effect exhibit and chest imaging (representing exactly 18,000 extra reports). In any case, beginning February 19, 2020, the two dashboards are in sync, displaying comparative all-out case tallies.

The WHO dashboard includes a pandemic forecast, which shows cases by date of disclosure. Placing the epi bend perception over the combined cases chart provides helpful information about episode movement. It may reduce anxiety, as the absolute number of new cases has consistently decreased every day since February 4, 2020. (Except for a spike on February 13, 2020, more than 15 K cases were added after China started to include "clinically analyzed" cases in its figures rather than just laboratory affirmed cases). A "hamburger" icon in the upper right corner of the WHO dashboard leads to additional COVID-19 data and an intuitive web map that places COVID-19 in context with other WHO identified health crises. Dengue fever, Rift Valley fever, and West Nile fever are just a few examples.

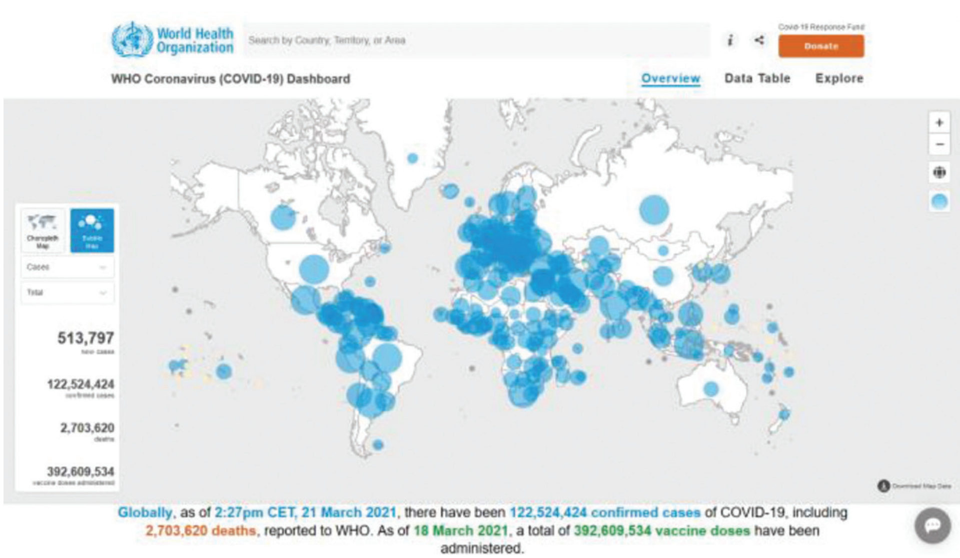
As a result, the WHO is updating its COVID-19 dashboard using ArcGIS GeoEvent Server to push updates to a single location.

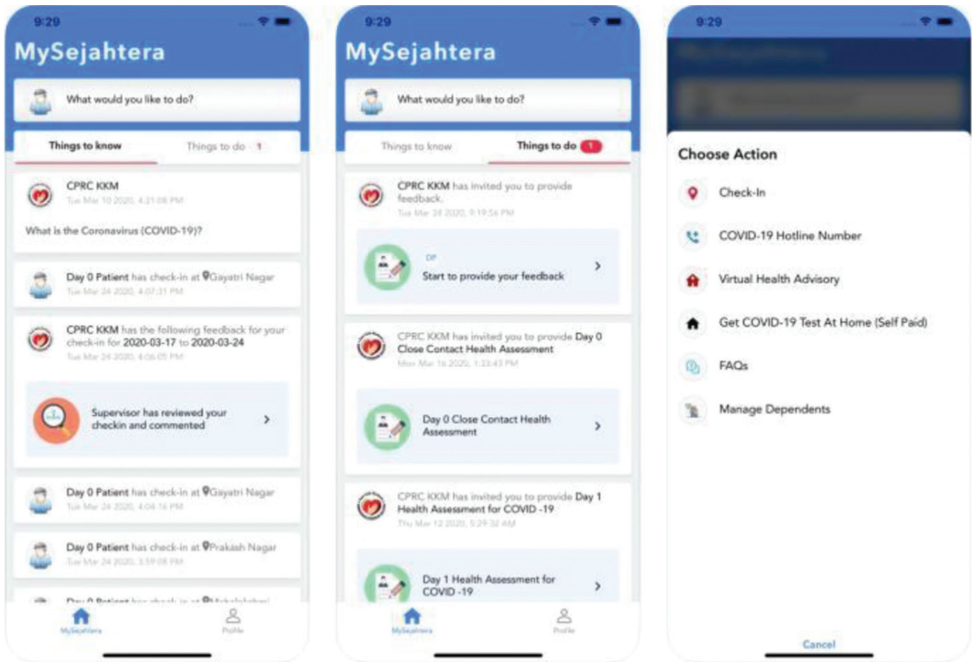
Every day, component management takes place on several occasions.

