University of Arkansas – CSCE Department
Capstone II – Proposal – Fall 2021

VacCheck

Team 2

Ellis Tran, Yaling Liu, Patrick Kwok, Sung Woo Kim

Abstract

VacCheck aims to assist with the problems of COVID-19 and potential future viruses. The problem is that there is no solid infrastructure in the United States to provide for a safe transition from quarantine to regular life. As cases began to slow down due to vaccines, the country began to open its economy up again. However, cases soon spiked in July and August 2021 when the Delta variant spawned and created an uptick in cases again. To help solve this problem VacCheck will be created.

VacCheck's objective is to help the community cut the transmission of the virus by allowing safe and clear communication between health professionals, businesses, and the community. The approach we are taking is to create both a web and mobile application. The health professionals will be able to input data for individuals, businesses will be able to check the vaccination statuses of their customers and their employees, and regular users will be able to generate a QR code to be scanned to be permitted into businesses. The significance of our project is to help the community cut the transmission of the virus, get more people vaccinated, and begin a safe transition back to a normal life.

Problem

While the world is recovering, many people are still concerned about the future possibilities of having another outbreak. Following CDC guidelines might have been the best option for now, but it is not enough as people still believe that it is ineffective against the recent surge of covid cases. In particular, businesses are skeptical about the guidelines as they are sometimes inefficient in slowing the rate of infection. Furthermore, as the Delta variant has a much higher transmission rate than the original virus, business owners continue to be concerned about re-opening up their business as they don't have transparent and safe guidance from the government.

To have a safer transition back to normal life, businesses need a way to ensure the safety of their customers and their staff. They may have the option to require customers to show them their vaccination cards. However, these cards are not portable and reliable because they can be easily misplaced.

Recent news also shows that fraudsters are selling forged copies of government-issued "vaccination record cards" that show people have been inoculated [1]. The impact of not having the solution to this issue is worrisome. Fraudsters will undoubtedly swindle business owners with fake vaccination cards while businesses are left to deal with authenticity issues. As a result, COVID-19 cases continue to surge and hospitals are swamped with patients; therefore, we created VacCheck to help the community recover from this pandemic.

Objective

VacCheck introduces a new way for users to keep records of their vaccinations and exchange this information with businesses safely, which aims at slowing down the spread of Covid-19.

For individual users, it gives them quick access to restaurants, concerts, museums, and schools as well as other entities. As an increasing number of institutions reopen to the public, some are requiring customers or participants to show proof of vaccination [2]. Since it is hard to predict when the next Covid-19 variant will appear and how much stronger it will be [3], we can reasonably argue that there could be many years before the virus simmers down. Businesses will likely adopt entry limitations, only accepting those who are vaccinated. VacCheck aims to bring the lives of its users back to normal by allowing them to enjoy their favorite businesses safely.

Currently, if the physical card is lost, one should first contact the vaccination provider. And if that does not work out, he or she must reach out to the state health department’s immunization information system. This process could be a hassle for some people. One important objective of VacCheck is to eliminate the need for a physical card. The data rendered by QR codes are retrieved in real-time from a secure cloud database, which is always updated and available.

For businesses, the main objective is that VacCheck guarantees that customers’ records come from a trusted source. If connected to the Arkansas Immunization Information System, VacCheck guarantees that the vaccination data obtained from QR codes are genuine. Alternate vaccination proofs, such as paper cards and digital copies of the cards, have turned out to be easy to fake. An Instagram account sells laminated coronavirus vaccination cards for $25 each, and a user on Telegram offers bogus cards for $200 [4]. It is even simpler and cheaper to edit a photo of a real vaccination card with a phone app or photoshop-like software. With VacCheck, paper cards and digital copies can be abandoned. Although VacCheck cannot help to tackle every situation of fraud, it can significantly raise the level of difficulty for those opposed to getting the vaccine to cheat the system.

Lastly, VacCheck aims to facilitate the task of keeping covid-19 under control. For starters, it helps to prevent the spread of the virus by providing an easy way for vaccinated groups to gather together. Large gatherings, which consist of conferences, parties, weddings, and places such as restaurants and museums, often involve close distances between participants. It is highly recommended by the Centers for Disease Control and Prevention [5] to take safety measures, and one of those measures is to get fully vaccinated. VacCheck facilitates the task of exchanging vaccination information for businesses/organizations and

individuals. Its mobile app provides individuals a unique QR code that contains their vaccination information using the customer version, and the event holders or business owners can quickly scan attendees' QR images using the business version. By maximizing the convenience of information exchange, VacCheck encourages society to adopt rules regulating large gatherings, which could in turn increase vaccination rates.

Background

Key Concepts & Related Work

We were certainly inspired by the South Korean government requiring more than 80,000 facilities that are deemed to be "high-risk" of spreading COVID-19 [8] to check visitors' temperatures along with their names and residence addresses to keep a precise record for contact tracing. These could be performed with pen and paper only, but now, people who wish to enter such facilities will need to scan their QR codes from their smartphone apps or emails. The individual's record will be logged into a database managed by the Social Security Information Service for 4 weeks, then it automatically gets deleted.

