Universität Zürich[UZH]

Institute for Banking and Finance

Seminar Paper, Blockchain, Spring 2021

Blockchain Solution Fighting Covid-19

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Handover:	Zürich, 01.06.2021

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BAG	Bundesamt für Gesundheit – Federal Office for Public Health
BIT	Bundesamt für Informatik und Telekommunikation – Federal Office of Information Technology, Systems and Telecommunication
BLE	Bluetooth Low Energy
DLT	Distributed Ledger Technology
DP-3T	Decentralized Privacy-Preserving Proximity Tracing
EEA	European Economic Area
EPR	Electronic Patient Record
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GPS	Global Positioning System
ICU	Intensive Care Units
ID	Identity document
NFT	Non-Fungible Token
NPO	Nonprofit Organization
QR	Quick Response Code
UZH	University of Zurich
SECO	State Secretariat for Economic Affairs
VPN	Virtual Private Network

1. Introduction

Since almost everyone carries and uses a smartphone nowadays. Our project idea is straightforward. It is based on the red-yellow-green system like the traffic light. When your phone is green, meaning you are free to do whatever you want outside. Once your phone is red, you are diagnosed with Covid (backed by Covid Test-Center information). And whenever you pass by a region, everyone else's phone within a given distance turns yellow, meaning you ought to go into quarantine or isolation. It is important that the system cannot trace back to you as an individual, which is an issue that concerns the people the most and why people probably don't use the Covid App in Switzerland, for instance for the same reason (not to provide private information and potentially risk their freedom). The blockchain-based app operates in a trustful decentralized network that gives the user an environment of anonymity. Everyone only cares about their screen colour that hints at the possibility or potential of having Covid. The privacy issue only comes in place when another person is interested in the other person's screen colour.

The idea of using blockchain technology for tracing the coronavirus arises from the practicality to combine social relevance and the matters of privacy. We ought to bring in some movements and prevent people from gathering and exposing us to the risk of getting infected when an individual is not aware of and cannot control.

The theory part consists of the basic concepts and terms of the research. The analysis chapter sets the focus on already existing approaches. The chapters Design and Evalution will provide a more detailed view on the innovative blockchain application.

2. Theory

2.1 Theoretical concepts and terms

2.1.1 Covid-19

COVID-19 is caused due to the infection with SARS-CoV-2. The actual symptoms of disease vary heavily across the cases. Most reported are respiratory ailments, fever as well as the loss of the olfactory sense. Moreover, the intensity of the symptoms is also variable. Especially for older people or people with health issues the disease could lead to life-endangering stages.[1]

In December 2019 there was the initial report of an infected person with a new virus. Researchers since then traced the origins of this new virus that causes the disease COVID-19. There have been conclusions that the origin of SARS-CoV-2 has developed from animals. Prominently a market in Wuhan was the centre of global discussion, where the outbreak might have started. It is unclear that the market represents the origin of the pandemic, but researchers have agreed that it played a significant role in spreading. [2]

SARS-CoV-2 is highly contagious, masks can ensure us an appropriate protection during human interactions. This is a common and easy practice in many countries around the world. To prevent an infection best, both individuals wear a mask, if there is a face-to-face interaction. There is still a chance the virus finds its way through the mask. Therefore, it is important that not only COVID-19 diseased people, but also healthy people are equipped with such masks.[3]

2.1.2 Blockchain

Decentralized networks are organized in a decentralized, peripheral structure. On the other hand, in a centralized network there is a centre in the network where the control of the system takes place and is located. In that case one could think of a single server providing the information. The whole lead of a network arises from this one node. This central node coordinates the allocation of resources and decides who joins the network. In decentralized networks the data of the system is distributed across multiple nodes. These agents act autonomously. The coordination of allocation is therefore distributed across multiple nodes. If you simplify these two categories, it comes down to whether the system is controlled by one central agent or by

[1] Cf. Federal Office of Public Health FOPH (2021).
[2] Cf. World Health Organisation (2020).
[3] Cf. Alaska Departement of Health and Social Services (2020).

multiple independent agents. Both systems have multiple advantages and disadvantages. The decentralized network tends to be a robust and trustful system relative to the more susceptible centralized alternative. This is due to multiple independent agents that control the information flow. Of course, this decentralization creates an intertwined and dense structure that is not easy to keep an overview of.[4]

