COMP4801 Final Year Project

Blockchain-based Decentralized Platform for COVID-19 Test

Project Plan

**Student**
Foo Zhi Qian (3035446100)
Yeo Zhi Wen (3035444516)

**Supervisor**
Dr. Yiu S.M.
# Table of Contents

1. Introduction  
   1.1 Background  
   1.2 Motivations  
2. Objectives  
3. Methodology  
   3.1 Blockchain-based Decentralized Deliverable  
   3.2 Platform and Framework  
4. Schedule  
References
1. Introduction

1.1 Background

Currently, the world is experiencing a pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first identified case was in December 2019 in Wuhan, Hubei, China, and since then it has spread rapidly throughout the world. At the time of writing, there are more than 35 million confirmed cases and more than 1 million deaths over 188 countries [1]. It spreads very easily and is able to linger in the air, primarily via small droplets and sometimes in aerosols, as an infected person breathes, coughs, sneezes or talks. As a result, it is very contagious in the environment where people are in close proximity. Common symptoms of COVID-19 include fever, cough, fatigue, breathing difficulties, and loss of smell. The incubation period is typically around five days but may range from 1 to 14 days [2]. There are currently no effective vaccines or cures available for the disease.

The COVID-19 pandemic has caused global social and economic disruption, including the largest global recession since the Great Depression [3]. This disease is raging across the world rapidly while the scientists are still working on finding an effective vaccine and cure. At the moment, there is only one way to stop the diseases in track, which is to identify the carriers of the virus, who may or may not exhibit symptoms similar to flu. Therefore, mass testing for COVID-19 that aims to find people with active infection who are asymptomatic or presymptomatic to quarantine, followed by rapid finding and testing of close contacts, are crucial to interrupt the spread of the disease.

How should we deal with the mass testing results of the public without compromising their privacy concern? Some people may be unhappy with their test results being collected and managed by a centralised agency, especially in COVID-19 testing where the information of whether a person has been tested positive is sensitive
and personal. Therefore, blockchain technology, which provides a decentralized storage, security, interoperability and immutability can be leveraged in this scenario. Our final year project will be focusing on building a blockchain-based decentralised platform for COVID-19 test to address the aforementioned issues.

1.2 Motivations

Traditional database storage of the public's COVID-19 testing results has some shortcomings. Firstly, it heavily relies on a single central server, which is vulnerable to malfunctions. When the central server goes down due to hardware failure, the entire database will be lost. Backing up thousands of millions of public’s COVID-19 testing results is not favorable in terms of cost efficiency, as it will incur a lot of money to buy extra servers just to store duplicated results. Therefore, the resiliency of the database storage depends on the robustness of the cloud infrastructure, which is not desired.

Secondly, a centralized server storing the results of different people in each hospital is inefficient. The fragmentation of public health data across different hospitals implies that the government will have slow access to the data that are scattered around, and thus lack of system interoperability [4].

Thirdly, the traditional database model is susceptible to data tampering by authorized personnel. Despite the implementation of access rights control in databases, the sensitive testing results are still vulnerable to tampering by authorized persons that might want to overwrite the results for their personal interest. This is particularly dangerous as people who carry the COVID-19 virus might be falsely discharged due to the tampered, misleading result data, spreading the infectious disease to the public.

Fourthly, privacy concerns of the testing results are highly questionable when stored in a traditional database. Most of the time,
people that are tested positive would not want anybody else to know, except for the government authorities to execute quarantine procedures and treatments. However, data breaching is not uncommon in traditional databases because there is no smart contract to execute instructions automatically. Result data has to pass through a lot of parties before it is transmitted to its final destination.

