

Graduation report

Coronavirus Rapid Test Data Platform



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GRADUATION REPORT

FONTYS UNIVERSITY OF APPLIED SCIENCES

HBO-ICT: English Stream

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Preface

This documentation functions as a graduation internship thesis, which was held at the Fontys University of Applied Science, in Eindhoven, the Netherlands. As a fourth grader, this process is a must. My graduation contract was from the 7th of September 2020 to the 29th of January 2021.

Throughout my graduation internship, I was working on all the implementations and documentation by myself and guided by my company tutor and university tutor. I would like to say thank you to Mr. Erdiñ Saçan as my company tutor for the help and the guidance during this project. I would like to say thank you to Mrs. Mieke van Vucht as my university mentor for all the feedbacks and advice she gave me. I would also like to say thank you to Mr. Bartosz Paszkowski for the technical support and advice. Besides that, I would like to thank all Cyber Security Minor students for the support for the security aspects of the project.

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Summary

This project was accomplished at Fontys Hogeschool ICT (FHICT). FHICT is one of the Fontys Bachelor's programs, with the knowledge and skills learned from FHICT students can work as high-level engineers in the ICT sector.

FHICT is developing a secure, open web platform called Coronavirus Rapid Test Data platform for capturing and sharing sensitive personal data and Coronavirus rapid test result data. People who did Coronavirus rapid test of the test machine can get their test result in two minutes from the web platform. What is more, the web platform provides not only individual test results to testers, but also represent an overview of test results to researchers. By this, researchers mean that after obtaining rapid test data from the web platform, they can check the data to make sure that no one in a given environment is infected with the virus. For example, the researchers are likely to come from airports and aviation departments, which need to keep passengers safe. Researchers may also come from nursing facilities, where their colleagues have a lot of contact with others, so they need to protect internal staff from infection. Researchers from GGD can use this web platform to quickly determine and map Coronavirus transmission without contact investigation. I believe this web platform ensures that people are not infected and that all contact occupations are possible. People can work, live, or study in a safe environment.

Because of the web platform shares the privacy-sensitive rapid detection data. Not everyone is allowed to access all the Coronavirus test result data in the web platform. So, the main goal of this project for me is to build up a front-end and back-end solution where multiple researchers must be authenticated and authorized to access some of Coronavirus rapid test data through the web platform. Besides, the web platform must follow some key privacy and data protection requirements of the GDPR. The web platform must also avoid web security vulnerabilities to prevent private data leakage.

During the implementation, most goals have been achieved. Researchers must apply for an account through the website. They can log in the web platform only after the account application is successful. The web platform is connected to a remote database with test results, so they can access the real-time Coronavirus rapid test data on the web platform. The security of the web platform has been tested by Cyber Security Minor students. They are using SonarQube to catch bugs and vulnerabilities in the web platform. The security of the web platform was greatly improved.

As a conclusion, the Coronavirus Rapid Test Data platform is a useful tool for compliant, fast, and reliable sharing of privacy-sensitive rapid test data. I believe all people will benefit from this web platform.

Glossary

API	API is a computing interface that defines interactions between multiple software intermediaries.
Axios	Axios is a library that helps us make HTTP requests to external resources.
DOM	The Document Object Model (DOM) is a programming API for HTML and XML documents. It defines the logical structure of documents and the way a document is accessed and manipulated.
DOT	The DOT framework can help you to structure your research and to communicate about it.
Draw.io	Draw.io is proprietary software for making diagrams and charts.
Express	Express is a minimal and flexible Node.js web application framework that provides a robust set of features for web and mobile applications.
GDPR	The General Data Protection Regulation (GDPR) is a regulation in EU law on data protection and privacy in the European Union (EU) and the European Economic Area (EEA).
GitLab	Gitlab is a web-based lifecycle tool that provides repository management, issue tracking, and CI/CD pipeline features.
HTTP	Hypertext Transfer Protocol (HTTP) is an application-layer protocol for transmitting hypermedia documents, such as HTML.
ReactJS	A JavaScript library for building user interfaces.
REST	REST is an architectural style for providing standards between computer systems on the web, making it easier for systems to communicate with each other.
SonarQube	SonarQube is a web-based open-source platform used to measure and analyze the source code quality.
SSL	Secure Sockets Layer (SSL) is a standard security technology for establishing an encrypted link between a server and a client.
JavaScript	JavaScript is a text-based programming language used both on the client-side and server-side that allows you to make web

	pages interactive.
JWT	JSON Web Token (JWT) is a compact URL-safe means of representing claims to be transferred between two parties.
MySQL	MySQL is a relational database management system.
NodeJS	Node.js is an open-source, cross-platform, back-end, JavaScript runtime environment that executes JavaScript code outside a web browser.
UI	At the most basic level, the user interface (UI) is the series of screens, pages, and visual elements—like buttons and icons—that enable a person to interact with a product or service.
VPC	A virtual private cloud (VPC) is a virtual network dedicated to your Amazon account.

Chapter 1: Introduction

Nowadays, Coronavirus cases are increasing rapidly throughout the world. Health systems in many countries have collapsed. The government has had to enact strict anti-epidemic measures and lockdown many cities and areas. Several shops, restaurants, schools, and entertainment facilities have been closed. This has caused great inconvenience to people's lives and also a huge impact on the economy. Companies have suffered financial losses and people have lost their jobs.

To prevent the spread of the Coronavirus, the demand for a reliable rapid test is increasing. Together with various partners, FHICT helps to find solutions to get Coronavirus under it as quickly as possible. FHICT is cooperating with company Spektrax and Datastreams.io. Spektrax is currently developing a nanotechnology-based ultra-rapid COVID-19 test kit that takes minutes instead of hours with a test machine to get the Coronavirus rapid test result. This greatly reduces the testing time. The rapid test data will be stored in the database and go through the Datastreams platform. The Datastreams platform is provided by the company Datastreams.io. They developed a platform that can capture, share, and manage your data within and between organizations. What is more, the privacy-sensitive Coronavirus rapid test data is shared by the Web platform. So, the web platform must be secured and follow GDPR rules. Also, multiple researchers must be authenticated and authorized to access the data. So that the web platform can share various data among researchers.

The Coronavirus rapid test could be set up in every place in society, such as a restaurant, airport, or stadium. To be able to open these places safely, a reliable test machine and the web platform are required. Here is how it works: The tester identifies himself on the device using a private key (biometric, NFC in passport). Then do a Coronavirus rapid test and encrypt the test result. Only the tester can share the results with the private key in a secure environment. The researcher can access testers' Coronavirus test result data by using the web platform to make sure that no one gets infected in this public environment. With the Coronavirus Rapid Test Data platform, the Coronavirus rapid test can play an important role in reopening the economy and avoiding infection.

This report is divided into five main chapters. The first chapter introduces the project. The second chapter provides more detail information about the company and its partners. Chapter three elaborates the overview of the project, including project objectives and details of the project. Chapter four describes achieved results as well as the decision that is made and the process during the project. Chapter five is written as a conclusion with recommendations. The last chapter reflects the experience gained during the graduation internship.

Chapter 2: Companies

In this chapter, the company and its partners will be introduced.

2.1 Companies Description

Fontys University of Applied Science

Fontys[1] University of Applied Sciences is a Dutch University of Applied Sciences with more than 44,000 students at several campuses in the south of the Netherlands. Fontys offers 200 bachelor's and master's programs in the fields of economics, technology, health care, social work, physical education, and teacher training. Among them, in Eindhoven and Tilburg, they offer an extensive bachelor's degree program: HBO-ICT. The course has five majors (software Engineering, technology, infrastructure, media design, and business), as well as independent majors, including network security, game design, data science, intelligent mobility, and management and security.

Spektrax

Spektrax[2] was founded in the spring of 2020. The company is headquartered in Amsterdam and has a laboratory in Delft. The company now has 23 employees. Spektrax is developing a nanotechnology-based ultra-rapid COVID-19 test kit that takes minutes instead of hours, with a handheld device. The test kits will allow for rapid testing (minutes), anywhere in the world, without expensive and time-consuming lab facilities. Allowing people who test negative to visit their grandparents, board international flights, enter healthcare facilities, attend events, go to work; to safely participate in the global economy with trust and confidence. This will keep the economy going and give our scientists and health professionals time to deal with patients and to find cures and a vaccine.

Datastreams.io

Datastreams.io[3] was founded in 2016. The company is located in Eindhoven and now has 24 employees. Datastreams.io is a regulatory technology ("RegTech") company, whose intelligent automation & collaboration platform helps organizations to assure high-quality data and compliant data operations. Business processes, value chain (network) partners and innovations are all dependent on continuous trustworthy data to be shared in a secure and compliant way. Datastreams.io enables companies to get the most out of their data while upholding ever-increasing (digital) regulations, data governance and privacy standards. Datastreams.io has a strong academic background coming from the Brain port region in Noord-Brabant, has strong ties to the TU/e, Fontys ICT and participated in the MIT Accelerator Program in 2014.

2.2 Companies Structure

Below on (Fig.1) shows the companies structure of the project.

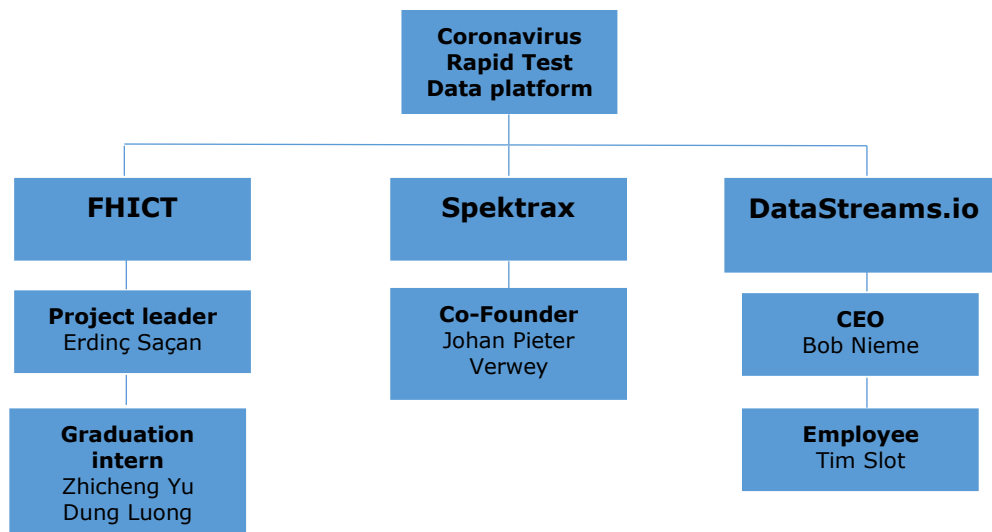


Fig.1 Companies Structure

2.3 Fontys Project Structure

I was working on this project with another graduate student intern. However, we got a different task. Lung Dung's task was to build a service that could receive test results from the test machine, then those test results will be stored in the user database and link to their accounts in the web platform. My task was to build the Datastreams service and the researcher service. The Datastreams service was developed by the Datastreams platform. It could get all test results from the user database and share test results to multiple researchers. The researcher service was developed by NodeJS. It was used to authenticate and authorize the researchers. My other task was to build the user interface of the web platform. Below on (Fig.2) shows the project assignment structure.