Blockchain is an application that is a decentralized network. Accounts or ledgers are one of the main elements of the blockchain. These ledgers include the information to keep an overview of transactions and resources. The idea of the distributed network is that information is shared across the network and multiple nodes have access to a single account. The name blockchain reflects the general bookkeeping of the system. That is the trade of properties among the agents which are recorded. This exchange of information is recorded in a block. The block is then positioned into cluster of other blocks. Therefore, the whole represents a chain of information boxes. Since the agents that are not directly active in a single transaction nonetheless have access to this information, the robustness of the system is ensured due to the constant audit of transactions by the participants of the network. Therefore, the organisation of blockchain prevents unjustified changes in properties or cyberattacks.[5]

2.1.3 Privacy Issues

The blockchain itself is built on trust employing the constant audit of the state of property. People are generally careful about sharing their personal data. The true meaning of having the blockchain technology is having the system to be trustworthy to all users. If it loses trust than the network loses its right to exist due to the drop of consensus and credibility of blocks. In that case property loses its worth. To prevent a situation like that it is important to set rules and trustful element. The governance must take in consideration the guidance set out by the participants of the network. But it is not enough. Additionally, successful utilization of blockchain also must integrate external law set by third parties not participating in the network. Only with such a set up structure sets the conditions for an acceptable platform. In our case the rights of data privacy of the Swiss Government must be integrated in the blockchain.[6]

As soon as ledgers report personal and therefore highly sensitive information for multiple use cases, a blockchain structure must provide an even greater data security. However, there is not

[4] Cf. vXchnge (2020), Blog by Alan Seal.
[5] Cf. Government Office for Science (2015), p. 9-21.
[6] Cf. Essebier, Wyss (2017), p. 7-8.

yet the appropriate infrastructure for such a robustness. Especially in the healthcare sector, where an blockchain implementation might not be primarily profit oriented and must work with intimate data about single people. It would be helpful if the architects of networks do keep a constant dialogue with a specific government and lawmakers. All the efforts are necessary to enable a privacy-secured, credible and save data management platform.[7]

To verify the identity of agents, blockchain solutions often work with virtual ID. This is made with unique signatures. If two agents exchange information there will be a signature created for this specific trade. This signature guarantees the transaction from one party to another. However, now there is rarely a transaction signature which is linked to an actual person. This would increase the trust due to its link-up to the physical world. There are specific applications that do guarantee such a link-up, while interfacing agent's signatures to governmental identity.[8]

2.1.4 Applications in healthcare

The healthcare sector is a dynamic industry. The sector operates closely linked to research findings, but on the other side provides customizable services. There is a constant evaluation of knowledge. Moreover, the branch tries to achieve societal health goals while working with complex networks of various disciplines. For example, current pandemic situation forced researchers to work together with the hospitals and the pharma sector to prevent the diffusion of the infection within the society.[9]

In the future this sector will be confronted with an immense challenge regarding data management. There is a growing demand for new medicine and a more complex value chain of the production to meet the high demand of senior or older age groups of customers. For example, Switzerland has spent the most on healthcare products and services relative to the European neighbours. The confederates expend 11.9% of the GDP, while the European average is almost 10%.[10] With the current data management of organizations, the challenges cannot be bare efficient. Not only the complexity will push these databases to the limit, also the administration costs will increase constantly. The aim is to implement new efficient and innovative system.[11]

[7] Cf. Government Office for Science (2015), p. 9-21.
[8] Cf. Yaga et al. (2018), p. 46.
[9] Cf. Hasselgren et al. (2020), p. 3-4.
[10] NZZ (2020), 02. December.
[11] Cf. Dimitrov (2019), p. 51-56.

There are already plenty of scenarios where blockchain supports the data management in the healthcare branch and blockchain opens new opportunities for the sector. Such as securing the patient data, since there is no central node holding the whole database. These databases are distributed and the information not only flow to a single administration. Moreover, blockchain uses complex processes to generate unique keys for agents stashing sensitive data from the owner. Therefore, it is hard to find out the actual identity of data owner within the blockchain. Additionally, the distributed architecture and therefore the multiple databases make it impossible that an information varies among different bases due to constant sharing of data and the consensus mechanism.[12] The new ways that blockchain could enable regarding the communication is also important. To ensure an accessibility of an electronic patient record (EPR) is immensely important across different medical service provider. If a pharmacy could access the medical history of an individual which is updated with analysis of its Doctor of Medicine, the expensive communication between the two professionals could be bypassed. Moreover, the link to the whole pharmaceutical industry could be made and guarantee an efficient supply chain management which is directly linked to the demand. That enables more efficient information what patients need in real time. The producers could therefore schedule their resources in an efficient way.[13]

2.2 Design research

Pivotal for an own application based on blockchain is the data security and the anonymity of patients using the platform. Also, in healthcare smartphones are starting to play a central role, it offers a quick and easy communication with healthcare parties, the use of services of the branch or even the traceability of humans which become more important during the last year regarding fighting a pandemic. However, there are a couple of aspects that are relevant for successful implementation. Since the medical data of individual is sensitive information for the person itself, it must be ensured that the individual remain anonymously for external parties who are not responsible for the individual care. To keep an individual anonymously in the network the agent receives a secret signature to mark its information in the blockchain.[14]

[12] Cf. Mazlan et al. (2020), p. 23663-23664.
[13] Cf. Built-In (2021), Blog by Sam Daley.
[14] Cf. Ashutosh et al. (2019), p. 1-15.

