

Undergraduate Thesis Prospectus

Blockchain Contact Tracing App Reporting

(Technical Research Project in Computer Science)

The Adoption of Contact Tracing Technologies

(STS Research Project)

By

Caroline Ehler

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Technical Project Collaborators: N/A

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: Caroline Ehler

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Date: 12/11/2020

Aaron Bloomfield, Department of Computer Science

Blockchain Contact Tracing App Reporting

Technical Research Project in Computer Science

Please note that I am a computer science student and will be conducting my technical project next semester. To supplement, this technical report is a proposal for a potential research project addressing the same issue as my prospectus.

The technical advisor of this capstone research project is Aaron Bloomfield of the Computer Science Department at the University of Virginia. This capstone research project proposal consists of two parts, researching how the implementation of emerging technologies impacts security and data privacy and how this influences the adoption of contact tracing applications amidst the coronavirus pandemic. In the United States, Virginia was the first state to introduce a mobile application facilitating automatic contact tracing in response to the COVID-19 outbreak (Hsu, 2020). The deployed application addresses user data privacy appropriately, but still not all of those in the Commonwealth have adopted the technology.

The first part of the research to be conducted would be to survey Virginians of varying demographics (age, socioeconomic status, gender, major of a UVA student, etcetera) to gain insight into their current knowledge and education of data privacy technologies. The survey would also collect data on each of these social group's feelings, opinions, and trust or mistrust of these technologies. This survey collection will establish a baseline of the social group's understanding of certain technologies like Bluetooth, GPS, Blockchain, and Artificial Intelligence.

Following the initial survey, each participant would then be told a short explanation of the certain technology for which they surveyed, and the data protection measures implemented to

protect data in a contact tracing application. Then the participant is given the same survey as before. The results will be used to analyze if there is a correlation in comfort or trust in a technology and the education exposure or understanding of the technology.

The second part of the project would address the preexisting COVID-19 contact tracing app released in Virginia, COVIDWISE. A prototype application would be built using swift to build an iOS mobile application, specifically implementing blockchain as the means to protect user data. Blockchain's core characteristics of decentralization, confidentiality and immutability make it an excellent solution to preserve user privacy. Private information would reside with the cryptographic signatures of each user, so one would own and control his or her private data and can share with trusted parties only. Blockchain provides confidentiality through a "zero-knowledge proof, a cryptographic methodology that allows a user to demonstrate that certain information is known, without revealing the information itself." This allows for verifiability of information between parties while information remains private. The immutability aspect of the created chain within blockchain prevents tampering with user data. Below (Figure 1) is an image of a proposed solution for a contact tracing application utilizing blockchain technologies for data privacy (Brumelow, Mis, Anastasiou, 2020).

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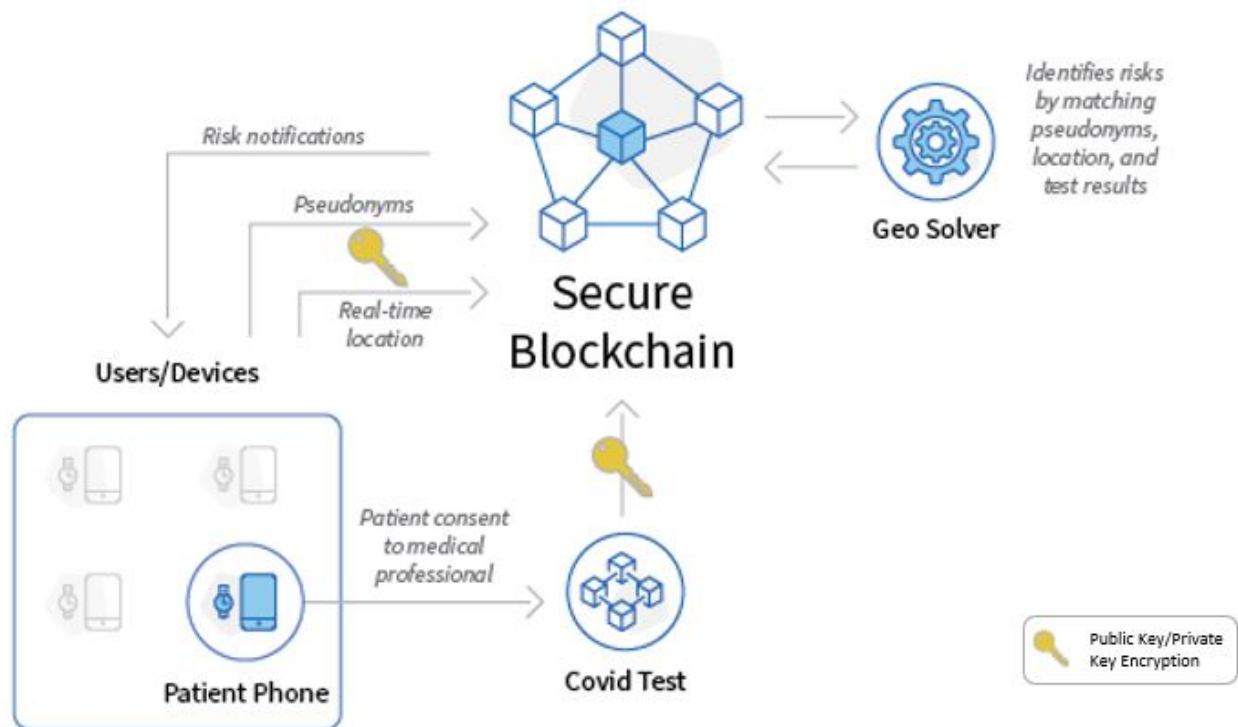