Review of Malaysian systems: My Trace



MyTrace is a mobile application that aids in the management of COVID-19 outbreaks by the health authority. When an app identifies another nearby device with MyTrace installed, it uses a community-driven approach to exchange proximity information. The app allows people who have been near an infected person to be identified.





Review of Malaysian Systems: MySejahtera

Sejahtera is a mobile application designed by the Malaysian government to aid in managing COVID-19 outbreaks in the country[3]. It helps people to self-assess their health and that of their family members. During the COVID-19 epidemic, people can also track their health progress. Sejahtera also allows the Malaysian Ministry of Health to keep track of users' health and respond quickly with the necessary treatments, yet it assumes that all patients are using smartphone with Wifi connection.

Comparison of coronavirus disease tracing system with Malaysian products

Feature/product	MyTrace	MySejahtera	Coronavirus disease tracing system
Login security	×	×	✓
Store patient/user details	×	✓	✓
Trace locations	✓	✓	✓
Health-care use	×	×	✓
Send data to the government	✓	✓	✓
Needs for internet to communicate	✓	✓	×
Collect information when no smartphone under use	×	×	✓

METHODOLOGY

To develop this project, we have used the Extreme Programming methodology. Extreme Programming is one of the agile methods. The main reason is allowing changes to the project according to the current situation or customer requirement even late in the life cycle. Feedback and communication are taken as essential aspects to improve better software development. We can communicate with users by giving them a chance to test using the software and gain feedback to change or add to the software (if any). These criteria help developers to change requirements and technology. Extreme programming methodology involves five phases and below has been explained the progress thoroughly in each stage:

Planning

The problems for CTS were identified and listed down. A research study was conducted to gather related information on COVID-19 tracings apps in Malaysia, a reliable application for health centers to store and trace their patients' details. I have searched for associated scenarios and cases that explain and support well the problem statements. Informal interview sessions were held to gather information from the health center employees. Finally, the objectives and scopes are drawn to get a picture of the system's functionality.

Designing

In this phase, generally, the website's design is created. First of all, I have used a prototyping tool to design the interface. Next, I develop a finalized user-friendly interface that can make it easy to learn and use. User experience is ensured for the employees to feel at ease when using the website. At this phase, the functionality is not added yet. In Figure 1, it illustrates entity relationship, and Figure 2 shows the relation table.

Coding

In this phase, the entire step involves coding to develop each objective is set into a practical and working application. Each