A blockchain application uses the creation of keys to ensure the ownership. Through blockchain two types of keys are generated. A private key which the agent uses to verify its ownership on the platform. There is also a public key. A transaction for example between two nodes means that Agent A can transfer data which is encrypted with its public key. Only the receiver agent B can decrypt the data with its private key. With an IoT device the scenario might be a meet between two agents where one agent shares sensitive information with the other one. Such information is only meant for a selective group or only one other party. Therefore, the encrypting and decrypting is necessary. Moreover, the agent B's private key is also necessary if B does a transaction sending information to Agent A. In that case B uses its private key to enable the transaction. Also, Agent A shares the process of the transaction with every other node in the network.[15]

The information in a blockchain application is distributed. However, the data storage might be inefficient if it is shared across the whole network if the users use mainly their IoT devices. To keep a database on one device might be expensive. To merge data at some specific distributed "centralized" points might cause problems since these nodes then could be single third parties which bring back problems of centralized networks just in a smaller size. Ashutosh et al. (2018) used for their blockchain solution a cloud to record the huge load of information. The data is also structured in blocks and uploaded and secured with signatures. Changes of assets are then reported in blocks and a generated hash is then used to link blocks together. These hashes do also contribute to the security of data.[16]

3. Analysis

3.1 Existence of Covid-19

Due to its contamination from person-to-person, a lot of countries in the world are using technology to keep track of interaction where we can break the chain of transmission among community. This is the main purpose of creating a single Covid application (mobile application) for the convention of contact tracing to track this infection.

[15] Bison Trails (2021), Blog by Andrew Tam.
[16] Cf. Ashutosh et al. (2019), p. 1-15.

However, in the Bengal strain, the three virus mutations combine to form a new variant named B.1.618. Scientist Vinod Scaria, Research Institute for Science and Industry said variant B.1.618 was isolated in October 2020. In addition to India, this strain also occurs in the US, Singapore, Finland, and Switzerland. The number of cases of the triple mutation has increased dramatically in recent months in Bengal. However, he said that there is still much that is unknown about this variant, requiring more studies.[17]

While it is necessary for people to maintain and keep their normal working and daily life. For instance, in Switzerland, the occurrence of COVID-19 results in the shrinking of the economy of 2.9% in 2020 where the federal government imposed a lot of restriction putting in place such as closing of restaurants, coffee shops or the mandatory mask wearing in public building, or public transportation, and so on.[18] Therefore, a useful tool for contact tracing and infection prevention together with vaccination is necessary to support the government to lift all restrictions and bring back normal life for citizens, especially in the second wage of COVID-19 since mid-April 2021.

3.2 SwissCovid App

The SwissCovid app combines an innovative technology, namely a new architecture governing user data privacy, with an already existing technology of Bluetooth Low Energy, or BLE. The app uses BLE to recognize when two users have been in close proximity for a certain time.[19]

The app exchanges private IDs with other mobile phones on which the app is installed via Bluetooth. These are unique combinations of numbers and letters. They have nothing to do with the owners of the cell phones. When receiving a warning, the app also considers the duration and distance of encounters with other people. It is not possible to draw conclusions about locations and identities.[20]

If the coronavirus test is positive, you will receive a Covid code from the cantonal authorities. You can enter this in the app. In this way it is possible to warn other, unknown people of an infection. Because all app users who meet the “duration and distance criteria” are informed.

[17] Cf. Business Today (2021).
[18] Cf. Swiss Info (2021).
[19] Cf. Cunche et al. (2020), p. 2-12; Cf. Misura, Ines (2020).
[20] Cf. Federal Office of Public Health (2021).

Entering the Covid code is voluntary. The warning occurs without anyone knowing who it came from.[21]

However, we acknowledge some limitations of the current app in the prevention of COVID-19 spreading and supporting the government to be at a comfortable level to open and bring back "normal" life with the lifting of restrictions in the community.