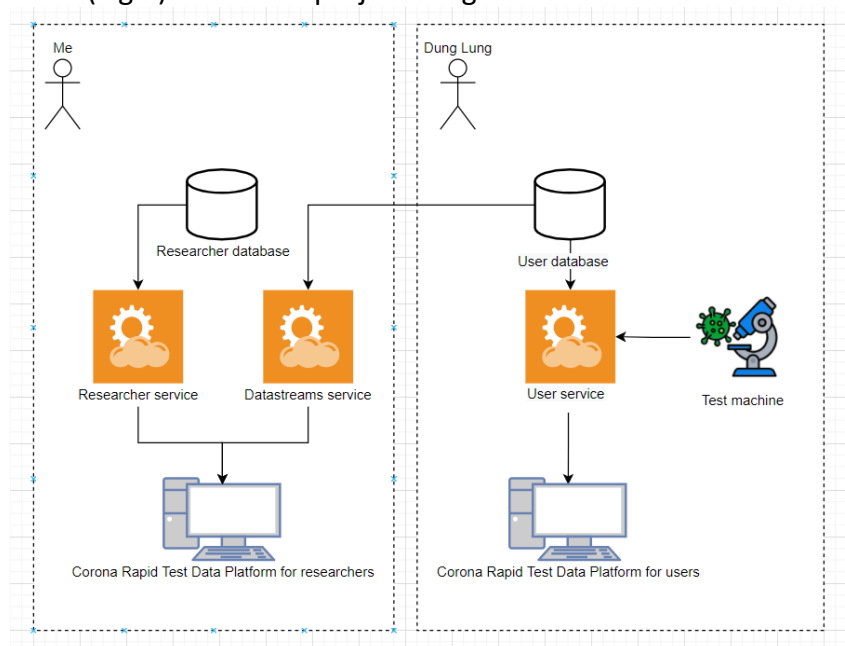


Fig.2 Project Structure

Chapter 3: Assignment Overview

In this chapter, the details of the assignment are described. The current situation, purpose, constraints, followed methodology, research strategy, and assignment phasing can be found below.

3.1 Current situation

At the moment, worldwide is searching for rapid tests. The company Bosch[4] has developed a new rapid detection method for its Coronavirus analysis equipment to detect Coronavirus. The test provides reliable results in 39 minutes and is currently the fastest polymerase chain reaction (PCR) test in the world. However, Spektrax is developing another high-precision test machine for the Coronavirus rapid test. It can be shown within just two minutes whether someone is infected or not. The Spektrax test machine will still have a big market in the future.

3.2 Problem Description

Currently, Spektrax is still developing the test machine. The test machine is not in use, which means no Coronavirus rapid test result data is available. So, the web platform is unable to capture the Coronavirus rapid test data from the database. Moreover, the web platform does not contain a front-end user interface and a back-end application programming interface.

3.3 Methodology

3.3.1 Research methodology

DOT (Development Oriented Triangulation) framework will be used as the research methodology. The DOT framework consists of five research strategies: Field, Library, Workshop, Lab and Showroom.

- Library: Find the needed resources and information about the technical aspect of the project. Most of the research is concentrated on the DataStreams service and the researcher service.
- Field: Collect all possible resources and information within the company. This means gathering requirements, setting goals, defining project issues, meeting with company mentors, and conducting research on GDPR, security risks and vulnerabilities, and software security best practices.
- Lab: Use the unit test to test the program. The test is accomplished before the new implementation.
- Showroom: Demonstrate the program to the company tutor. After each new Implementation, the result is shown to the company tutor to ensure that all requirements and functionalities correspond to his expectations.

- Workshop: Design and implement solutions based on the Library and Field strategy. Once the development phase is finished and the new development phase is being processed.

3.3.2 Development methodology

The methodology used in this project is Scrum. Scrum methodology is used to receive constant feedback from the company tutor which allows the project developer to successively improve and refine the product. The work is divided into regular, repeatable work cycles called “phases” that consist of planning, research, design, implementation, and testing. Each phase contains a weekly meeting, where the intern discusses with the company mentor what has been done the previous week and what is going to be done in the upcoming week. At the end of the phase, the developer shows to the mentor what he has done during the phase.

3.4 Goal

The requirement for the web platform is to capture Coronavirus rapid test result data for all testers through the Datastreams service and become available for researchers. Also, researchers must be authenticated and authorized to access some of the Coronavirus rapid test data, they are only able to read the data rather than edit, add, or delete the data. To fulfil the requirement of the web platform, the following implementations should be achieved:

- Create a remote database.
By using a Database Hosting Service to create a remote database. Due to lack of Coronavirus rapid test result data, some bogus data will be stored in the database for testing. Until the test machine is complete, the web platform can capture the real data from Spektrax’s database.
- Create a DataStreams service.
The Datastreams service can capture the test data from a remote database and stream the test data to the web platform.
- Create a researcher service.
The researcher service can authenticate and authorize the researchers. So, researchers can register an account and log in the web platform.
- Create a register page.
The registration page is for every researcher who would like to be a member of Coronavirus Rapid Test Data platform and has to be reviewed by an administrator.
- Create a login page.
The Login page is for every researcher and the administrator who would like to access the Coronavirus Rapid Test Data platform

- Create an admin page.
The admin page appears only after the administrator logs in to the web platform. After the administrator confirms that the researcher's identity is correct, the administrator can create a new account for researchers.
- Create a home page.
After the researcher logs in, it goes to the home page. The researcher will get a menu card with all available data types to select. Due to the project is to create an open standard and platform for the exchange of this type of privacy-sensitive data. Not only Coronavirus test data is available. But the Coronavirus test app is the first application.
- Create a data page.
All posted Coronavirus Rapid Test data will be shown on the data page. Researchers only can browser these data and search by TestDataID to access the specific data. Researchers are unable to edit or delete any test data.
- Create a profile page.
The profile page contains detail information about the researcher. The researcher can change the password in the profile page.

3.5 Phasing

The project is divided into six phases:

Phase1: The project survey and project plan are prepared for the beginning of the internship.

Phase2: Analysis research questions and find out the best solution to build up the web platform.

Phase3: Design front-end for user interface and back-end for the Datastreams service and the researcher service.

Phase4: Implement all the requirements and functions.

Phase5: Use the unit test to test the front-end and back-end application.

Phase6: All final documents are delivered, and the final presentation is prepared. The source code and documents will be pushed to the GitLab repository.

3.6 Project Constraints

The following constraints exist on this project:

- The front-end of the web platform must use ReactJS.
- Any use of data must comply with the EU's General Data Protection Regulations.
- Must use remote database.
- The web platform must be secured.
- The project must use the Scrum development methodology.
- GitLab must be used for a repository for storing the source code and documents.
- The project should be finished within the graduation internship period.

Chapter 4: Development process & Results

This chapter describes in detail the process and results of completing the project.

4.1 Project Initiation

The focus of the initial phase is to plan for the entire project. Develop a project plan after discussing with the company mentor what technologies and functions are required for the web platform. The technologies that are used on this project are ReactJS, NodeJS and the DataStreams platform. The functions of the Web platform are divided into two aspects. One is about GDPR compatibility and web platform security. The second is about data processing and data access.

4.2 Research & Analysis

To be able to design and implement the web platform, research questions must be prepared and answered. Due to the assignment adjustment, the following research questions will be slightly different from the project plan.

1. Which is the best back-end for ReactJS application and why?

Strategy – Library

Process:

The project requirement is to use ReactJS to develop the front-end of the web platform. Therefore, I needed to find the back-end language to build web platform. I did a lot of research on the internet based on this research question. I found out there are a lot of back-end languages could be used for React[5]. Each back-end language has its advantages and disadvantages, so the choice of one is a matter of personal preferences. Also, since React is a JavaScript library, the back-end language must be JavaScript. If the back-end language is not JavaScript, then the front-end cannot be tightly integrated with it.

Result:

I choose NodeJS[6] as a back-end language. There are several reasons why I choose NodeJS. NodeJS and React are both JavaScript Languages that can be executed both client-side as well as server-side. NodeJS uses the speed optimized V8 engine to address bulk requests that are handled through callback functions to ensure quantity and quality. Developers can run the React code directly in the NodeJS environment. The React DOM has components specially designed to work with NodeJS, which reduce lines of code, making server-side rendering comparably easy.

2. What is the Datastreams platform and how to use it?

Strategy – Field

Process:

Because there is no public document about Datastreams platform. I asked a meeting to meet with an employee from Datastream.io. He explained the technical details about the Datastreams platform.

Result:

Datastreams platform is a web application. It is a composable platform for real-time compliance service. There are many connection types can be created. There are two connections I must create to build the Datastreams service.

One connection is a SQL connection (Fig.3). The Datastreams platform is only able to make a connection with the SQL Database. The other connection is an HTTP Rest connection (Fig.4). The HTTP Rest connection contains several HTTP methods to perform CRUD functions. These two connections can compose the Datastreams service. The database connection will be used to create a SQL query. The SQL query can perform a SQL query with the selected database. The other connection will be used to create a data source. With this operation, it is possible to capture or read data from the selected input connection.

