**APPLICATION DESIGN FOLLOWING SOFTWARE DEVELOPMENT CYCLE**

1. **CONCEPTUALIZATION**

This web based application was designed to detect, display, rate (degree of infection), store, transmit data obtained wirelessly, access the data via the web and also create a platform for the enlightenment of the public.

 The purpose of this design is to assist in the combat of the covid-19 which has caused a serious pandemic across the world with serious impacts being felt in all areas of humanities.

 **2. SPECIFICATION**

This web based application it to function in accordance to the following broken down modules;

1. **Detection of the covid-19:** the first process to be carried out by the web development application is to detect the covid-19. The equipment used to carry this out is the igM/igG rapid detector (if the virus is to be detected in humans or the paper based device (if the virus is to be detected in the sewage or waste water of the patient’s abode).

The igM/igG rapid detector test compliments existing nucleic acid / antigen detection (nasopharyngeal swab, sputum or alveolar lavage fluid specimen).

Paper-based devices could be used on-site at wastewater treatment plants to trace sources and determine whether there are potential COVID-19 carriers in local areas.

 However, there’s a software alternative for detecting the covid-19. The use of unmaze (covid-19 tracking software) comes up. The technology is unique in that it works as an app, storing your GPS and vicinity data in the phone, while alerting and picking unique ID of other users of the app.

1. **Display of test results:** After detection of the virus, the results have to be displayed. Results can be displayed either using on an lcd (digital display) or on a software interface(github). Results could also be displayed on both.

A digital display can be used to display the results obtained after the testing of covid-19. The result will be displayed in the lcd (liquid crystal display) after being sent from the detectors in use.

It was discovered that data scientists were struggling to share information with each other, so the github project is used to aid in the sharing of data and information. This project aims to offer an accessible way for data professionals to share dashboards (that are updated with new data automatically) without requiring any expertise in front end development.

1. **Rate or degree of infection**: after the results have been displayed on the github dashboard and lcd, the degree of infection in the individual or community is measured in ranges (the range in which the covid-19 subtends).

Since most serious covid-19 cases are characterized by advanced symptoms like respiratory failure, coronary disease etc. we could use a chest radiograph, apnea monitor or a large scale temporal dynamics software to determine the extent of the covid-19 virus.

A chest radiograph, called a chest X-ray (CXR), or chest film, is a projection radiograph of the chest used to diagnose conditions affecting the chest, its contents, and nearby structures. The chest radiograph could be used to detect the pulmonary infiltrates and decrease in lymphocytes and white blood cells in a severe covid-19 case.

Apnea monitors detect the cessation of breathing (apnea) in infants and adults who are at risk of respiratory failure and alert the parent or attendant to the condition. The severe covid-19 cases are characterized by progressive respiratory failure due to alveolar damage from the virus, which may lead to death.

 The large scale temporal dynamics software is simply a software which gathers information about the rate or degree of covid-19 infection over a large period of time within a large perimeter. Thus, the software can predict the rate of a particular covid-19 infection within such statistics.

1. **Data storage:** After collation of all the necessary data, it has to be stored until when next it’s to be retrieved for processing. It is most suitable to store the data in an electromagnetic energy modulating tape. It is a form of electric data storage as it requires electric power to store and retrieve data. The data could be stored either in analog or digital format. The data is electronically encoded.
2. **Data transmission:** In order to wirelessly transmit the data, Wi-Fi is employed. This is achieved using two main hardware devices; computer wireless adapter and wireless router.

A computer wireless adapter is used to translate data into a radio signal which it then transmits using an antenna.

A wireless router is used to receive signals and decode it. The router sends the information to the internet using a physical, wired Ethernet connection.

 The process also works in reverse, with the router receiving information from the internet, translating it into a radio signal and sending it to the computer’s wireless adapter.