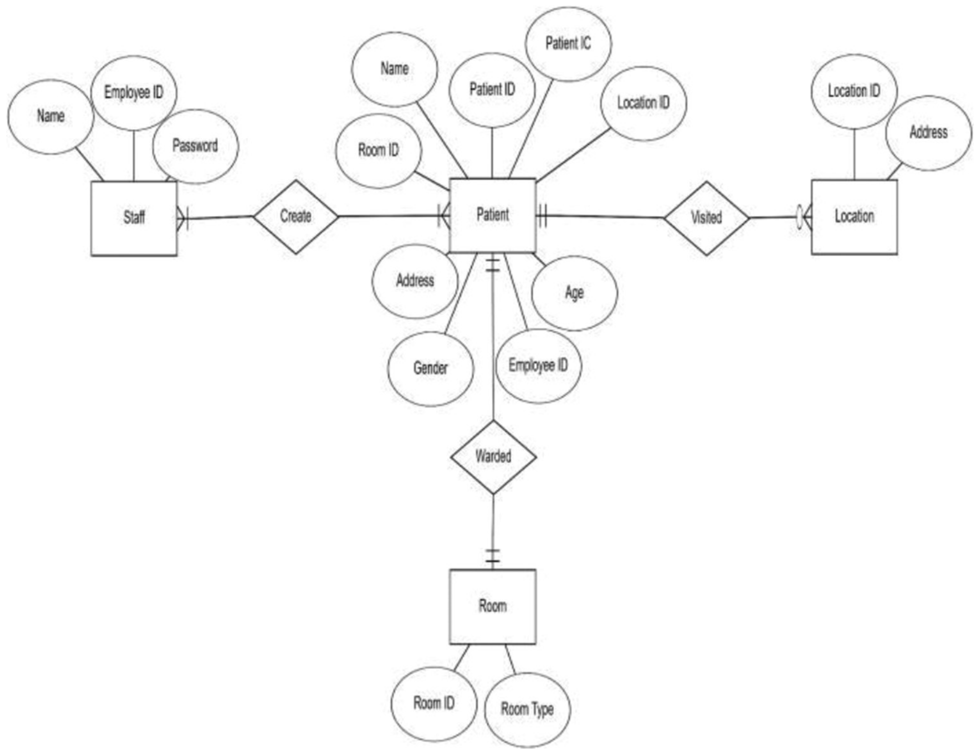


Figure 1: Entity relationship diagram

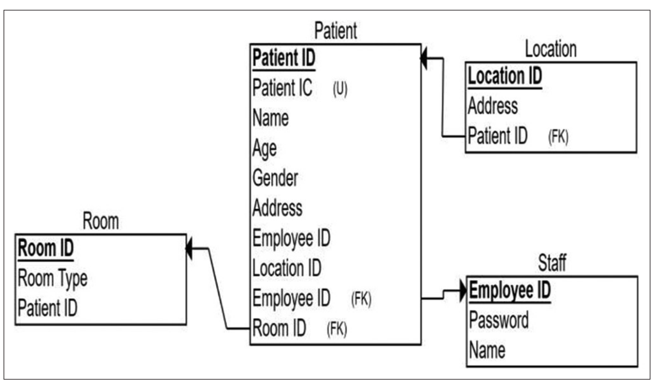


Figure 2: Rational table

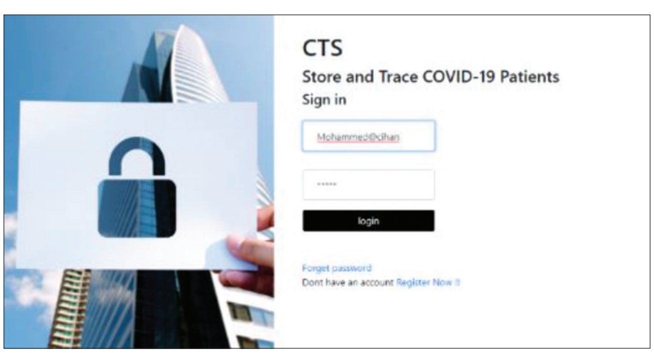


Figure 3: Login screen

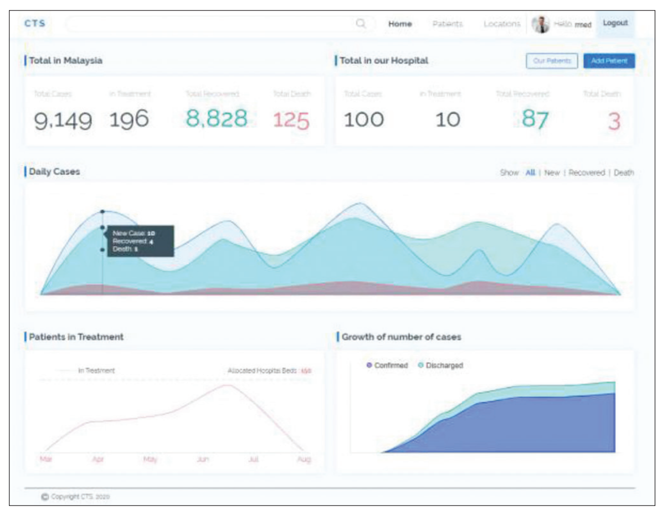


Figure 4: Dashboard

button will be added with functionality. Certain functionalities were integrated with a government-linked application such as MySejahtera to load the places the patient has visited. Adding the ability to generate a distinguished code with unique credentials to be printed out as QR code, define the mechanism to read SMS from patient identify their status, and written location, that will after done, the program is compiled and build.

Testing

Each class of code is tested to detect any bugs and errors. Those detected bugs and errors should be fixed to produce an error/bug-free application. Besides, system testing and user acceptance testing were done, and the data were documented.

Managing

Management is vital throughout the development process. It is crucial to managing time in developing the software within the given time. The works should be documented and presented clearly on the fixed dates. When carrying out research methods such as surveys or asking for feedback, good ethics and proper communication should respect the user. It is vital to keep the application up to date and obtain input from the supervisor or user who may assist in its development.

ER Diagram and SQL Codes