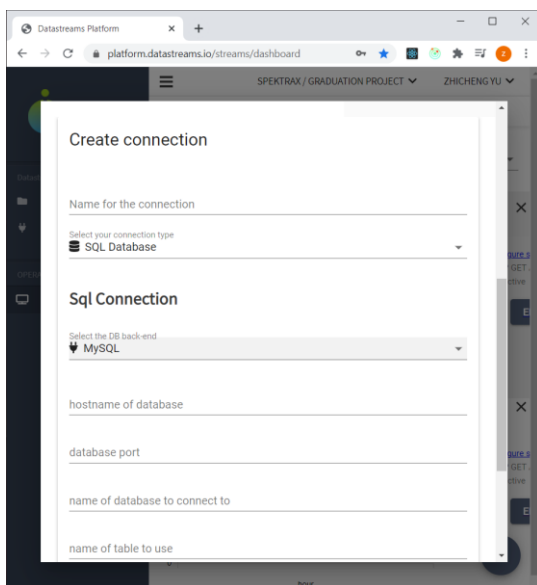


Fig.3 SQL Connection

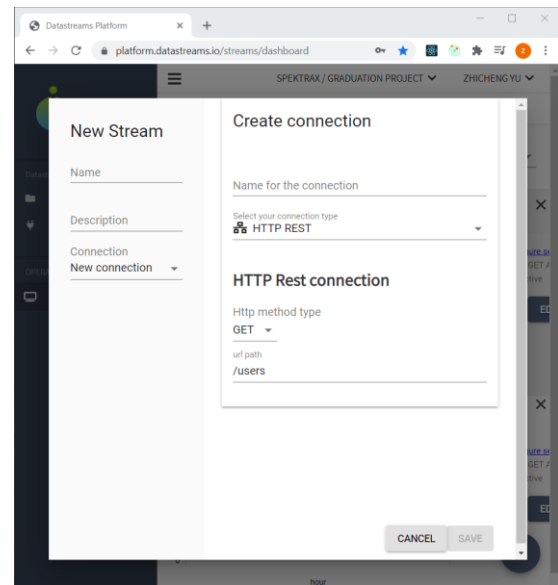


Fig.4 HTTP Rest connection

3. How to make the web platform GDPR compliant?

Strategy – Library

Process:

To answer this question, I did a lot of research on the internet. I need to understand “What is GDPR?” and “How to design the web platform to make it GDPR compliant?”.

Result:

GDPR[7] is the full name of the General Data Protection Regulation. The rules are designed to protect the personal data of people in EU countries.

The first step is to fill out the Privacy Policy. I have to let my users know what data I am going to collect, what I am doing with their data and how do I collect data and store it. This policy must be written in as much detail as possible. The easiest way is to add a link. Then, when users click on the link, they go to another page. This page contains the privacy policy.

The second step is to create an SSL certificate. An SSL certificate should be fitted to my website to encrypt the data to stop people from hijacking it. Thirdly, forms on the website should not include pre-ticked boxes. User needs to accept the opt-in tick box for each option. Fourthly, the website must have the correct procedures in place to detect, report and investigate any personal data breach. Fifthly, all data stored in the database will be encrypted to prevent the leakage of users' private data.

4. How to secure the web platform?

Strategy – Library

Process:

For this research question, I did discuss with Cyber Security Minor students. We discussed the security aspects of the project, including security interaction between systems, security advice and security of the architecture.

Result:

The web platform should be protected at two different layers[8]. At the API layer, the data that the user can read or change. At the React layer, the paths of the React app that the user can access.

The web platform has an authentication feature where researchers can log in or create an account. Typically, client authentication and authorization are exposed to multiple security vulnerabilities that can break these protocols in an application. The authentication and authorization feature can be secured by using JWT. JWT is a good way of securely transmitting information between React layer and API layer because they can be signed, which means you can be sure that the senders are who they say they are. JWT works like this (Fig.5). If a user logs in the web application, the JWT will be created with an encoded string in the API layer and the API layers return the JWT to the client application. On the client-side, JWT will be stored in cookies. Cookies are managed by the browser. They require less work on the application and can be more secure. So, the JWT will be managed at the browser and makes the application more difficult to create a bug that can potentially open some security vulnerability.

Besides, at the React layer, React router is used to protect routes for unauthorized access. If the user is not authenticated and authorized, he is unable to access other web pages.

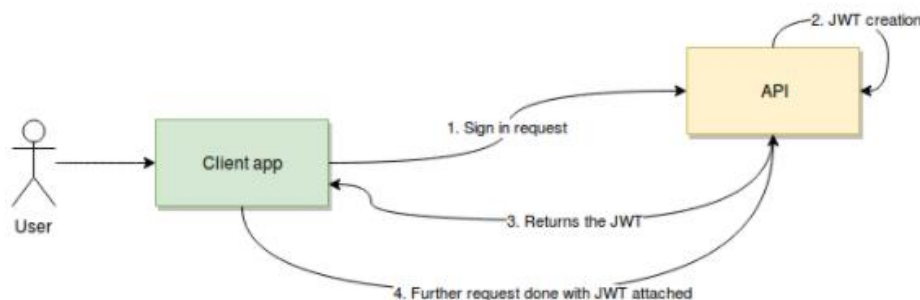


Fig.5 JWT workflow(<https://blog.logrocket.com/how-to-secure-a-rest-api-using-jwt-7efd83e71432/>)

5. What is the design pattern of the system?

Strategy - Library & Field

Process:

When I was researching the first question, I understood that React can be used with the MVC structure with React contributing to the View layer. Then I needed to research whether NodeJS can be used in the model layer and controller layer.

Result:

The design pattern of the system is MVC[9] (Fig.6). It is used majorly by Node developers and by C#, Ruby, PHP framework users too. M for the model, V for the user interface, and C for the controller. Structurally, it can be divided into three levels. The top layer is the "view layer", which is directly facing the end-user. It is provided to the user interface, is the shell of the program. So, the React layer is located in the view layer. The bottom layer, the core "data layer" (model) is the data or information that the program needs to manipulate. The middle layer, the "controller layer", is responsible for selecting the data in the "data layer" according to the user's input from the "view layer", and then acting on it to produce the final result. So, the API layer contains the data layer and the controller layer.

These three layers are closely related but are independent of each other, and changes within each layer do not affect the other layers. Each layer provides an interface for the upper layer to invoke. In this way, the software can be modularized, changing the appearance, or changing the data without changing other layers, greatly facilitating maintenance, and upgrading.

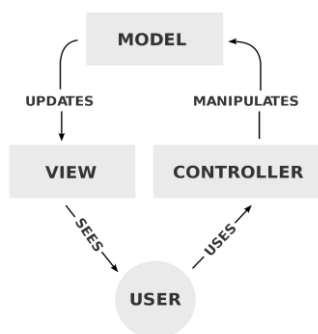


Fig.6 MVC design pattern

(<https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller>)

6. What is the architecture of the system?

Strategy – Library & Field

Process:

Since the front-end language is ReactJS and back-end language is NodeJS and the database is MySQL. I needed to research how to link them together.

Result:

The application will be built with the following architecture[10] (Fig.7). The user visits a website and sees the front-end which is built by React. When the user requests the data, the front-end will connect with the API endpoints built by NodeJS to send an

HTTP request and retrieve the HTTP response using Axios. NodeJS with Express.js exports REST APIs and interacts with MySQL database. So, the NodeJS with Express.js will query the data from the MySQL database, then send the result back to the front-end.

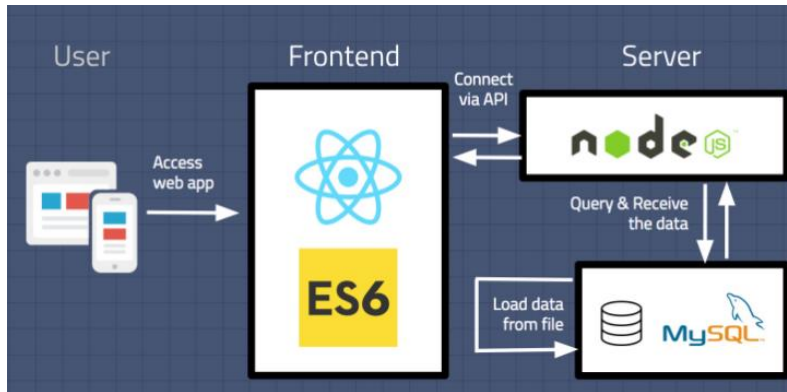


Fig.7 System Architecture

(<https://www.byperth.com/2018/04/19/guide-building-data-science-web-application-with-react-nodejs-and-mysql/>)

7. Which service is used to host a remote MySQL database?

Strategy –Library & Workshop

Process:

Because of the Datastreams service is only able to connect SQL database. So, I needed to find a service that can host a remote MySQL database. Besides, the service must ensure that the data is securely stored and accessed. After the remote MySQL database was created, I created a data table in the database and insert some data in it. Then check if the DataStreams service can connect to the MySQL database and fetch the data from the database.

Result:

I decided to use Amazon Aurora to host the remote MySQL database. Amazon Aurora is a fully managed relational database engine that is compatible with MySQL.

Amazon Aurora[11] provides multiple levels of security for your database. These include network isolation using Amazon VPC, encryption at rest using keys you create and control through AWS Key Management Service and encryption of data in transit using SSL. On an encrypted Amazon Aurora instance, data in the underlying storage is encrypted, as are the automated backups, snapshots, and replicas in the same cluster.

For the workshop research, I created a MySQL database in Amazon Aurora. The connection between Amazon Aurora and Datastreams platform was created successfully. Then I tried to use SELECT Statement to capture all the data from the data table and all the data represents in the Datastreams platform as JSON format.

4.3 Design

The design phase followed the MVC design pattern.

4.3.1 Front-end Design

The React front-end was created in the view layer. For the front-end design, a tool called draw.io was used to design the web platform user interfaces. There is a shape library Bootstrap is used to create the user interface. By using this shape library to help me to design the web platform faster and easier.

4.3.2 Back-end Design

The back-end design was divided into two parts. One part was to build the researcher service. The researcher service uses the router, controller, service, and database directory structure (Fig.8).

The database can make a connection with the database. The service was created in the data layer (model). The service connects with the database and contains several methods to deal with the database. These methods execute different SQL statement (SELECT, UPDATE, and INSERT INTO) to get data, update data from the database or insert new data to the database. Then the callback function is called inside the methods. It receives the data from the controller layer and passes the parameter as a result to the controller layer.

The controller was created in the controller layer. The controller called the models to get the data from the data layer and put that data to the view layer. The router contains several API routes. These API routes are used to handle all CRUD functions.

The other part was to build the Datastreams service. The Datastreams service consists of two connections. One connection is HTTP Rest connection. The HTTP method type is GET. That method is used to get data from the SQL query. The other connection is the database connection. That can connect Azure MYSQL Database service.

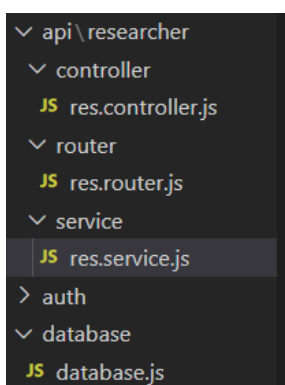


Fig.8 Back-end directory structure

4.3.3 Database Design

There were three data tables were created in Amazon Aurora MySQL database server. The first data table is called "Testdata". This data table contains all test result data which includes test id, test DateTime, test result and test location. The Datastreams service is used

to capture the data from this data table. The second data table is called “Verifyemail”. It stored the researcher’s email, verification code and verify state. The researcher service uses this data table to check whether the researchers have verified their email. If not, they will not be able to apply for an account. The other table is called “Register”. It is used for registration and login. It stores the researcher’s email and password. The password will be encrypted by the researcher service.