2. Objectives

Our Final Year Project strives to provide a blockchain-based decentralized platform for COVID-19 testing to solve the shortcomings of traditional data collecting methods. In a decentralized network of blockchains, each block is connected to all the blocks before and after it. This makes it tamper-resistant because in order to change a data on a block, a hacker would need to change the block containing that record as well as those linked to it to avoid detection. As blockchains are continually updated and kept in sync across all the nodes in the network, it would require massive amounts of computing power to access every instance (or at least a 51 percent majority) of a certain blockchain and alter them all at the same time, making the cost far outweighs the benefit and rendering it highly impossible to happen [5]. Data are stored in blockchains which are publicly distributed to every node in the network, hence if a node goes down, we can always recover the blockchain from another node. Therefore, blockchain-based decentralized platforms will be able to provide data security, immutability, and tolerate single-point-failure, which resolve the problems of traditional database in storing COVID-19 testing results.
3. Methodology

3.1 Blockchain-based Decentralized Deliverable

By the end of this Final Year Project, we will deliver a blockchain-based decentralised web application that allows users to register for COVID-19 testing. Each registered user will be assigned a public key and a private key. Users will be anonymous to each other and encryption will be applied to records in the blockchain to ensure that a user can only view his or her own test result. If a user is tested positive, a smart contract will be executed automatically to deliver the records of the user to the health department for quarantine and treatment purposes. No centralized agency or third party is involved in the process so users’ privacy can be protected.

3.2 Platform and Framework

Ethereum and Hyperledger are the two most prominent and developed platforms for building blockchain-based applications. In this project, we will be using Ethereum platform for the back-end development because it is generic in purpose and supports both public and private platforms hence ideal for B2C transactions. This is well suited for our project because our target audience would be the public which means anyone can sign up for an account for COVID-19 testing. In contrast, Hyperledger is only ideal for B2B transactions since the participation of nodes is permissioned as it only approves a set of predefined members to get access to its blockchain [6]. Moreover, Ethereum is a type of programmable blockchain that supports smart contracts, a form of executable code written in Solidarity programming language. Smart contracts allow defined instructions and transactions to be carried out between different parties without the existence of a third party central authority [7]. There are also various existing libraries with API that facilitate the development of our decentralized application. Currently, we plan to
use web3.js and react.js to allow us to connect and interact with Ethereum for our front-end development.

One downside of using Ethereum compared to Hyperledger is that it does not provide transaction privacy as all transactions are posted to the public ledger and are visible to all participants. This is completely opposite to Hyperledger where privacy is available when transacting across different channels. With Hyperledger, we can allow something to be possible to one person and not visible to the rest. Nevertheless, confidentiality of transactions is not a huge concern when it comes to our project because all of the transactions posted on the blockchain are to be treated equally and with the help of encryption mechanism, only a user with a key can access his or her information on the blockchain.
4. Schedule

Below is the tentative schedule that we have for the duration of our final year project.

<table>
<thead>
<tr>
<th>Time period</th>
<th>Works planned / Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2020</td>
<td>Background researches on our final year project topic</td>
</tr>
<tr>
<td>October 2020 - November 2020</td>
<td>Deliverable of Phase 1:</td>
</tr>
<tr>
<td></td>
<td>- Project Plan</td>
</tr>
<tr>
<td></td>
<td>- Project Website</td>
</tr>
<tr>
<td></td>
<td>Enhancing our knowledge in blockchain by</td>
</tr>
<tr>
<td></td>
<td>- Learning on how to build a blockchain in Ethereum platform</td>
</tr>
<tr>
<td></td>
<td>- Learning on how to write smart contract in Ethereum platform</td>
</tr>
<tr>
<td>December 2020 - January 2021</td>
<td>• Finalizing the system design of our application</td>
</tr>
<tr>
<td></td>
<td>• Starting the development of our application</td>
</tr>
<tr>
<td></td>
<td>Deliverable of Phase 2:</td>
</tr>
<tr>
<td></td>
<td>• First presentation</td>
</tr>
<tr>
<td></td>
<td>• Interim Report</td>
</tr>
<tr>
<td>February 2021 - March 2021</td>
<td>• Completion of our application</td>
</tr>
<tr>
<td></td>
<td>• Extensive testing and debugging</td>
</tr>
<tr>
<td></td>
<td>• Review and refinement</td>
</tr>
<tr>
<td>April 2021</td>
<td>Deliverable of Phase 3:</td>
</tr>
<tr>
<td></td>
<td>• Final report</td>
</tr>
<tr>
<td></td>
<td>• Final presentation</td>
</tr>
</tbody>
</table>
References