1. **Data accessibility:** The data collected could be easily accessed by connecting to the internet and entering the recognized uniform resource location (URL). Thus, the data is easily accessible to the public**.** Since this web based application processes information, storing and receiving information could be accessed either through a separate portable(removable) recording medium or a permanent component.
2. **Q & a interface:** This is simply an additional interface created for the sole purpose of entertaining pertinent questions of the public concerning covid-19. This aims at educating the masses to prevent further spread of the virus.

**3. DESIGN**

There are 2 ways of accomplishing software design which are algorithm and flowchart.

**ALGORITHM**

Assume patient=x; patient’s abode=y

**STEP 1:** start

**STEP 2:** enter the code letters

**STEP 3:** check for the presence of covid-19 in ‘x’ using igM/igG antibody rapid detector.

**STEP 4:** If x==positive

Print “x positive” on digital display

Display “x positive” on github dashboard

Check for the presence of covid-19 in ‘y’ using the paper based device.

**STEP 5:** If y==positive

Print “y positive” on digital display

Display “y positive” on github dashboard

**STEP 6:** Else if y==negative

Print “y negative” on digital display

Display “y negative” on github dashboard

**STEP 7:** Else

Print ‘negative’ on digital display.

Display ‘negative’ on github dashboard.

**STEP 8:** Determine rate or degree of covid-19 infection in ‘x’ using apnea monitors and chest radiographs.

**STEP 9:** Print the rate in ranges on digital display

**STEP 10:** Determine the rate or degree of covid-19 infection in ‘y’ using the large scale temporal dynamics software.

**STEP 11:** Print the rate in ranges on the github dashboard

**STEP 12:** Store data in electromagnetic energy modulating tape.

**STEP 13:** Transmit stored data wirelessly from the storage (electromagnetic energy modulating tape) to the internet using computer wireless adapter and wireless router.

**STEP 14:** Make data accessible via the internet.

**STEP 15:** Stop

**FLOWCHART**

Enter the code letters

Check for the presence of covid-19 in ‘x’ using igM/igG antibody rapid detector

 **FALSE**

If x==positive

Print ‘negative’ on digital display

 **TRUE**

Print “x positive” on digital display

Display ‘negative’ on github dashboard

Display “x positive” on github dashboard

Check for presence of covid-19 in ‘y’ using paper based device

Print “y negative” on digital display

If y==positive

 **FALSE**

 **TRUE**

Print “y positive” on digital display

Display “y negative” on github dashboard

Display “y positive” on github dashboard

Determine rate or degree of covid-19 infection in ‘x’ using apnea monitors and chest radiographs

Print the rate in ranges on digital display

Determine the rate or degree of covid-19 infection in ‘y’ using the large scale temporal dynamics software

Print the rate in ranges on the github dashboard

Store data in electromagnetic energy modulating tape

Transmit the stored data wirelessly from storage to the internet using computer wireless adapter and wireless router

Confirm data is accessible via the internet

**4. IMPLEMENTATION**

The programming language to be used in this web based application is a high level language, preferably c++ as it’s the most suitable high level language to use with respect to the algorithm.

**5.TESTING AND DEBUGGING**

The algorithm put forth has not been tested to run properly neither has there been logical nor semantic error noticed. Thus, it hasn’t undergone testing and debugging.

**6.RELEASE AND UPDATE**

The web based application has not yet been released for use due to the absence of real time data and testing and thus, obviously hasn’t undergone updating.

**HARDWARE AND SOFTWARE FEATURES**

**DETECTION OF COVID-19**

**HARDWARE**

**1.igM/IgG antibody rapid detector:** In the continued effort to deliver high quality on-site testing technologies, it’s advisable to procure on of the **first COVID-19 IgM/IgG Antibody Rapid Tests which will be licensed by Health Canada (Class III). The rapid test is approved by the FDA in the US** **and by CE in Europe.** This on-site rapid test detects antibodies produced when infected by the COVID-19 virus (Corona Virus Disease), caused by 2019-nCoV (SARS-CoV-2).