- Precondition to turn on Bluetooth.
- Random IDs storage limited for 14 days.
- Swiss Covid App only serves as an info providing platform, but active Warning is not possible. The warning only appears when one of the close contacts is tested positive with COVID and put their test result in the app.
- People may tend to venture out more as they are relying on the app to inform them of a potential exposure. However, as not every citizen has the app downloaded, it is not 100% effective in breaking the chain of infection, and so someone with the app may still contract the virus and infect others.
- The anonymity aspect of the technology makes it impossible to enforce quarantine or testing. As the privacy of users is the largest issue and most essential element to the innovation, people are not legally required to quarantine or get tested upon receiving a notification.

3.3 Corona-App in China

In China, they also used Covid tracing app during the whole pandemic time while the government was encouraging their citizens to go back to work and to lift national restrictions in most aspects of people life including travelling. The government cooperates with Ant Group and its popular e-wallet and Alipay app to assign a colour code including three levels of green, yellow or red. Each of this colour represents different health stage or status of an individual.[22]

The one with an arrow is for traveling between provinces. The green QR code is scanned when people want to visit public restaurants, cinemas and parks.[23] People are asked to fill in a form where it is asked by law to state truthfully and face legal consequences otherwise, and answer questions such as "Do you cough?" "Do you have fever?" "Where have you been in the past 14

[21] Cf. Federal Office of Public Health (2021).
[22] Cf. Mozur et al. (2020).
[23] Cf. Ricci (2021).

days?" "With whom in close contact/ travel with?". Then bases on your answers the system generates a code with a colour. After 14 days the code expires, and people must generate a new one by answering designated questions again. The colour is determined by the location and the health authority assessment. Additionally, people from the risk region are not "allowed" to enter public places unless they have been "in quarantine" for 14 days and after 14 days you have the chance to generate a new health QR code.[24]

Additionally, this app is integrating with GPS shared by telecommunications companies. This allows the government to look back at users' travelling history in the previous 14 days. Required information of the app for each users include their name, identity card number, telephone number and sometimes a photo. This app has been critical for any mean of travel within China.[25]

Along with the advantages of using QR code for the health status and regular update for COVID-19 tracing and prevention, there have been several concerns on the issues of privacy as well as security of this app.[26]

3.4 The analysis and suggestions for the current situation

A survey was conducted with 6,464 people in China, 2,021 in Germany, and 2,180 people in the US. Results have shown the difference in perception of tracing apps between German, US, and Chinese population.[27]

The Swiss government is considering lifting restrictions given the considerations of different criteria of "the infection positivity rate over 14 days should fall below 5 percent, occupancy of the intensive care units (ICU) by coronavirus patients should be below 25 percent, and the R-rate — which indicates Covid's ability to spread —must be below 1".[28] However, in the meantime, they decided to make a small, conciliatory gesture with the opening of restaurants' terraces, and very limited numbers on different cultural and sport events, or even in case of schools and universities around the country.[29]

However, we believe that a simple green-yellow-red signalling solution operating in a trustworthy decentralized blockchain might accelerate the process of getting back to pre-covid lifestyle.

[24] Cf. Mozur et al. (2020).
[25] Cf. The Japanese Times (2021).
[26] Cf. The Japanese Times (2021).
[27] Cf. Kostka et al. (2021).
[28] Cf. The Local (2021).
[29] Cf. Swiss Info (2021).

At this point there is plenty of covid apps operated by different states. Therefore, we perceive our text as a proposition for Swiss blockchain covid app.

Recent studies indicate that blockchain technology still lacks tangible application for the society, but 2021 is the year of the emergence of promising blockchain projects.[30]

Literatures emphasize the lack of real-world applications that go beyond cryptocurrencies and the "current excitement is around using the technology to sell digital art".[31] In this sense we would like to contribute more to the real-world applications and offer a solution how to leverage the blockchain technology in the common fight against COVID-19.

Our idea is unique and just in time and concerns the wellbeing of us all on the planet Earth. It incorporates traceable technology (e.g., blockchain), and Data security in the existing SwissCovid App as well as political issues such as government monitoring, cyber security and many other contributing stakeholders to participate. We hope that our new innovative idea can contribute a little in the process of combatting Covid. Make a small difference in the humankind and unify us all by combating the same "enemy". We have given our careful consideration in regard to the normalization of people's lives during this pandemic, especially with the incurrence of the second wage of new virus type and serious raising numbers of cases around the world.

Our blockchain based solution has no means to put the Government or any political systems in question. Authorities can remain their power and centrally make the best decisions for the people. Thanks to the advancement of blockchain technology, it is possible to trace the virus. People are incentivised to provide Covid related data to feed the system and the data can be evaluated by an authority such as The Swiss Federal Statistical Office with simple regression or machine learning.