4.4 Implementation

4.4.1 Back-end Implementation

Researcher service

Data layer (Model)

The researcher service was developed by NodeJS. Several methods were created in the data layer (model). The first method “checkemail” is used to execute the SQL SELECT statement to get all the data from the data table “Verifyemail”.

The second method “addemail” gets the input email value and verification code value from the controller layer and executes the SQL INSERT INTO statement to store the input data to the data table “Verifyemail”.

The third method “activate” executes the SQL UPDATE statement to update the verify state data to “activated” in the data table “Verifyemail”.

The fourth method “create” gets the input email value and password value from the controller. It executes the SQL INSERT INTO statement to store the input data to the data table “Register”.

The fifth method “checkregisteremail” gets input email value from the controller and executes the SQL SELECT statement with WHERE clause to get the specific email data from the data table “Register”.

The sixth method “addverifycode” executes the SQL UPDATE statement to update the verification code data in the data table “Register”.

The seventh method “checkverifycode” gets input verification code value and email value from the controller and executes the SQL SELECT statement with WHERE clause to get the specific verification code data and email data from the data table “Register”.

All the methods above are used in the controller.

Controller layer (Controller)

Several methods were created in the controller layer. The first method is “sendverifyemail”. It gets user input email data from the view layer. Firstly, it uses the method “checkemail” from the data layer to check whether the researcher has verified his email. If the email value does exist, that means the researchers have verified his email. It sends an error message to the front-end. If the email value does not exist, it uses the other method “addemail” from the Model to add email value to the data table “Verifyemail” and use the module “nodemailer” to send an email (user input email value) with a verification link to researchers.

The second method is “activateemail”. It uses the method “activate” from the data layer. If the researcher clicks the verification link, it will update the verify state to “activated”.

The third method is “sendform”. It also gets user input email data from the view layer. It uses the method “checkemail” from the data layer to check whether the verify state is “activated” or not. If the verify state is “activated”, the method sends all researcher’s information to the administrator by email. Otherwise, the method will send the error message to front-end.

The fourth method is “register”. It gets user input email value and password value from the view layer. It uses the method “create” from the data layer to store email and password in the data table “Register”. The method uses a library “bcrypt” to hash the password.

The fifth method is “login”. It also gets user input email value and password value from the view layer. It uses the method “checkregisteremail” from the data layer to check whether the user is already registered. If the email data exists in the data table “Register”, “login” method will create JWT by the library “jsonwebtoken” and send JWT to front-end.

The sixth method is “twofactorauth”. It gets the user input email value from the view layer. It generates the verification code and sends it to the email (user input email value). Then it uses the method “addverifycode” from the data layer to store the verification code with specified email in data table “Register”.

The seventh method is “checktwofactorauth”. It gets the user input email value and verification code from the view layer. It uses the method “checkverifycode” from the data layer to check whether the user entered the correct verification code.

Then I define all routes for handling all CRUD operations. The following table shows an overview of the RESTful APIs that will be exported:

Methods	URLs	Actions
POST	/sendverifyemail	Send a verification link to the researcher.
POST	/activateemail	Activate the email.
POST	/sendform	Send the researcher’s detail information to the administrator.
POST	/register	Create a new account for researchers.
POST	/login	Login in the web platform.
POST	/twofactorauth	Two-factor authentication.
GET	/checktwofactorauth	Check the verification code.

Datastreams service

There are multiple Datastreams services (Fig.9) were created in the Datastreams platform. The data source was created to capture or read data from the selected input connection

“HTTP GET API”. When the connection is selected it will show the schema which is a list of known incoming data. This list can (based on input connection type) differ when processing real data. Then add a child operation “SQL query” to perform an SQL SELECT statement with the selected database connection. After that SQL query connects to a child operation “write to destination”. With this operation, it is possible to write stream data to front-end.

Besides, each DataStreams service can only capture one specific test location data from the database. Because the researcher only can access the data that is relevant to him. As a result, researchers have not been able to get all Coronavirus rapid test data.

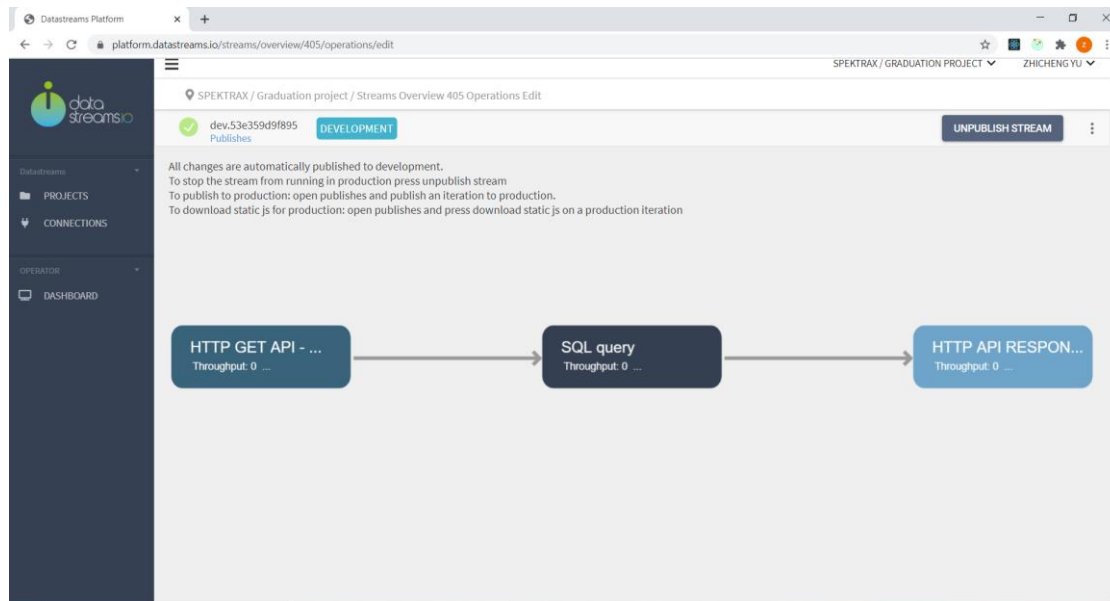


Fig.9 Datastreams service workflow

4.4.2 Front-end Implementation

View layer (View)

ReactJS is used to develop User Interface. There are several React components have been created. These React components contain some Bootstrap components which are imported from React bootstrap, including Alerts component, Buttons component, Forms component, Navbar component, Pagination component and Table component. These components build several web pages based on the front-end design. Besides, these React components are consuming REST APIs with Axios to send HTTP requests to the back-end service and manage HTTP response from the back-end service.

4.4.2 Results

Account application page:

The account application page (Fig.10) is for every researcher who would like to be a member of Coronavirus Rapid Test Data platform. The researcher must provide their email firstly. The researcher needs to click the link to verify the researcher’s email. Then the researcher will receive a verification link from his email (Fig.11). The researcher has to click that link. If the email is verified successfully, the interface will jump to the website page and show that the authentication has been successful. If the email is registered, the researcher will be alerted that your email is registered. After that, the researcher must enter his detail information (First name, last name, phone number, company/Institution name, URL, and position). The

Google Recaptcha prevents any spam or bots from entering data into fields on the web platform. Besides, researchers can click the link to check terms and conditions and privacy policy of the web platform. In the end, after clicking the “send” button, all the detailed information will send to the administrator via email. The administrator will verify against this data (Fig.12).