To make the ERD Diagram drawing precise and efficient, the team has used the ERDPLUS web tool. We started defining the personas. Employees from the health-care center can update patient information such as patient ID, IC, name, address, visited locations, gender, and age. Employees would have qualities such as their name, employee ID, and password.

Furthermore, when entering the patients' locations, a new entity called zone will be created, which includes attributes such as location ID and address. The most basic requirement is that employees must associate a patient with a room with qualities such as room ID and room type.

With the help of ERDPLUS, the relational table was generated, with minor tweaks to maintain the precision of data explained between the ERD diagram and relational table. We then developed the SQL from ERDPLUS, did minor tweaks, and ran through a PHPMyAdmin web-based tool. We used an apache server to run the code and get the output. Attached below are the ERD Diagram, Relational Table, and SQL Code samples used. Below are the ERD Diagram and Relational Table.

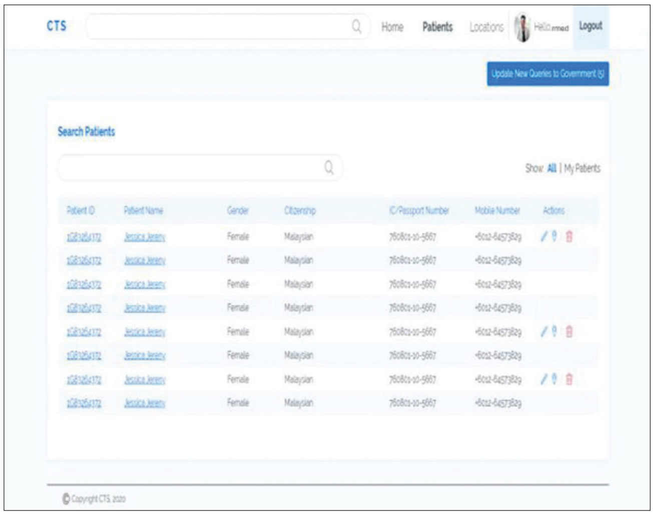


Figure 5: Patients list

RESULTS AND ANALYSIS

CTS is developed as a web-based system. The front end is built using an angular framework with bootstrap styling. Whereas the database is created using SQL. Before the development, a simple design brainstorming is done to ensure all the scenarios are catered to address the health-care need while storing the patients' details and send the updates to the government every often.