4. Design

In the following chapter we present our business model, which involves collaborations with different strategic partners who were either affected by the COVID-19 crisis or own enough recourses to master it. Our solution approach seeks to connect our partners via data flow in

[30] Cf. Lim et al. (2021), p.4-11.
[31] Cf. Clark, Mitchell (2021).

order to create an efficient and encouraging tracking-system for COVID-19 to grant a real-time monitoring of the spread of the virus. This tracking-system should be an update of the current Swiss Covid-App and be built upon the DP-3T-Protocol.

This point leads us to the technical architecture in the back-end environment of our application. We rely on the blockchain-technology, which seems a suitable data-handling method, because our system contains multiple parties that exchange information. Furthermore, the consensus-mechanism creates a trust-worthy verification system, whose indispensability is imminent for an efficient tracking. Especially, since many governmental applications do not fulfill the point of privacy, blockchain guarantees the anonymity of every single user and the protection of the shared data.

Thus, we have the users and their data at the center of attention in our application, which can be examined in the front-end environment. For our incentive-system we create a coin system which rewards the users for sharing private information related to the tracking of the virus.

4.1 Business Model

The key activity of our operations is a suggestion for an update of the current Covid-App, which allows a more efficient tracing via blockchain-technology. The healthcare industry reports a strong increase in blockchain solutions due to their more secure, decentralized and efficient nature, which also can be used in our update case. The current Covid-App by the Swiss government allows us to get in contact with a user-base from over 1.7 million people (Status 22.04.2021).

But in regard of the Swiss population, we aim to increase this user rate of the current application through providing incentives. These incentives, a newly created digital coins called “Solidarity Coin” will be given for sharing information, which contributes to the fight against the virus. These coins can be redeemed for goods and services of selected partners.

Our application consists of a network of different key partners, who exchange relevant information with each other. The most important player for our purpose is the Swiss government. Precisely, the BAG and BIT departments, which are already working on the containment of COVID-19.

Other important partners for the success of this application are telecommunication companies like Swisscom, sunrise, etc., since the mobile phone number is used for our operations and

notifications concerning potential contact points with the virus. To make the system work more efficiently we suggest inserting also user-profiles for public locations like restaurants, bars, coffee's, event venues, etc. This allows having a more coherent view over traffic data, instead of having it distributed on servers from third parties. Thus, Gastrosuisse could also be a strategic partner, since this association represent the gastro-industry in Switzerland. To enhance the user-engagement and spread awareness for a new update of the corona-app, we chose different distribution channels like social media, newspapers, online/offline advertisements and word of mouth.

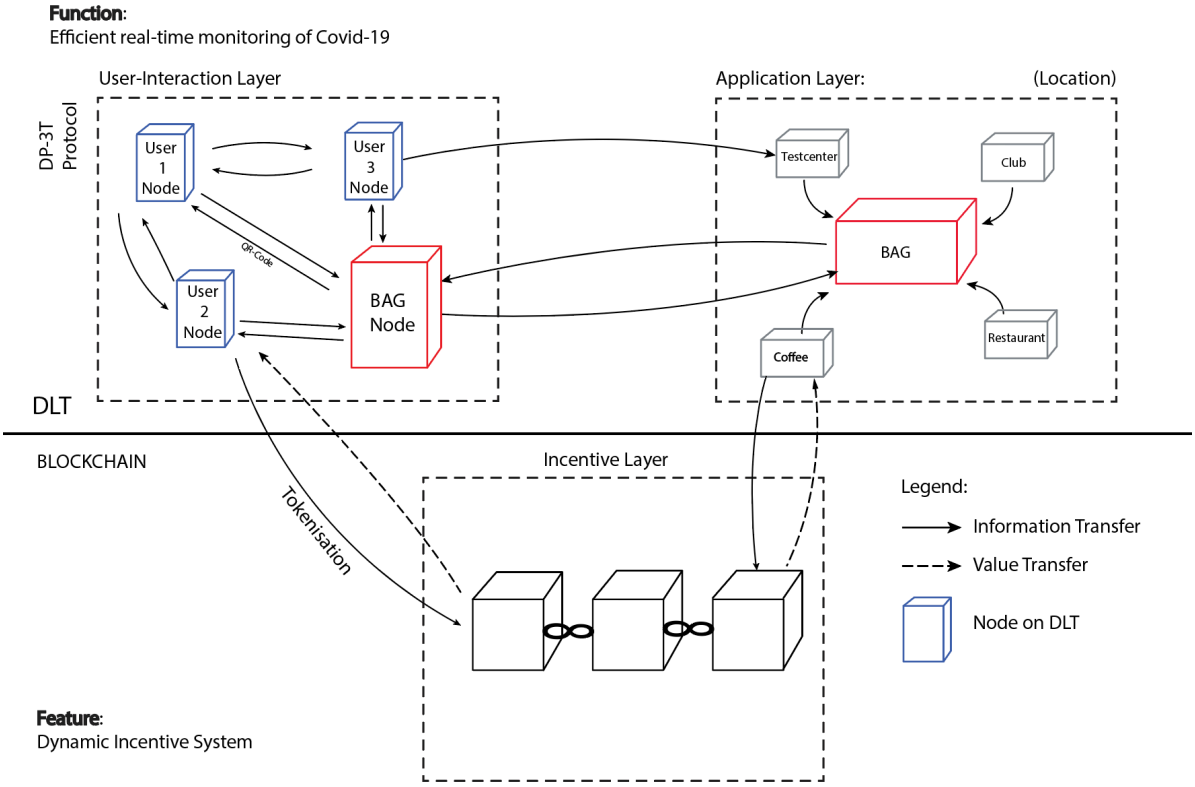
By providing a tool to track the virus within the system, our main customer will be the Swiss government. We plan to secure financial aid from different key resources like UZH Digital Entrepreneurship Grants, Angel money, SECO Start-up fund or Fund raising to turn this project into reality, since we act as a NPO.