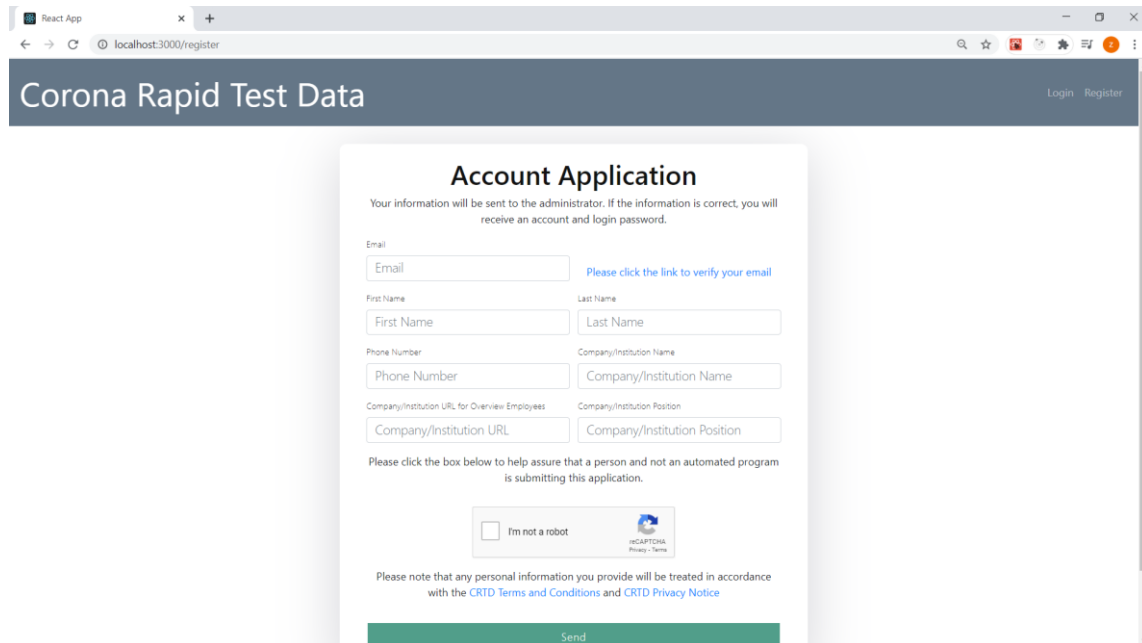


Fig.10 Account application page

Please confirm your Email account Inbox x

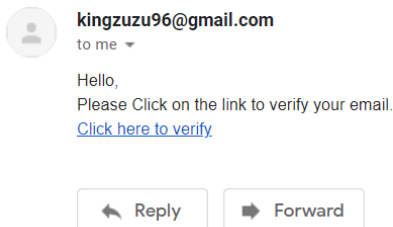


Fig.11 Verification link

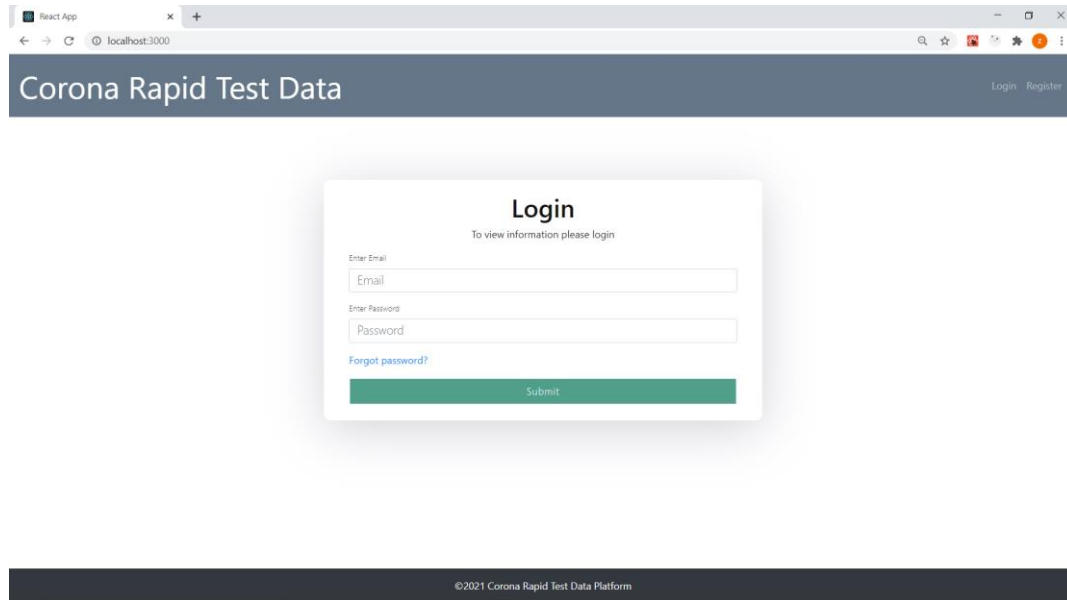
Please verify researcher's information Inbox x



Fig.12 Researcher information

Login page:

The Login page (Fig.13) is for every researcher and the administrator who would like to access the Coronavirus Rapid Test Data platform. They must provide their email and password to log in. The link 'forgot password' can help a researcher to reset his password.

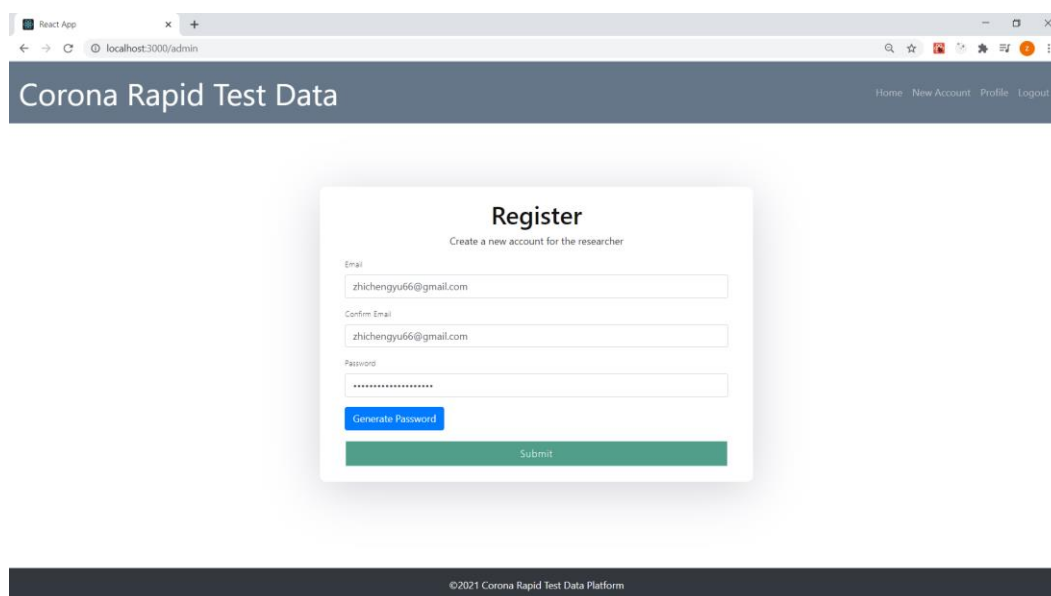


The screenshot shows a web browser window with the URL 'localhost:3000'. The header 'Corona Rapid Test Data' is in a dark blue bar, with 'Login Register' links on the right. The main content is a white 'Login' form with the subtitle 'To view information please login'. It contains two input fields: 'Email' and 'Password'. Below the password field is a blue link 'Forgot password?'. A green 'Submit' button is at the bottom of the form. The footer is a dark blue bar with the text '©2021 Corona Rapid Test Data Platform'.

Fig.13 Login page

Admin page:

The admin page (Fig.14) appears only after the administrator logs in to the web platform. After the administrator confirms that the researcher's identity is correct. The administrator must provide (username, researcher's email, and password) to create a new account for the researcher. The 20-digit password will be randomly generated from numbers and strings. After that, the system will send the username and password via email to the researcher (Fig.15).



The screenshot shows a web browser window with the URL 'localhost:3000/admin'. The header 'Corona Rapid Test Data' is in a dark blue bar, with 'Home New Account Profile Logout' links on the right. The main content is a white 'Register' form with the subtitle 'Create a new account for the researcher'. It contains three input fields: 'Email' (with 'zhichengyu66@gmail.com' entered), 'Confirm Email' (with 'zhichengyu66@gmail.com' entered), and 'Password' (with a masked password '*****'). Below the password field is a blue 'Generate Password' button. A green 'Submit' button is at the bottom of the form. The footer is a dark blue bar with the text '©2021 Corona Rapid Test Data Platform'.

Fig.14 Admin page

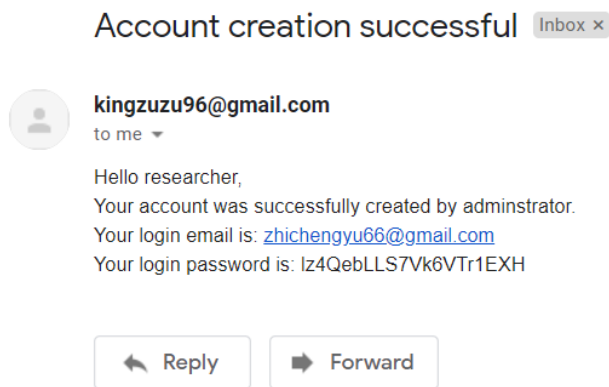


Fig.15 Account details

Two-factor authentication page:

Before logging in to the web platform (Fig.16), the researcher will receive a verification code in his email (Fig.17). Then the researcher needs to enter the correct verification code to log in.

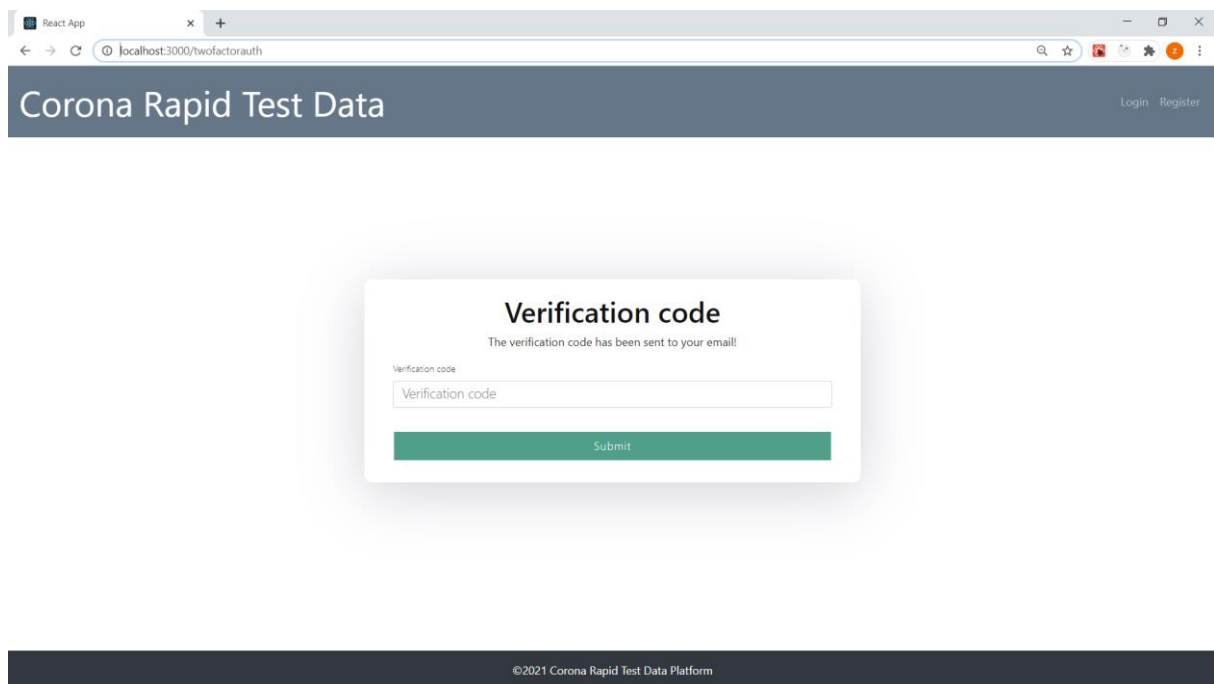


Fig.16 Two factor authentication page

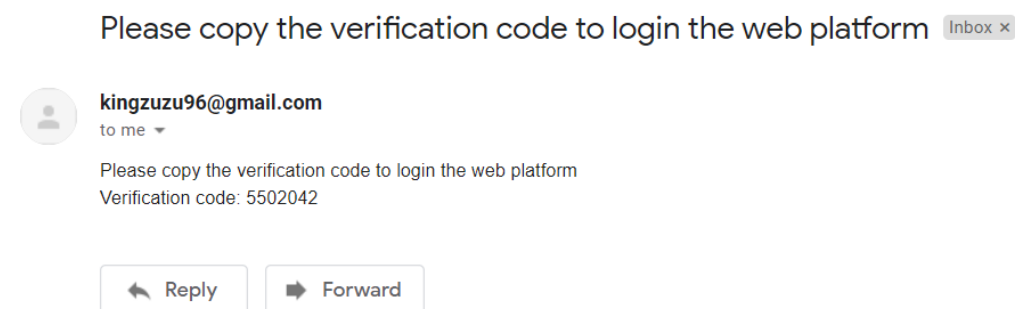


Fig.17 Verification code

Home page:

After the researcher logs in, it goes to the Home page (Fig.18). The research will get a menu card with all available data types to select. Due to the project is to create an open standard and platform for the exchange of this type of privacy-sensitive data. In the future, the web platform does not only share the Coronavirus rapid test data. But now the Coronavirus test app is the first application.