Figure 1: Proposal for blockchain implementation for a COVID-19 contact tracing application (Brumbelow, Mis, Anastasiou, 2020).

The challenges of this project would be conducting enough surveys so that the number of participants reaches a statistically important sample size. To streamline the process and maintain social distancing, the survey could be provided virtually through the use of survey web applications such as Google Forms. A video would be provided explaining the technology, and then participants would be asked to fill out the same survey they took previously.

Secondly, blockchain is a difficult technology to implement, especially for an undergraduate student who has never worked with blockchain before. The project would be best if paired with graduate facilities and faculty or students to help implement it as well. Scalability of the project would not be considered, as the application is a prototype of a contact tracing app.

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By

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October 18, 2020

Technical Project Collaborators:

N/A

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Signed: Caroline Ehler

Date: 10/18/2020

INTRODUCTION

Proposal

The proposed STS thesis shall analyze how the implementation of emerging technologies impacts security and data privacy and how it influences the adoption of contact tracing applications amidst the coronavirus pandemic. In response to an epidemic, contact tracing is conducted to limit the spread of a virus, but the large numbers of cases of the coronavirus pandemic has led to the development of contact tracing technologies to automate the process. These technologies may monitor the user's location, which has slowed the adoption of the technology due to privacy concerns (Hsu, 2020). Understanding why society may be apprehensive to adopt such pertinent and life-preserving technology is important amidst the pandemic. To reach this understanding, the STS theory of Social Construction of Technology (SCOT) shall be used so as to facilitate analysis of the adoption of this technology. To gain further understanding of this research problem, the thesis will provide background and context for the pandemic, introduce the STS framework, and utilize the framework within the analysis of the problem to further develop the SCOT theory.

BACKGROUND

Contact Tracing Amidst the Coronavirus Pandemic

The coronavirus SARS-CoV-2 disease (COVID-19) is “the most current threat that challenges health and economic sectors in the world.” Presently there are no known cures, with deaths estimated to reach 40 million (Abuhammad, Khabour, Alzoubi, 2020). The rapid spread of the virus exceeds the capacity for health agencies to undertake traditional contact tracing (Kleinman, Merkel, 2020). Contact tracing is one of the most effective ways to decrease the spread of the virus by tracing the primary and secondary contacts of confirmed coronavirus cases

(Abuhammad, Khabour, Alzoubi, 2020). With such a vast number of cases, governments and technology companies have begun to automate the contact tracing process utilizing technologies such as GPS, Bluetooth, and mobile applications for tracing. Some apps keep relevant information such as where one has been and with whom, whereas other apps provide an alert that one has been in close proximity with an individual that has tested positive for the virus and thus may need to be tested or self-isolate (Hsu, 2020).

China has been very successful at controlling the spread of COVID-19 using tracing technology (Abuhammad, Khabour, Alzoubi, 2020); China's success is largely due to major societal participation because of China's governmental influence and control over its citizens. Other countries such as the UK and the United States have tried to implement contact tracing apps, but have been less successful while facing many privacy and security concerns. As Hsu states, "in many parts of the world, most people will willingly participate only if they trust in the system." In their concern for privacy and distrust of contact tracing apps, people may choose not to participate in these apps.

In the United States, Virginia was the first state to release a contact tracing app that does not rely on personal information or location data, but uses Bluetooth technology developed by Apple and Google (Yarmosky, 2020). As of October 1st, only 7% of the state's population, or 13% of the estimated number of users with a smartphone had downloaded the state's contact tracing app. It remains unclear as to why the adoption rate is so low. Some users commented they were slow to download the app due to privacy concerns, but after further research, adopted the technology (Leonor, 2020). In addition to the United States' efforts, Apple launched a public API to assist the development of contact tracing apps (Sainz, 2020) and pushed out a built-in contact tracing app in the iOS 13.7 update. Google's Android has also implemented a built-in

contact tracing app with the Android 6.0 OS update. The tech giants added this feature to make contact tracing abilities more accessible rather than having to download an independent app in hopes more would adopt the technology (O'Flaherty, 2020).