Through our key recourses we should be able to cover the expenses of the needed infrastructure like coding the blockchain, which could be executed by Ubique, the responsible IT-company for the current application.

In the following chapters, we explain a possible solution for the design of the back-end and front-end architecture of our application.

4.2 Back-End Environment: Technical Architecture

Illustration 1: Technical Architecture



Source: Own illustration

For the back-end environment of our application, we suggest the use of three different layers like it is presented in Illustration 1, which are divided into a distributed ledger system and a blockchain system. The parties involved in these systems are the individual users (node) and business users (location)

Our app is built on DLT architecture and provides the function of a more efficient real-time monitoring of the Covid-19 pandemic. The purpose of this distributed enterprise system is the efficient tracking of COVID-19 in our country and contains the application or the user's interaction layer. The application layer is providing users with all functionalities via standardized API based on the blockchain technology and the Covid-19 app. The user-interaction layer provides functionalities to collect all the necessary data to create a QR-code for entry into different event locations, public transport, etc in the application layer. Depending on different variables like personal data, history, vaccine, travel history, or temperature checks the QR-code turns into a specific colour to indicate if this person might have infected herself or himself with the virus.

The data of the application layer is transmitted to a unified ledger containing hashed data of personal ID-Number, location, Check-In & Check-out time. A process called consensus ensures that the nodes on the network validate the transactions and agree on their sequence and existence on the ledger, which is critical to the function of this distributed database. That data is deleted after 31 days to minimize the size of the ledger on the one hand and ensuring that it's only used for the tracking of the virus on the other hand. The mentioned three layers communicate with each other using smart contracts. These act as an automatization mechanism to transfer necessary data to the related user-nodes in case of a detected infection-chain. The QR-code might change their colour after actualization to prevent further spread of the virus.

As a feature of the application, incentives are given to users depending on the current policy of the federal government and the level of Covid legislation. Depending on the given Covid legislation, the policy of the state might change and thus, the incentives must be accredited differently. This makes the incentive system more dynamic and adaptable. The blockchain layer is used for incentives and transactions for the individual user of the application.

Thus, the QR-code defines whether a user has access to an event location or not. In contrary to the current application, we suggest two different user profiles: individual user & business user. The individual user is every person in the country using the application, while business users are the different event locations and stores. These are equipped with a QR-code scanner to grant access to the individual user into their business or reject him or her. As illustrated in figure 3.6, business-user operate on the application layer, while individual user are nodes in the user-interaction layer.

Just as the current Covid-App, we keep the DP-3T Protocol in the interaction layer to provide a mechanism that informs users that have been in close physical proximity to a confirmed COVID-19 positive case for an extended period. This allows a more efficient tracking of the virus as notifications for potential infections occur instantly and not time-delayed, as it is the case up to date. To fulfil the task of proximity tracing, the system needs to meet the following requirements[32]:

- Completeness: The exposure history captures all exposure events.
- Precision: Reported exposure events must reflect actual physical proximity.

[32] Tronosco et al. (2020), p. 12-14.

- Authenticity: Exposure events are authentic, i.e., users cannot fake exposure events.
- Confidentiality: A malicious actor cannot access the contact history of a user.
- Notification: Individuals can be informed about prolonged exposure to the virus.