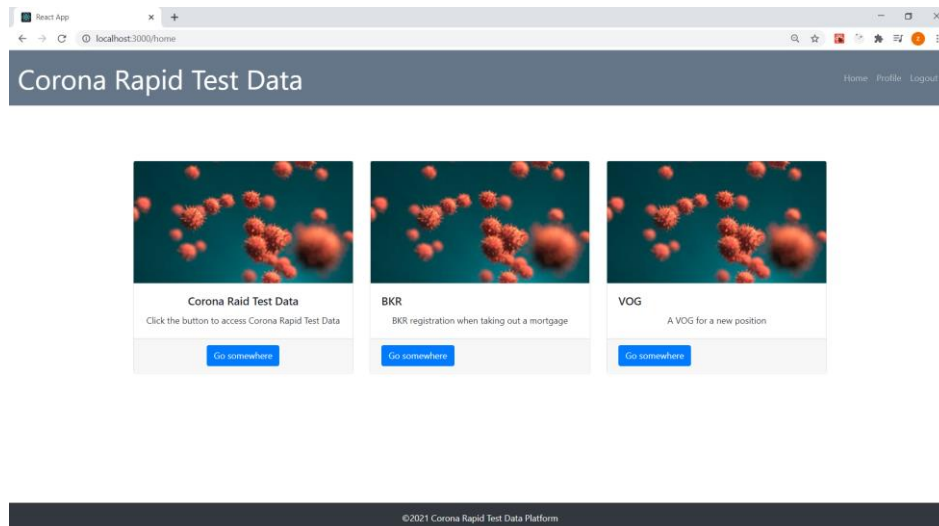


Fig.18 Home page

Data page:

After the researcher selects the menu card 'Coronavirus Rapid Test Data'. All posted Coronavirus Rapid Test data will be shown on the data page (Fig.19). The administrator can access all Coronavirus rapid test data. Researchers only can browser these data with one specific test location. For example, a researcher from airlines can only access the test location "Airport". Research also can search by TestDataID or Test DateTime or test result or test location to access the specific data.

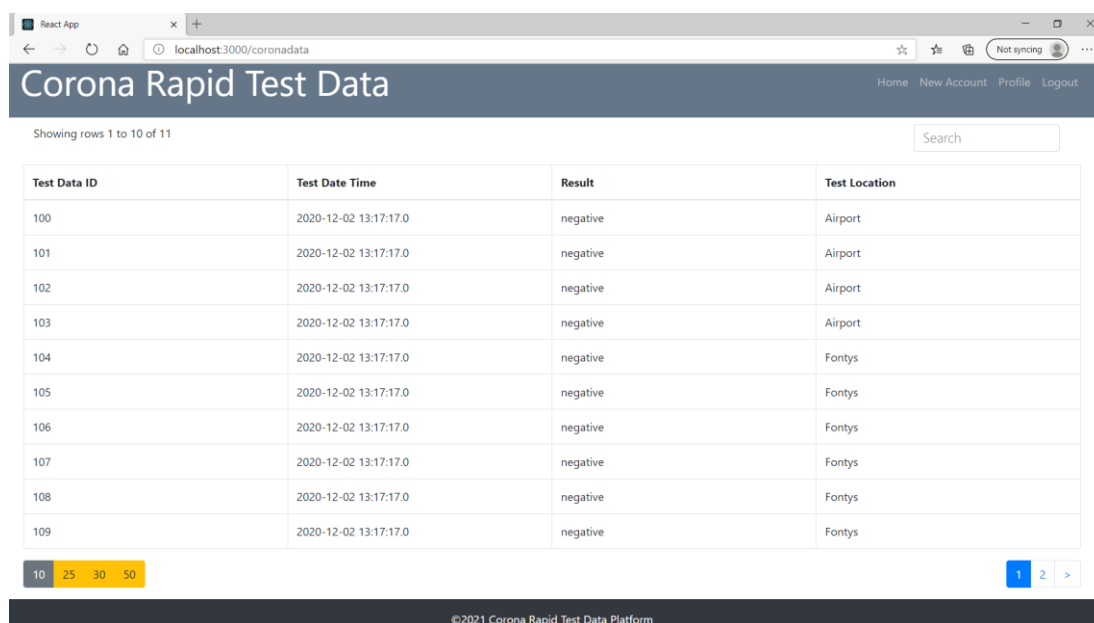


Fig.19 Data page

Profile page:

The profile page (Fig.20) contains the detail information about the researcher. The researcher can change the password in the profile page. The researcher needs to enter email, old password, and new password to change the password.

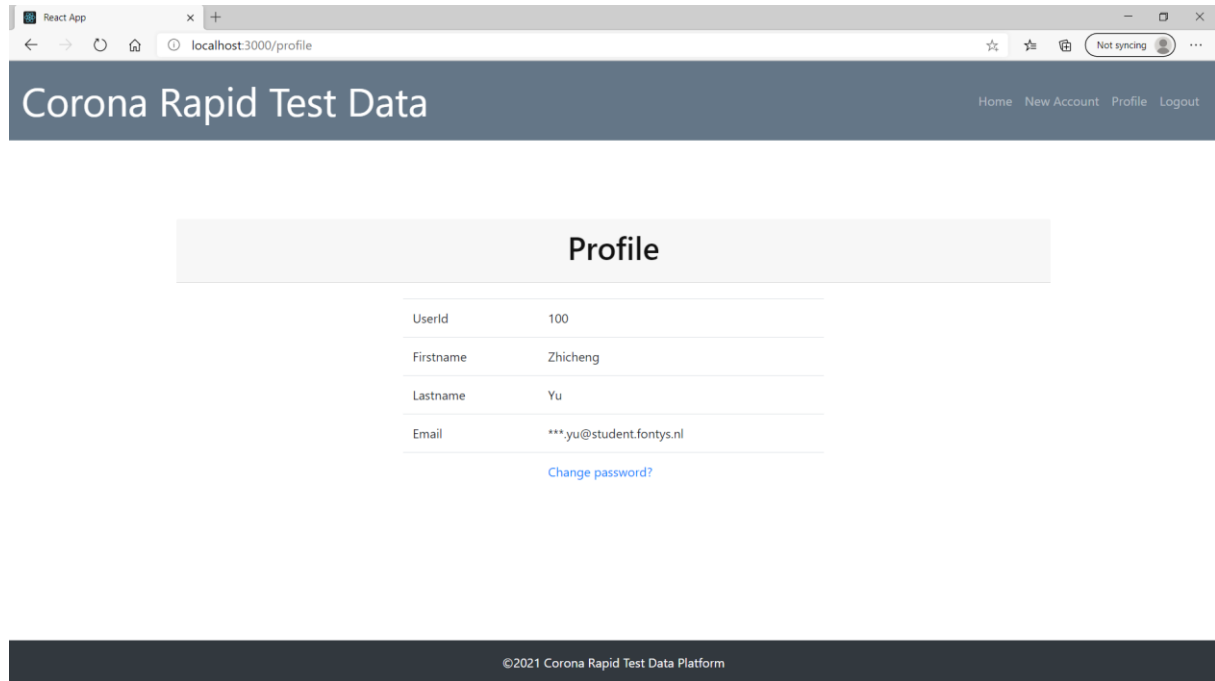


Fig.20 Profile page

4.5 Unit Testing

The final product shall be tested before release. The purpose of this test is to ensure that all requirements are well implemented and run. Both front-end and back-end for unit testing will be tested by Jest. Jest is a delightful JavaScript Testing Framework with a focus on simplicity. Jest is used to test components and functions in the source code and ensure that the code does not report errors during execution.

4.6 Finalization

At the end of the graduation internship, all the documentation and the source code will be pushed to the GitLab repository. A final presentation will introduce the graduation internship process and final results to the company tutor and school tutor.

Chapter 5: Conclusions and recommendations

The Coronavirus rapid test data platform is a tool which shares the Coronavirus rapid test result to researchers. Multiple researchers have to be authenticated and authorized to access the web platform. After that, they can read the data and find out if anyone is infected. This would allow infected people to be detected and prevent further transmission.

The front-end of the web platform is developed by ReactJS. ReactJS is used to develop the user interface. The back-end of the web platform consists of NodeJS and Datastreams service. NodeJS is used to back-end API services. Datastreams service is created in the Datastreams platform. That is used to capture, share, and manage the Coronavirus rapid test data.

Besides, the web platform is also suitable for all companies who want to enable the sharing of sensitive personal data safely and reliably. This can concern medical but also personal financial or legal data.

For future development and research, some recommendations can be:

- Make the test machine that can connect to the web platform. So, the web platform can present real-time Coronavirus rapid test data immediately.
- The researcher can change their password in the web platform.
- If the researcher forgot his password, he could reset his password.
- The administrator can delete researchers' accounts when they do not cooperate with Spektrax.
- Using React Native to develop a mobile application. The mobile application has the same features as the web platform. So, it will be more convenient to use.
- The content of the privacy policy needs to be improved.

Evaluation

Due to the special circumstances of this year, most of the internship time was spent at home. I thought that the internship at home might not get much help and guidance from company mentors. However, during the internship period, I had enough attention from my company mentor, Mr. Erdiñ Saçan and Mr. Bartosz Paszkowski. We did a lot of brainstorming about the content of the assignment. More importantly, we have weekly meetings where I get feedback. And I use that feedback to improve the quality of my work. Besides that, this internship also gave me a lot of lessons in technical and non-technical aspect.

On the technical aspect, the Nodejs web application framework is a new skill that I have gained. Before the start of my internship, I did not know the Nodejs web application framework, however, by the time I gained a lot of new knowledge and that made me feel more confident to continue.

On the non-technical aspect, I learn how to work in a team, how to do a professional meeting with the client, how to negotiate with a client when something is not technically possible to implement and giving suggestion on the technical side of a problem.

In general, I am grateful for the opportunity to do a graduate internship at Fontys. The company mentor attaches great importance to my ideas and opinions. Let me be proud of the effort put into this project. I am also pleased to announce that this project has been successfully implemented. The skills I accumulate, whether they are new or improvements to existing skills, will play a role in my future career.

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Appendix A: Project proposal

Form V1.1

Project Proposal

Student details

Initial study route : Software Engineering

Stream : English

Graduation route : S

Studentnumber : 2626845

First name + Family name : Zhicheng Yu

Organisation details

Name : Fontys University of Applied Sciences

Visiting address : Rachelsmolen 1

Zipcode + City + Country : 5612 MA Eindhoven the Netherlands

Phone : 08850 80000

Website : <https://fontys.nl/>

Company mentor

(person who guides the student on a regular basis)

First name + Family name : Erdinc Saçan

Department : ICT & Business

Position : Project manager

Background (highest education) : Master

Background URL :

Phone : +31638501002

Email : e.sacan@fontys.nl

Duration

Start date : 31/08/2020
(note: official start date, documented in the studyguide, flexibility allowed for OvP)

End date : 12/01/2021
(note: official end date, documented in the studyguide, flexibility allowed for OvP)

ASAM Assignment : No

If yes, link to assignment in ASAM :

Description of the project

Title (define a name for your assignment)

A robot does not receive Corona

- 1. Problem/opportunity analysis** Describe the company and the context they operate in. Who are the different stakeholders involved? Are there related projects? What problem(s) or opportunities are relevant for your assignment, and why? Describe the starting situation. Who is affected by the problems? Etc.