Due to the nature of the necessity for contact tracing, though, mass participation is needed for its success. A study conducted at University of Oxford modeled the coronavirus' spread through a simulated city of one million people and found that 60 percent adoption of contact tracing is needed to stop the pandemic (Hsu, 2020). Time is of the essence in regards to the adoption of contact tracing, since millions of deaths could be prevented. The technology that will allow for mass contact tracing might determine life or death for some. Even though lives are at stake, it is obvious both governments and citizens are concerned with privacy issues, maybe even more than potential imminent death. Contact tracing adoption issues are extremely relevant to research and analyze in order to create an effective, trusted solution. The thesis will look at how society's concern for privacy has impacted the adoption of contact tracing apps using SCOT as a framework for analysis so as to better understand the societal issues with this technology.

FRAMEWORK

To facilitate my analysis, I will be utilizing the STS Framework, Social Construction of Technology. The SCOT framework derives from the theory produced by Pinch and Bijker. SCOT is ultimately defined by its belief that human actions shape technology, rather than the other way around. The thesis will utilize SCOT theories, principles, and topics drawn from Empirical Programme of Relativism (EPOR) (Klett, 2018) such as interpretive flexibility, rhetorical closure, design flexibility, and relevant social groups. The relevant social groups regarding the adoption of contact tracing apps would be the government or public health

agencies that might deploy them, the citizens expected to use them, and the engineers that design the apps (Bijker, Pinch, 1987).

Interpretive flexibility supports that this technology is subject to different interpretations by these identified social groups (Bijker, Pinch, 1987). In Hsu's journal, he quotes from Zissman, that "There just isn't the time, so instead what's happening is people [and engineers] are doing the best they can, and making the best engineering [and data privacy] judgments they can, with the data they have and the time that they have." He also states that developers of contact tracing apps admit that "the technology has not yet proven that it can slow the spread of the virus," yet that has not stopped national governments and communities from pushing for or using these apps (Hsu, 2020). This dissonance between the interpretations of the privacy and effectiveness of the apps between government and engineers provides an appropriate scenario to utilize SCOT and interpretive flexibility for analysis of the adoption of contact tracing apps.

Rhetorical closure, another aspect of the SCOT framework, examines that when social groups define a problem as being solved, the need for alternative solutions diminishes (Bijker, Pinch, 1987). There may not even be a need for a different solution to be provided from the ones already produced and being utilized presently, so long as society believes the problems have been fixed. Along with interpretive flexibility and analysis of how different social groups interpret the technology, rhetorical closure analysis can provide better understanding as to when these groups will consider the problem as being solved.

Another aspect of SCOT, design flexibility, will allow for analysis between different constructions of technologies. Due to varying interpretations of social groups, different designs may occur such as the varying use for these apps like tracking location with either Bluetooth,

which is more private but less accurate, or GPS, which is less private, but more accurate (Kleinman, Merkel, 2020).

METHODS

The objective of the thesis is to explore how emerging technologies impacts security and how that in turn influences the adoption of contact tracing apps. Using the SCOT STS framework, the thesis will analyze varying aspects of the topic and explore answers to certain questions. Considering relevant social groups, the thesis will analyze varying groups' awareness of their data privacy or data security technological practices, and why some are apprehensive of contact tracing apps due to data tracing issues. Additionally, the thesis will analyze using the SCOT theory of design flexibility, the validity of various deployed contact tracing apps and their respective data privacy issues. Once these issues and questions are addressed, the thesis will provide a synoptic explanative contract for the either potential success or failure of both currently deployed and future applications made in response to identified security issues. Though the thesis will not ultimately propose a solution to the inherent security problem of location tracing applications, it will explore various proposed technical solutions (such as Blockchain or Artificial Intelligence) so as to analyze relevant social groups comfort level with these technologies, and how they may impact the adoption of contact tracing apps.

CONCLUSION

Despite COVID-19's extreme impact on billions of lives across the globe either social distancing or in isolation, there is still much to battle if the pandemic is to halt. To combat the pandemic, the technical innovation automating contact tracing is yet to be a complete solution since its success rides on mass participation, and too many people distrust the data privacy

capabilities of the currently deployed applications. If a true solution is to be developed to meet the requirements of society, research and analysis must be done as to why society mistrusts the technologies so as to identify what can be improved upon these technologies. The SCOT framework adequately provides structure for the analysis of the development, interpretation, and adoption of this technology within certain social groups. As the SCOT's framework implies society influences technology, a technology will only be accepted and utilized by a society if they trust in it, apparently even if it means life or death for themselves or for others.

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