This indicates the importance of having enough data to guarantee real-time monitoring of the situation. Providing more personal data which is related to a possible chain of infection acts as an incentive. For these information users will be rewarded with a digital coin called “Solidarity coin”, which can be used to redeem with business partners. We examine this coin in a later chapter.

The application, interaction, and blockchain layer might fulfil different functions, but combined with a system they contribute to efficient real-time monitoring of the COVID-19 pandemic in Switzerland.

Every user of the application is assigned with a randomly generated User-ID, after passing a two-factor-authentication to verify the personality. Furthermore, these circumstances ensure the functionality and validity of this system, since that the user owns the device on which the application is installed. This proves the authorization on the respective phone and prevents malicious activities like swapping phones to access a location because the specific location must check the congruence of the identity card and the name above the QR-Code.

4.3 Front-End Environment: App Design

Our core questions during the process of building this application were, how should an ideal “blockchain healthcare app” look like. To design the interface, we seek an intuitive, friendly and easy-to-use design, including a colour scheme for which our society is already primed for in different situations (e.g., traffic light, etc.): red-yellow-green. These propositions will be mainly based on research (e.g., academic papers, current solutions, etc) and mock-up testing (e.g., what do people like and don't like).

The structure of the application will be explained without difficulty in an introduction video which acts as an operational manual. Thus, this movie shows how the application works and the added value each individual can contribute to society if he or she is willing to use it.

Of course, the point of incentives will be highlighted to keep the motivation of the user engaged.

Illustration 2: App's User Interface

Source: Own illustration

For the mock-up of our application, we used a software called "just in mind", which allows us to have a broad overview of our planned project. This is shown in Illustration 2.

For the user journey of our application, we need to consider the different parties (visitors & Location) that are crucial for our application network. The following steps in Table 1 describe how the ideal customer experience looks for setting up a working node in the system depending on whether the user acts as a visitor or location:

Table 1: Registration Process

Visitor	**Location**
1. Download Application from App-store	1. Download Application from App-store
2. Register as Visitor	2. Register as Location
3. Login	3. Login
4. Fill out forms	4. Use Location QR-Code-Scanner to man-age Check-In /-Out
5. Create QR-Code	
6. Receive rewards	5. Keep an eye on max. allowed capacity
7. Be alert for potential distance warnings	6. Receive rewards
	7. Be alert for potential distance warning

Source: Own figure.

As soon as the nodes are established, people can enjoy a normal life again, since there's more transparency concerning the spread of COVID-19 in our society. The main page for each profile type clarifies the functions of the application. Three different buttons are visible for visitors: Health QR-Code, Distance Warning and Wallet. Visitors must show their QR-code each time they check-in or -out at a public location. As already mentioned, the QR codes determine access to a certain place or not. It will expire after seven days and must be renewed then. In case of a warning for potential infection, the owner of the device receives an information notification and a request to go to quarantine. By doing so, the agent receives rewards, just as if he or she adds voluntary additional information into the system and using the application. These are displayed on the wallet screen of the application and can be used for purchasing goods in specific coffee, bar, club and other partner businesses.

Locations on the contrary are asked to scan every client, as soon as he or she enters their business and when he leaves it again. Their main page is broken down into four different buttons: QR-Code-Scanner, Visitor-History, distance warning and wallet. The QR-Code-Scanner registers the QR-Code of the visitor and grants access or not. Before letting the visitor enter the location, the identity of him or her must be verified through a check with the ID card. After successful registration, the capacity manager will be shown, where the location has an overview of its occupation. Once the maximum capacity is reached, no more registrations will be possible to prevent an overcrowded space. All the information concerning the past check-in and check-outs can be tracked on the button visitor history. The distance warning and the wallet buttons work just as in the visitor profile. This leads us to our digital coin called "Solidarity coin".

4.4 Solidarity Coin

Our vision is that the Solidarity coin will serve as an incentive to help broader usage of our covid app. The earning of the coin is determined by how frequently and how much data does the user share with the app. The coins can then be redeemed for items on dedicated websites through our app. We suppose that the given municipality / government will decide what items will be available for the redemption. As an example, the items can be motorway vignettes, charitable contributions etc.

Our logic implies that the value of "Solidarity coin" is fixed against the domestic currency. In the case of Switzerland, it would be the Swiss Franc.

5. Evaluation

To assess the proposed solution, we conducted a survey with 21 participants. We asked participants to try and evaluate the Swiss Covid app, Chinese Covid app and mock-up version of our proposed solution.

The evaluation criteria were four: Convenience, Trustworthiness, Motivation to use and Comprehensiveness. Each criterion had the weight of 25% and survey participants were asked to score each criterion on the scale from 1 – 10 with 10 being the highest possible mark. Table 2 describes the evaluation criteria.