Fontys Hogeschool ICT (FHICT) is a leading and innovative institute that provides contemporary and exciting ICT education at the Associate degree and Bachelor in full-time and part-time levels. They work closely with ICT companies and organizations from the professional field, our 'Partners in Education'. FHICT cooperates with a company called Datastreams. Datastreams is a regulatory technology ("RegTech") company, helps organizations to assure high-quality data and compliant data operations. The stakeholder is Spektrax. Spektrax is a company that has further developed an existing spectrum analysis technology for Corona. With a prototype it can be shown within 2 minutes whether someone is infected or not. So the related project is to build up a "Tikkie" application and open platform for compliant, fast and reliable sharing of privacy-sensitive rapid test data.

The problem is the government, companies and organizations want to get these Corona test data to guarantee the secure environment. The starting situation is we want to create a 100% reliable data system around this application. With a private key (biometric, NFC in passport) a user identifies himself at the device, the Corona test is taken, stored encrypted and only the user can share the result with his or his key and in a secure environment.

A lot of people can be affected by the problems. In airport, the aviation sector can guarantee the safety of travelers. All contact professions that become possible if there is a guarantee that people are not infected.

- 2. Assignment** Specify initial assignment, goals, scope, products to be delivered/realized, technology to be used

The initial assignment is to realize a privacy-friendly and secure information platform. In order to realize that, I need to develop appropriate Identification Methods and Encryption Methods. The identification method can identify the user's information correctly. The encryption method ensures that personal information and data of test results will be stolen.

The goal of assignment is to develop a secure, open platform for capturing and sharing sensitive personal data and corona related information flows. The platform is suitable for all parties who want to enable the sharing of sensitive personal data in a safe and reliable way. This can concern medical but also personal financial or legal data. Data streams can develop services on this, just like other entrepreneurs. The platform is offered open source to stimulate the creation of a standard, which also increases the chance of commercial application and therefore economic impact.

- 3. Relation to research** Which areas of the assignment are expected to require a research attitude? What could be related research questions?

Main question:

How can we record critical personal data 100% securely and reliably and make it accessible once upon approval of the owner, with the convenience of a Tikkie?

Sub-questions:

- What needs to be done to make the platform generalizable to other use cases?
- What does the identification process look like, which user interaction is appropriate for this? Which development tools can you best use for this
- How do you disconnect the data platform from the identification process. Which development tools are appropriate for this?

Appendix B: Project plan



PROJECT PLAN
FONTYS UNIVERSITY OF APPLIED SCIENCES
HBO-ICT: English Stream

Data student:	
Family name, initials:	Zhicheng Yu
Student number:	2626845
project period: (from – till)	07-09-2020 to 15-01-2021
Data company:	
Name company/institution:	Fontys University of Applied Sciences
Department:	FHICT
Address:	Rachelsmolen 1, 5612 MA
Company tutor:	
Family name, initials:	Erdinç Saçan
Position:	Project Leader
University tutor:	
Family name, initials:	Mieke van Vucht
Project plan:	
Title:	A robot does not receive Corona
Version:	3.0
Date:	24-09-2020

Approved and signed by the company tutor:

Date:

Signature:

Approved and signed by the university tutor:

Date:

Signature:

Agreed and signed by the student:

Date:

Signature:

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MAIN RESEACH QUESTION	XL
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PHASE 2: RESEARCH & ANALYSIS	XLI
ITERATION ONE	XLI
ITERATION TWO	XLI
PHASE 6: FINALIZATION	XLII
DETAILED PLANNING	XLII
TEST APPROACH AND CONFIGURATION MANAGEMENT	XLIII
TEST APPROACH AND STRATEGY	XLIII
TEST ENVIRONMENT AND SUPPLIES	XLIII
CONFIGURATION MANAGEMENT	XLIII
MANAGEMENT PLAN	XLIV
MONEY	XLIV
SKILLS	XLIV
METHODOLOGY	XLIV
QUALITY	XLIV
INFORMATION	XLV
TIME	XLV
ORGANIZATION	XLV

INTRODUCTION

Now, Coronavirus is raging around the world. To slow the spread of the virus, people have to change their way of life. People are working from home, taking classes online and cutting down on unnecessary trips. The epidemic has also had a huge impact on the economy, with restaurants and tourism hit hard and a large number of workers losing their jobs. To bring people back to their normal lives, many countries are developing vaccines. But until a vaccine is developed, many countries are rapidly testing the virus to avoid widespread transmission.

SPEKTRAX is a company that has further developed an existing spectrum analysis technology for Corona. With a prototype, it can be shown within 2 minutes whether someone is infected or not. With this project, we want to create a 100% reliable data system around this application. With a private key (biometric, NFC in passport) a user identifies himself at the device, then the test is taken, stored encrypted and only the user can get the test result with his or his key in a secure environment. The spectrum meter is used for reliable and user-friendly detection of the Coronavirus. The project is working on the realization of a privacy-friendly and secure information web platform.

The web platform can share the Corona test data to researchers. Those researchers are coming from the government, companies, and organizations. All of them become users of the web platform. Multiple users have to be authenticated and authorized to access the Corona test data. Besides, the web platform must follow the rule of the General Data Protection Regulation (GDPR). This regulation was put in place to protect the privacy of European Union citizens as it relates to Non-Personal Data and Personal Data that is collected when using data capture entities, including websites. To share the data in a GDPR proof way, the web platform needs to apply DataStreams service. Datastreams is a regulatory technology ("RegTech") company, whose intelligent automation & collaboration platform helps organizations to assure high-quality data and compliant data operations. Datastreams service can collect, stream, process and share data – in a simple, ethical and (GDPR) compliant manner. So, the data has to go through the DataStreams service then becomes available on the web platform. Then multiple researchers that they are authenticated and authorized to access the web platform to check the test data and users agreed that their data can be shared. With this data, the government, companies, or organizations can ensure a safe environment in which no one is infected.

What is more, the concrete question can easily be generalized to other applications in which privacy-sensitive data sometimes has to be shared. For example, taking out a mortgage in Credit Registration Office. That is why we want to create an open standard and platform for the exchange of this type of privacy-sensitive data. The Corona test app is the first application.

The goal of this project plan is to create a web platform for compliant, fast, and reliable sharing of privacy-sensitive rapid Corona test data. Within this document, the following subjects will be taken into consideration: the project statements, project objectives, project sprints, and the management plan.

PROJECT STATEMENT

Formal Client

Mr. Erdinç Saçan from FHICT is my company tutor with background Master on ICT Business. He is also the project leader of this project. The company SPEKTRAX commissioned him and his group to complete a web platform for ultra-rapid COVID-19 test kit application.

Current Situation

Worldwide work is being done on rapid tests with which Coronavirus can be detected. SPEKTRAX is currently developing a nanotechnology-based ultra-rapid COVID-19 test kit that takes minutes instead of hours with a handheld device. The government, companies and organizations want to get these test data to guarantee a secure environment. The test data is stored only at the data source (cloud of SPEKTRAX) and as long as testers agreed that their data can be shared.

I think there are already some platforms that can store and share sensitive data. But I think the database from SPEKTRAX is going to be very large because in the future a lot of people is going to do the rapid test and all the test data is going to store in the database. If the company SPEKTRAX wants to use another platform, they need to pay a lot of money for sharing data service. What is more, I think most platforms must store data before they can share it, but the company SPEKTRAX does not want to store these sensitive data in the other platforms. They would like to only store the data in their database.

Consequently, there is a need for a platform that can share the test data to researchers. The data must be anonymized, secure, reusable, supports analytics, robust and scalability. Multiple researchers have to be authenticated and authorized to access some of the data.

Project Justification

Recognizing the demand from the government, companies, and organizations, it was decided to develop an application to provide a web platform where they can get valuable information. Every party is going to benefit from this web platform. For example, Airports and the aviation sector can guarantee the safety of travelers. Care organizations in which employees have a lot of contact with others because it can be guaranteed that the employees who are inside are not infected. All contact professions that become possible if there is a guarantee that people are not infected. In the case of contact investigations of GDD, the spread of the contamination can be established and mapped much faster.

The application will have a front-end (client) talks to the backend (server) by using a protocol through the RESTful API. The backend is going to use DataStreams service to receive these calls and call the backing database through TCP to fetch such data and send it back to the frontend. One database is coming from SPEKTRAX which stores test data, and the other database stores the data about researchers detailed information. So, researchers can access the test data or register a new account or login the web platform through the frontend.

Project Goal

The goal of the task is to develop a secure, open web platform for capturing and sharing sensitive personal data and corona related information flows. The web platform is suitable for all parties who want to share sensitive personal data securely and reliably. This may involve medical data, but also personal financial or legal data. Like other entrepreneurs, DataStreams can also develop services on this basis. The platform provides an open source

to facilitate the creation of standards, which also increases the opportunities for commercial applications, thereby increasing the economic impact.

PROJECT OBJECTIVES

Project Product

The proposed product is to develop a secure, open platform for capturing and sharing sensitive personal data and corona related information flows.

The following functionality must be implemented:

- The web platform can get Corona test data from the data source (SPEKTRAX). Data is shared only if the tester agrees to share it.
- The web platform can store researchers' detail information after researchers register a new account.
- The Corona test data has to go through DataStreams service and become available for the government, companies, and organizations.
- The researcher has to be authenticated and authorized to access some of the Coronavirus test data.
- At some point in time researchers' authorization can be revoked.

Project Deliverables and Non-Deliverables

Deliverables for Fontys

- Project Plan
- Project Final Report
- Day Declaration Form
- Assessment Form
- Personal Evaluation Form
- Final Presentation

Deliverables for Company

- Project Plan
- Project Final Report
- Final Presentation
- Running and working web platform application
- The source code of the project
- Test report

Non-Deliverables

- Training

Project constraint

Software implementation

- The front-end framework for web application should be developed by ReactJS.
- The back-end framework for web application should be developed by JavaScript.
- The main programming language of the project is JavaScript.
- For the project development, the integrated development environment is Visual Studio Code.
- The web platform needs to integrate with DataStreams service and a cloud of SPEKTRAX.

Design

- The web pages (functionalities) should be user friendly.

Time

- The duration of the internship is 5 months (from 7th of September to 25th of January), so the web platform must be finished before the end of the project.