As the Delta variant is the most dominant strain of the coronavirus in America today and vaccination remains our best tool in preventing the spread, we benchmarked Korea's QR code-based registration for businesses, health professionals, and customers to be able to access their data with their own unique QR code.

Design

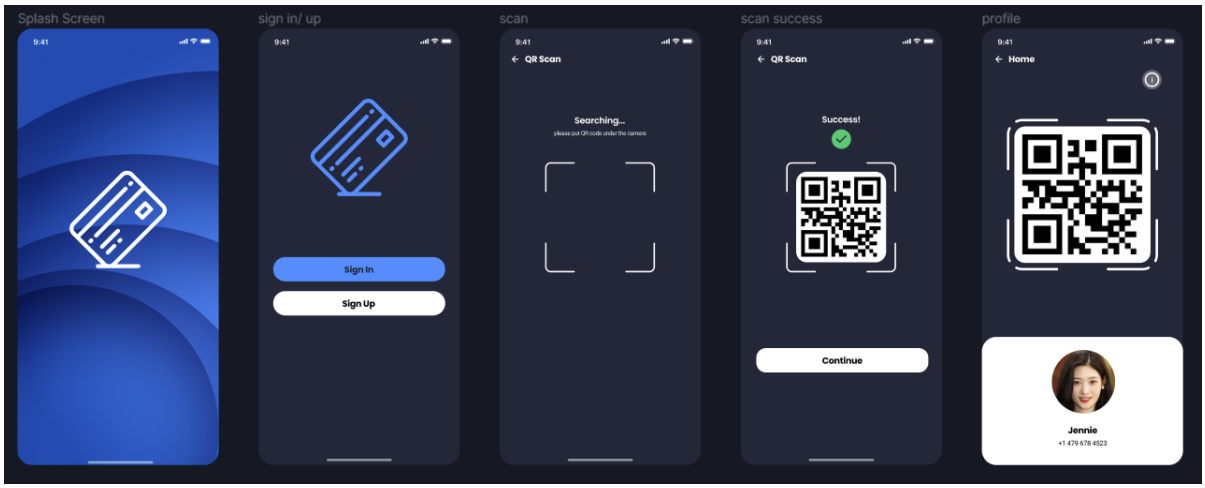
Requirements and/or Use Cases and/or Design Goals

Requirements:

1. Create a website designed for health professionals to log patient vaccination data.A QR code is automatically generated by the software and scanned by users and businesses to record basic information of visitors and vaccination records.
2. Generate a special database to store the information of these visitors or businesses.
3. Create a mobile application on iOS and Android devices to retrieve and scan information from the database about the user.
4. Be able to store electronic versions of people's vaccination cards so that they don't have to store physical cards.

VacCheck Architecture

VacCheck aims to provide a seamless transition from traditional cards to a digital system. The initial design is to have health professionals insert/modify customer records through a database that is heavily regulated by them. This helps to prevent any fraudulent attempts. From here, businesses could access an individual's record via VacCheck. To be able to access an individual's record, businesses must have their VacCheck application ready to scan for a QR code that is shown by the customer. This is the only way for businesses to check a person's record.



To refine our application design, we brainstormed and exposed ourselves to the UI/UX development process in order to come up with the best solution to deliver an *easy-to-understand* application with a sophisticated design. The mobile application design above is created by Patrick using Figma software. Royal Blue is chosen to be the color scheme for this application as it symbolizes trust, loyalty, and faith. Hence, we choose this color scheme in hopes to ignite businesses and customers' trust.

For the mobile application, we are going to use flutter for a couple of reasons. We believe that flutter is the fastest way to ship on mobile as it is a cross-platform that delivers native code. Hence, it is fast to both develop and run. Furthermore, by using flutter, we will eliminate any UI design irregularities between IOS and android. Therefore, we believe that this framework would be the most rational choice to develop our mobile application.

For the web application, we are going to use the React.js framework. React is a fast framework that allows engineers to quickly create progressive web apps. Its main language will be JavaScript. Along with JavaScript, we will use HTML and CSS for page structure and design. This framework is a rational choice as it is fast, reliable, and there is a large community based around it.

Data Flow

Data flow in any application is a challenging task. We have to have a comprehensive understanding of how data flows between the server and client. Since we are working on two separate clients, mobile and web, there is a slightly different structure. We have to ensure consistency in saving data to the database on all devices.

Risks

Risk	Risk Reduction
Data protection	Including a privacy policy, being transparent with customers about what & how & why on accessing the personal data.
Community engagement	Having partnerships with reliable companies, reaching out to small businesses, releasing a demo version & gathering feedback.