The COVID-19 Rapid Test compliments existing nucleic acid / antigen detection (nasopharyngeal swab, sputum or alveolar lavage fluid specimen). These nucleic acid / antigen swab tests, which detects the virus, will be made available. The COVID-19 Rapid Test detects at the onset of symptoms, once a patient begins producing antibodies to fight the virus. For workplace and non-public applications, this qualitative screen can immensely assist in the assessment of individuals potentially showing flu, cold, or COVID-19 symptoms.

**2.Paper based device:** A new paper-based device can be used to detect corona virus within the wastewater of communities infected with the virus.

According to the study, published in the journal Environmental Science & Technology, rapid testing kits using paper-based devices could be used on-site at wastewater treatment plants to trace sources and determine whether there are potential COVID-19 carriers in local areas.

The wastewater-based epidemiology (WBE) approach could provide an effective and rapid way to predict the potential spread of COVID-19 by picking up on biomarkers in feces and urine from disease carriers that enter the sewer system.

“In the case of asymptomatic infections in the community or when people are not sure whether they are infected or not, real-time community sewage detection through paper analytical devices could determine whether there are COVID-19 carriers in an area to enable rapid screening, quarantine and prevention,” explained researcher Dr Zhugen Yang, Professor at Cranfield University in the UK.

**SOFTWARE**

 **Covid-19 tracking software(unmaze) developed by cyborg systems:** A multinational supplier of technology used in national security, Cyborg Systems, has used its inherent expertise in tracking to develop 'Unmaze', a powerful solution to track those infected, and those who came in touch with them. The technology is unique in that it works as an app, storing your GPS and vicinity data in the phone, while alerting and picking unique ID of other users of the app. The information remains in your app for 14 days, and is erased on a first in first out basis. Only if you came in contact with someone who tests positive are health agencies alerted and you are told to self-quarantine. It also alerts users when in the vicinity of an affected person, so that evasive action can be taken.

The solution is comprehensive as it detects the vicinity of those infected, observes those in quarantine and can be integrated with other ankle and wristband solutions for those who are under forced quarantine. It is near tamper-proof to tackle runaway cases, which are the riskiest segment of the population.

**DISPLAY OF TEST RESULTS**

**HARDWARE**

**Digital display:** A digital display can be used to display the results obtained after the testing of covid-19. The result will be displayed in the lcd (liquid crystal display) after being sent from the detectors in use.

**SOFTWARE**

**Github:** In order to publish updates and current statistics or if it interests, mythbusters on the covid-19, a github covid-19 dashboard could be created to offer such information.

This project is supported by a virtual team of open source collaborators that gather data, make visualizations and perform analysis regarding the COVID-19 epidemic. It was discovered that data scientists were struggling to share information with each other, so this project is used to aid in the sharing of data and information. This project aims to offer an accessible way for data professionals to share dashboards (that are updated with new data automatically) without requiring any expertise in front end development.

**RATE OR DEGREE OF INFECTION**

**HARDWARE**

**Chest radiograph:** A chest radiograph, called a chest X-ray (CXR), or chest film, is a projection radiograph of the chest used to diagnose conditions affecting the chest, its contents, and nearby structures. The covid-19 case definition guidelines mention the decrease in lymphocytes and white blood cells, new pulmonary infiltrates on chest radiography and no improvement in symptoms after 3 days of antibiotics treatment as covid-19 infection in the severe stage.

The chest radiograph could be used to detect the pulmonary infiltrates and decrease in lymphocytes and white blood cells in a severe covid-19 case. If it’s a mild covid-19 case, there will not be any existent changes in the number of lymphocytes and white blood cells as well as the pulmonary infiltrates on the chest radiography.

**Apnea monitors:** Apnea monitors detect the cessation of breathing (apnea) in infants and adults who are at risk of respiratory failure and alert the parent or attendant to the condition. The severe covid-19 cases are characterized by progressive respiratory failure due to alveolar damage from the virus, which may lead to death. Thus, the Apnea monitors help detect the severity of the covid-19 infection.