Table 2: Criteria and Weights

Criteria	**Weight**
Convenience – How convenient is usage of the given apps?	25%
Trustworthiness – How trustworthy is the given solution?	25%
Motivation to use – How much does the solution's architecture drive usage?	25%
Comprehensiveness – How is the overall comprehensiveness of the given solution?	25%

Source: Own figure.

5.1 Mock-Up Testing

The Table 3 shows results of our survey. Our solution earned the highest score especially thank to overall higher perceived trustworthiness and motivation to use.

We believe that the key factor for our solution to score highest in trustworthiness is the utilisation of blockchain technology. On the other hand, the blockchain technology also reduces overall comprehensiveness of the app which is something our survey showed as well.

Finally, our solution also scored highest in the criteria of Motivation to use. We believe that the driving force behind this is the possibility to earn the "Solidarity Coin" with our app.

Table 3: Results of the survey

App	Final Score
Our proposed solution	7.2
Chinese covid app	6.5
Swiss covid app	6

Source: Own figure.

5.2 Positioning of Platform / App

Our App solution based on the decentralized blockchain unify different industries and relieves authorities from stress, lengthy debates and data overflow. We believe that this solution can significantly contribute to the fight against a global socio-technical issue, such as the Covid pandemic.

Our proposed app scored higher in our survey than current solutions available in Switzerland and China. The higher score was primarily due to better-perceived trustworthiness and motivation to use.

What we view as a challenge, is the overall comprehensiveness of our app. As the blockchain technology is very recent, the public is not familiar with how the technology works. We believe it is key to effectively and in a simple matter communicate benefits and the key functions of our app based on blockchain.

5.3 Privacy / Data Security

Cookies are used for the purpose of improving our application and learning about our App users more and providing better tailored products that suit their needs. Machine learning or AI can be applied in this respect. Our solution does not plan to sell any data or metadata to third parties.

5.4 Legal Clarification

This document in any form and the ideas therein are our intellectual property. It is prohibited to turn it into a NFT and be traded or declared as their own property. We hereby declare the originality and the ownership of this idea. The use of the platform/App and the rights the platform/App users have are regulated by the Epidemics Act concerning the contact tracing (launched by the Federal Government of Switzerland) and the amendment to the Act is approved by the Parliament on 19 June 2020. The Epidemics Act regulates organisational, operational matters and the processed data.

We encourage the "leakage" of our knowledge about the most advanced blockchain technology and support the competition among different consortia. As long as we remain the originals.

The Federal Act adopted by Parliament in September 2020, on the Adaptation of Federal Law to Developments in Distributed Ledger Technology (DLT bill) adapting various federal laws give us possibility to develop the blockchain and DLT area. It remains the duty of the Federal Council and makes sure Switzerland remains as a leading, innovative and sustainable location.

The amendments to the Code of Obligations, the Federal Intermediated Securities Act and the Federal Act on International Private Law that are envisaged in the DLT bill entered into force from 1 February 2021. These provisions enable the introduction of ledger-based securities that are represented in a blockchain. The remaining provisions of the DLT bill will probably enter into force on 1 August 2021.

Our platform/App/product complies with the General Data Protection Regulation (GDPR) in the European Economic Area (EEA) or any regulation on data protection and privacy, because it operates on a decentralized Network without the possibility to trace back to you as a person no matter where you are located, so no need to use VPN.

Natural person (eg. Prof. Dr. iur. Thomas Gächter) confirms that the platform/ app usage is rewarded with "Solidarity coin" whose value is determined by the willingness, frequency, pace of data provision as well as the usefulness and the amount of truthful data. Non-compliance is punished by the possibility of losing your loved ones simply formulated. Consequently, there are no legal or monetary consequences for you as a private person. Nonetheless, we expect generous donations to maintain our system, get smart people on board and follow our duty and pay tax.

6. Literature

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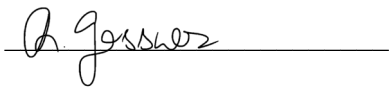
We hereby declare that the thesis with title

„Blockchain Solution Fighting Covid-19“

has been composed by ourself autonomously and that no means other than those declared were used. In every single case, we have indicated parts that were taken out of published or unpublished work, either verbatim or in a paraphrased manner, as such through a quotation. This thesis has not been handed in or published before in the same or similar form.

Zürich, 01.06.2021

Rudolf Gessner 

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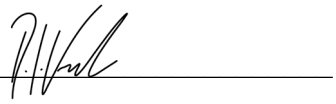
Räto Kessler 

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