Tasks and Deliverables

1. Get Familiar with tech stack
    a. JavaScript/React
    b. Dart/Flutter
    c. Firebase
2. Design
    a. Rough draft of design pages for frontend
    b. Design an flow architecture of how data will be passed around
3. Database/Server
    a. Setup
        i. Firebase set up
        ii. Establish connection
    b. Authentication
        i. Establish connection with Mobile and Web Front-ends
    c. Receive Input from Health Professional
    d. Process of business scanning QR code (on the backend side)
4. Web Frontend
    a. Login Interface
    b. Business UI
        i. Chart/Table of people coming into business
            1. Shows only # of vaccinated, and no sensitive information is revealed.
        ii. Shows employee section to see if they are vaccinated or not
    c. Health Professional UI
        i. Create form to input data
        ii. Form to input image of patient
        iii. Confirmation modal
5. Mobile Frontend
    a. Login Interface

    b. Client
        i. Main Page - Shows name, UUID, image of user, QR code
        ii. Confirmation of Scan
    c. Business
        i. QR Code Scanning
        ii. Post QR Scan Information
6. Data Flow
7. Testing
8. Documentation

Results

Key Personnel

Ellis Tran – Tran is a senior Computer Science major at the University of Arkansas. He has completed Software Engineering, Computer Vision, Computer Graphics, Database Management, Algorithms, and is currently enrolled in Computer Networks. He has experience in two research opportunities and 4 internships. He has done work for J.B. Hunt, Paycom, L3Harris, and Asimula where he did various work from backend server/automated testing, and frontend work for mobile in both ios and android. He has experience using Firebase, SQL, Python, Flutter, and React Native. He will be the team leader as well as setting up the initial backend and then working with Patrick to work on the mobile project.

Yaling Liu – Liu is a senior in Computer Science. She has completed Algorithms, Formal Language and Computability, Cryptography, and Computer Networks. She has participated in a cybersecurity research project for which she wrote an android app and a Chrome extension to enhance authentication security in browsers. She has also gained experience in backend and frontend web development using .NET Core and React as an intern at the Harvest Group Inc. Currently, she is contributing to Bastazo's internal application using Django and Angular. In the VacCheck project, she will be part of the subteam that designs and develops the web application using React and Firebase.

Patrick Kwok – Kwok is a senior Computer Science major with a minor in Mathematics at the University of Arkansas. He has completed Software Engineering, Database Management, Computer Network, and is currently enrolled in a Mobile Programming course. He is a proficient Mobile Developer with a demonstrated history of working as a mobile development intern at X/Link Software in Jakarta, Indonesia. He will be assisting in designing the UI/UX experience as well as working on the mobile application. Tools & technologies that are going to be used are the Flutter framework, Postman, and Figma UI/UX.

Sung Woo Kim – Kim is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed Software Engineering, Programming Paradigms, Database Management Systems, and Algorithms. He worked as a software engineer & executive assistance at Asimula Inc and IT technical assistance at Fullbright College. He is knowledgeable in understanding user interfaces, general web functions, and standards, and is experienced in building practical web pages that can effectively display material, provide interactivity, and increase efficiency using React. Therefore; he will be responsible to work on the frontend for the web application using programming frameworks like React and languages like JavaScript, CSS, and HTML.

Advisor - Dr. James Parkerson – Dr. Parkerson is an Associate Professor of Computer Engineering with degrees in Electrical Engineering. He was a design engineer in industry for 1.5 years and a senior design engineer for eight years. He was a Research Assistant Professor for four years, an Assistant Professor for six years, and an associate professor for 15 years. Currently, he is assisting us as an advisor for VacCheck for our Capstone Project.

References

[1] www.cbsnews.com/, https://www.cbsnews.com/news/covid-vaccination-cards-fake-scammers-fraud/

[2] Olson, C., Change, A. and Martin, H., 2021. *Businesses see opportunity and risk in California's digital vaccine records*. [online] Los Angeles Times. Available at: <https://www.latimes.com/business/story/2021-06-18/california-digital-vaccine-verification-system-new-tool-for-business> [Accessed 8 September 2021].

[3] "What You Need to Know about Variants," Centers for Disease Control and Prevention, Aug 2021. [Online]. Available: https://www.cdc.gov/coronavirus/2019-ncov/variants/variant.html.

[4] R. Romero, "Fake COVID-19 vaccination cards worry college officials", APNews, Aug 2021. [Online]. Available: https://apnews.com/article/coronavirus-education-fake-vaccination-cards-8c4ca2b4d54434c2fc022b34087df8cb

[5] "Small and Large Gatherings," Centers for Disease Control and Prevention, May 2021. [Online]. Available: https://www.cdc.gov/coronavirus/2019-ncov/your-health/gatherings.html.

[6] "Contact Tracing," Centers for Disease Control and Prevention, Feb 2021. [Online]. Available: https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/contact-tracing.html.
https://computer-science-and-computer-engineering.uark.edu/directory/index/uid/jparkers/name/Pat+Parkerson/

[7] *College of Engineering computer science and computer engineering*. Pat Parkerson | Directory | Computer Science and Computer Engineering | University of Arkansas. (n.d.). https://computer-science-and-computer-engineering.uark.edu/directory/index/uid/jparkers/name/Pat+Parkerson/.

[8] http://www01.koreaherald.com/view.php?ud=20200617000718