**SOFTWARE**

**Large scale temporal dynamics software:** this was used to analyze the temporal dynamics of the coronavirus disease 2019 outbreak in China, Italy and France in the time window 22/01 − 11/03/2020. A first analysis of simple day-lag map points to some universality in the epidemic spreading, suggesting that simple mean-field models can be meaningfully used to gather a quantitative picture of the epidemic spreading, and notably the height and time of the peak of confirmed infected individuals.

 The analysis of the same data within a simple susceptible-infected-recovered-deaths model indicates that the kinetic parameter that describes the rate of recovery seems to be the same, irrespective of the country, while the infection and death rates appear to be more variable. The model places the peak in Italy around March 21st 2020, with a maximum number of infected individuals of about 15,000 and a number of deaths at the end of the epidemics of about 9,300, consistent with figures typical of seasonal flu epidemics. Since the confirmed cases are believed to be between 10 and 20 % of the real number of individuals who eventually get infected, the apparent mortality rate of COVID-19 falls between 3 % and 7 % in Italy, while it appears substantially lower, between 1 % and 3 % in China.

Based the calculations of the temporal dynamic software, it estimates that 2000 ventilation units should represent a fair figure for the peak requirement to be considered by health authorities in Italy for their strategic planning.

Finally, a simulation of the effects of drastic containment measures on the outbreak in Italy indicates that a reduction of the infection rate indeed causes a quench of the epidemic peak. However, it is also seen that the infection rate needs to be cut down drastically and quickly to observe an appreciable decrease of the epidemic peak and mortality rate. This appears only possible through a concerted and disciplined albeit painful, effort of the population as a whole.

**DATA STORAGE**

**HARDWARE**

**Electromagnetic energy modulating tape**: This is a non-volatile (permanent) storage medium because the data remains stored when power is removed from the device supporting the web based application. It is a form of electric data storage as it requires electric power to store and retrieve data. The data could be stored either in analog or digital format. The data is electronically encoded.

**DATA TRANSMISSION**

In order to transmit the data obtained wirelessly, we can adopt the use of Wi-Fi.

**HARDWARE**

**Computer wireless adapter**: A computer wireless adapter is used to translate data into a radio signal which it then transmits using an antenna. During a reversed process, it also receives information which has already been translated in radio signals from the wireless router.

**Wireless router**: A wireless router is used to receive signals and decode it. The router sends the information to the internet using a physical, wired Ethernet connection.

 The process also works in reverse, with the router receiving information from the internet, translating it into a radio signal and sending it to the computer’s wireless adapter.

**DATA ACCESSIBILLITY**

Since this web based application processes information, storing and receiving information could be accessed either through a separate portable(removable) recording medium or a permanent component. However, due to the alternative adopted (use of Wi-Fi) all that work load is eliminated.

 The data collected could be easily accessed by connecting to the internet and entering the recognized uniform resource location (URL). Thus, the data is easily accessible to the public**.**

**It is to be noted that any data to be publicized would be done after getting permission from the patient to do so.**

**Q &A INTERFACE**

This is simply an additional interface created for the sole purpose of entertaining pertinent questions of the public concerning covid-19. This aims at educating the masses to prevent further spread of the virus.

 This could be achieved by setting up a proxy server. From the figure below, communication between the client and internet is achieved by connecting a proxy server. The client doesn’t know to whom the information is going to, which is the reason proxies can be used to protect privacy.

 Thus, the public can put out their questions in the platform and they will be duly answered.



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**TOP DOWN APPROACH OF WEB BASED APPLICATION**

Web based application

detection

display

Rate of infection

Q & A interface

Data accessibility

Data storage

Data transmission

software

hardware

hardware

hardware

software

hardware

Covid-19 tracking software

Digital display

Github dashboard

Electromagnetic energy modulating tape

Computer wireless adapter

Wireless router

IgM/igG rapid antibody detector

Paper based device

hardware

software

Large scale temporal dynamics software

Chest radiograph

Apnea monitors

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