The employee can log in using their employee id [Figure 3]. An employee can also use their id name generated

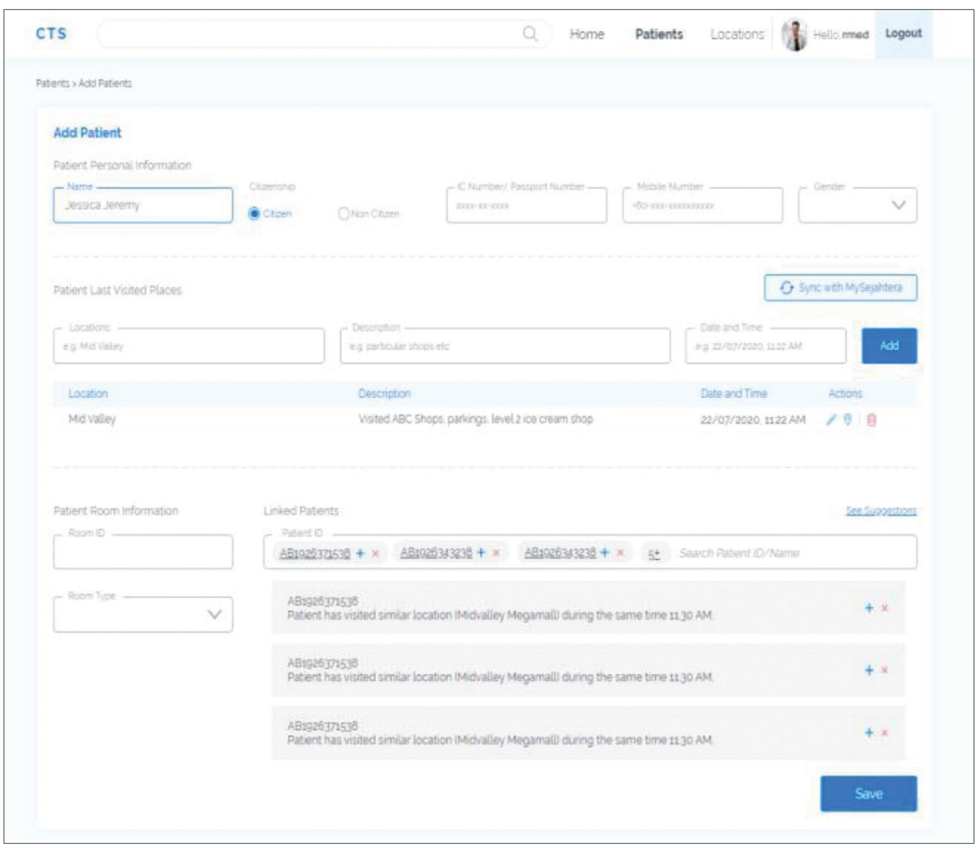


Figure 6: Patients details

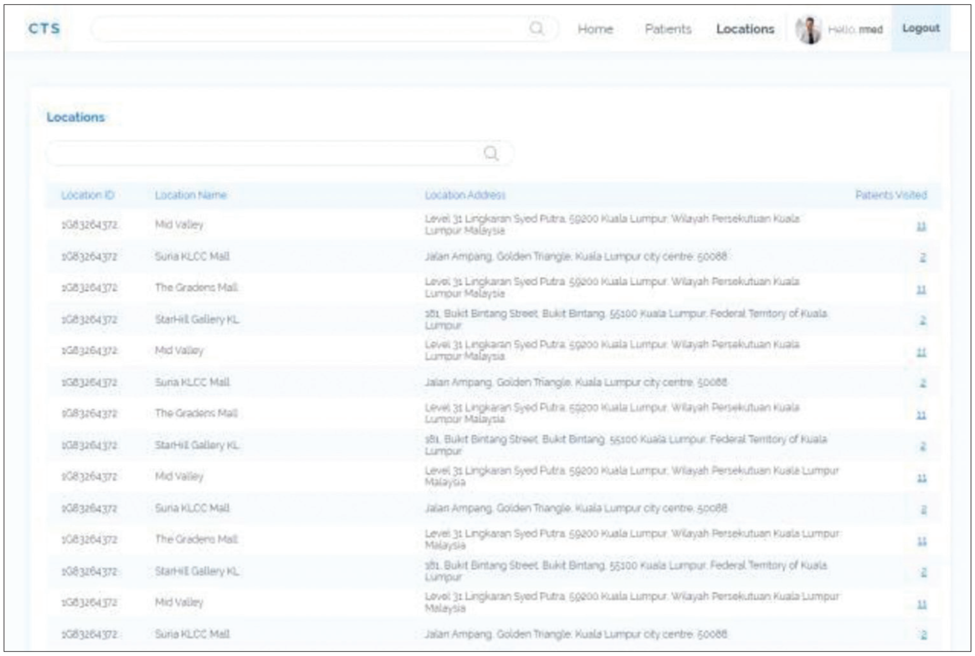


Figure 7: Location list

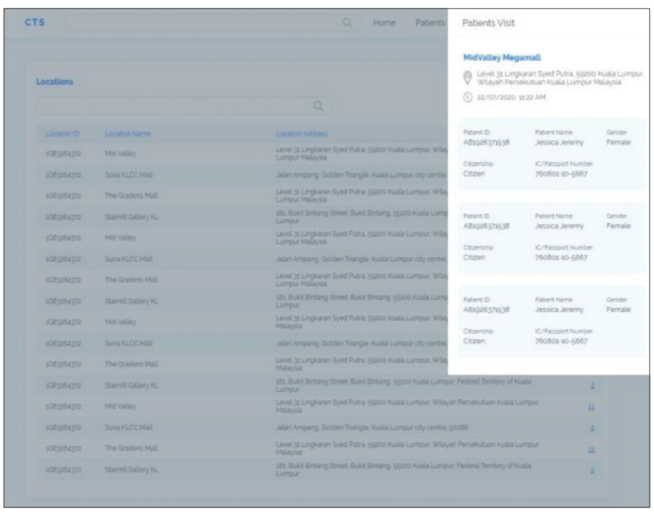


Figure 8: Locations details

uniquely for them by the administrator, which will detect the employee id in the backend.

The home shows the country's entire cases [Figure 4], the whole point within the health center (currently assumed it is a hospital), with daily case breakdowns, filter able to see new only, recovered only, and death only. Patients in treatment at the hospital and overall growth of several cases also shown.

(For illustration purpose, dummy data shown) [Figure 5]. This screen will reveal the high-level details of patients on clicking the patient ID and patient name. It will take you to the patient's information screen. The button update new government queries will submit the attachment of further patient information through email. For now, the email of government authority is embedded within the system.

Figure 6 shows that all the details will be stored; here, the past visited locations will also be synced through MySejahtera. The dashboard will be helpful for the government agencies in the contact tracing work.

(For illustration purpose. dummy data shown) Figure 7 shows the list of places visited by patients that are admitted or diagnosed within the health center.

On clicking the location id, it will show the patients who visited the location and their time as its shown in Figure. 8.

CONCLUSIONS

At the point when disease numbers begin to ascend in a state, general well-being authorities and inhabitants stress over whether there are sufficient medical clinic beds for genuinely sick patients. A zone's medical clinic limit is a gauge, took care of by the information that special emergency clinics report. General well-being authorities depend on the assessments to see whether emergency clinics are in danger of being overpowered.

Clinics should report day by day to the government what number of beds they have, the number involved, and the accessibility of escalated care beds. Under the new framework, the Department of Health and Human Services totals the data at a state level and offers a simple spreadsheet of the data accounted for – holes whatnot.

To aid the health center in keeping track of their COVID-19 patients, CTS featured to store the patients details, with added vital functionality such as communicate with patients through SMS when Wifi is down or non-smartphone being used, QR code scan in case of phone switched off, or out of charges, or even no Wifi connection, to link cases based on visited place and time and locations visited, it helps the government agency track and traces the contacted people based on comparing patients location and distance.

This website can be enhanced with built-in Bluetooth functionality where multiple phones can be keyed in the future (auto-communication). The system security can also be enhanced using Blockchain technology[7].

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