Project risk

The risks of the project are assessed below.

Risk	Description	Likelihood	Impact	Mitigation Strategy
Missing Deadline	Not all of the discussed functionality might be implemented before the deadline	Medium	Medium	At the beginning of each week, the intern will put some deadlines for the tasks for the week and do not try to miss them
Changes	Changes might be requested and might not be possible to implement because of various reasons (e.g., not enough time, not applicable)	Medium	Low	The changes will be discussed in detail and either rejected or required resources will be provided to accomplish the changes
Accuracy	Needed functionality will not be 100% precise	Medium	Medium	Each functionality will be tested before starting another task and if there is some inaccuracy coming from the source code, the intern will rewrite the part where the problem is
Implementation Error	The system might encounter errors	High	Low	A different approach will be used as the intern tries not to miss the scheduled deadline
New technology	The technology of DataStreams platform is new for me	Low	Low	Contact the Datastreams technician and get help immediately if I have a problem

Data leak	Sensitive data could be compromised	Medium	High	Using appropriate Identification methods and Encryption methods to avoid data leak
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PROJECT RESEARCH

Main research question

How to create a web platform to share people's Coronavirus test data?

Sub research question

- How to capture the Corona test data from SPEKTRAX?
- How can we share in a GDPR proof way the data of various medical tests among researchers?
- Which real-time data-processing architecture are we going to use?
- How to establish the connection between front end, the back end of the web platform and database from SPEKTRAX?
- How can multiple researchers be authenticated and authorized to access Corona test data?
- How to revoke the researcher's authorization in some way?
- What needs to be done to make the web platform generalizable to other business uses?

Research methodology

In the report, a 'DOT' research framework will be used. This framework consists of 5 strategies. They are,

Library: Information gathering from resources.

Field: Information gathering the project itself.

Workshop: Implementation of the product.

Lab: Product testing.

Showroom: Product demonstration.

Sub question	Method
How to capture the Corona test data from SPEKTRAX?	Library & Field
How can we share in a GDPR proof way the data of various medical tests among researchers?	Library & Field
Which real-time data processing architecture are we going to use?	Library & Field
How to establish the connection between front end, the back end of the web platform and database from SPEKTRAX?	Field & Workshop & Lab
How can multiple researchers be authenticated and authorized to access Corona test data?	Field & Workshop & Lab
How to revoke the researcher's authorization	Library & Field & Lab

in some way?	
What needs to be done to make the web platform generalizable to other business uses?	Workshop & Showroom

PROJECT PHASING

The project is divided into 6 phases, each phase resulting in different deliverables. Phase 3, 4 and 5 will be repeated in each one of the iterations. The iterations take place between Phase 1 and Phase 6. A general phasing overview can be found below.

Phase 1: Initiation

During the Initialization phase, I am going to create the first version of the project plan, the scope and the goals of the project will be described and determined. Since this project is about developing a web platform with DataStreams service, it is good to know the technology of DataStreams.

Phase 2: Research & Analysis

Research and analysis of the project are needed for the implementation phase to make sure the used technology and methodology are the right one. I am using the DOT Framework approach for it.

Iteration One

Phase 3: Design

During the design phase, I am going to use data processing architecture – Kappa. the Kappa architecture is composed of only two layers: stream processing and serving. The stream processing layer runs the stream processing jobs. The stream processing job is run to enable real-time data processing. The serving layer is used to query the results.

Phase 4 & 5: Implementation and Testing

During the implementation phase, I am going to use backend with DataStreams service to define and capture the data from the database. Then configure and manage privacy and compliance levels to anonymous or personal data according to data regulations like the GDPR. Then choose the destination and stream the data to the frontend of the web platform. Then the web platform can share the real-time data to researchers.

During the testing period, I am going to perform testing which is based on the use case and debug if needed. Then show the result to the company mentor.

Iteration two

Phase 3: Design

During the design phase, I am going to design to two pages. One of the pages is used for researchers to register a new account. The other page is used for the researcher to log in the web platform. I am also going to create a database. After researchers register a new account, all the detail information about researchers will be store in the database.

Phase 4 & 5: Implementation and Testing

During the implementation phase, I am going to work on the front-end framework to realize the design of web pages. The front-end also contains router and component to send HTTP requests to the backend. The back-end server that has a router, controller, and model to process the request and query the database server. The database server processes the

query, and the back-end server will grab the data and sent it back to the front-end as a JSON response. The front-end will now have the data and show the data to researchers.

During the testing period, I am going to perform testing which is based on the use case and debug if needed. Then show the result to the company mentor.

Phase 6: Finalization

This is the last period of the project. This is the final product of this project will be given to the client. Besides that, the final report will be completed, and a presentation of the project result will be presented. The software products are stored in a GIT repository and all other relevant documentation in the project wiki.

Detailed Planning

Phase	Activities	Deliverables	Deadline
Initiation	Create a project plan	Project plan	02-10-2020
Research & Analysis	Research DataStreams technology	Use cases	02-10-2020
Design	Create data process architecture	Data process architecture	18-10-2020
Implementation	Get data from the data source	Web platform shares the data	06-11-2020
Testing	Testing the source code	The web platform is running without any error	27-11-2020
Design	Design web pages and database	Design for Register page and login page	04-12-2020
Implementation	Create register, login page and database	Register page, login page and database	18-12-2020
Testing	Testing the source code	The web platform is running without any error	01-01-2021
Finalization	Finish the final report	Final report and the final product	15-01-2021

TEST APPROACH AND CONFIGURATION MANAGEMENT

Test approach and strategy

I will test several functionalities behaviors on the web platform by following functional and non-functional requirements.

Non-Functionality Test

1. User Interface Testing

Evaluates the overall performance of the system. Key elements are as follows:

- The application must have good compatibility with distributed environments.
- The application must be user-friendly, so the user selections must be smooth and direct the users into the wanted pages in no more than two clicks.
- The application will have an easy-to-understand GUI, the buttons, selections etc. must be recognizable by the user. So, the mechanism would not take a lot of time.

2. Transferring DataEvaluates the GUI. Key points are:

- Data is travelling correctly between backend and frontend.
- GUI should not annoy the user or gets difficult to understand.

Functionality Test

1. DataStreams service can capture the data.
2. DataStreams service can configure and manage the data.
3. DataStreams service can stream the data to the web platform.
1. User can register a new account.
2. User can log in a new account.
3. User can access the shared data.

Test environment and supplies

We recommend systems that meet or exceed the following specifications:

- Processor (CPU): Intel Core i5 1.7ghz
- Operating system: Microsoft Windows 8 or above
- Memory: 8GB RAM
- Monitor/Display: 14 " LCD monitor

Configuration management

The source code is stored in a GitLab repository. In the process of developing the web platform, I am going to create several branches. Each branch is going to match each functional requirement. After that, all the branches will be merged and push to the master branch. So, the master branch contains the final project product.

The integrated development environment is Visual Studio Code (version 1.49). I decided to use visual studio code as my code editor because it has many features and advantages. One of the features is that it has a built-in terminal, this feature makes it very convenient since there is no need to switch windows or alter the state of an existing terminal to perform a quick command-line task. Simply hit Command/Control+Shift+P to bring it up. Another feature, it has Git built-in, which makes it easy to instantly see the changes you are making in the project. On the left of the sidebar, the user can find the Git icon where the Git can be initialized, as well as perform several Git commands such as commit, pull, push, rebase, publish, and look into the changes within the file.

For the front- end development I decided to use ReactJS (version 16.13.1) because it is a highly used open-source JavaScript library, It helps in creating impressive web apps that

require minimal effort and coding. The main objective of ReactJS is to develop User Interfaces (UI) that improves the speed of the apps.

For the back-end development, I decided to use NodeJS (version 12.18.4 LTS) because it is a JavaScript runtime environment that helps in the execution of JavaScript code server-side. It is an open-source cross-platform JavaScript that helps in the development of real-time network applications.

For the database, I decided to use MySQL Workbench 8.0 CE. It is a very popular database. It provides data modelling, SQL development, and comprehensive administration tools for server configuration, user administration, backup, and much more. The database is going to connect with NodeJS and perform the CRUD operations.

MANAGEMENT PLAN

Money

The amount that is spent on this project is given on the following list.

Description	Amount
Student Trainee Expense	+/- €450 / Month
Travel Expense	+/- €0 / Day
IDE	+/- €0
Laptop	+/- €0 (Owned)

Skills

The skills required to finalize the project are as follow:

Web framework knowledge.

Experience in working with Database and SQL.

Critical thinking.

Responsible, punctual, and professional attitude.

Good time management.

Good communication skills.

Methodology

The project follows an Agile approach (SCRUM). The entire development process is divided into iterations (or sprints) that last from one to few weeks each. At the beginning of each week, the team (or individual) sets a goal that is desired to be achieved.

Each iteration contains a piece of work that is mainly independent. Instead of doing a lot of tasks in a short period, this approach supports the developer to create smaller pieces of work, but to conduct tests and to verify the quality constantly.

Quality

To deliver a good quality end product, some Key Performance Indicators need to be followed. They are,

Periodic Meeting with the Client

The periodic meeting is purposed to understand the client's needs and what can be improved from the previous implementation.

Fulfil the Client's Requirement

Implement the requirement that is given by the client. Testing would also be useful to avoid error during the demo and delivery. It helps to keep the client satisfied.

On-Time Delivery

By delivering the product on time, it gives the client time to try and review the application before the next periodic meeting.

Information

The information will be communicated amongst the client, the company tutor, the intern, and the university tutor. Verbal communication will be used for critical decisions and tasks, whereas written reports and weekly updates will be sent via email.

The communication between the student and the university tutor will be done weekly via email. In case of emergency, a meeting will be organized between the participants.

Role	Project Plan	Process Report	Prototype	Documentation
Intern	Ex/Dr/S/Di			
Company Mentor	R			
University Mentor	R			

Legend (Di = Discuss, A = Approve, S = Send, R = Receive, Dr = Draw up, Ex = Execute)

Time

The projected lifespan is five months. The project is split into 5 phases: Initiation, Design, Implementation & Testing, Finalization. The project requires 40 hours of work each week.

The official duration of the internship is 20 weeks.

Start date: 07-09-2019.

End date: 25-01-2021.

Organization

Below is an outline of the organizational chart of the project.

University tutor	Mieke van Vucht
Project leader/Company tutor	Erdoğan Saçan
Fontys (FHICT)	Bartosz Paszkowski
	Gerard Schouten
	Mark de Graaf
	Teade Punter
Fontys (JHAF)	Colette Cuijpers
	Noortje Lavrijsen
DataStreams (cooperator)	Bob Nieme
SPEKTRAX (Stakeholder)	Johan Pieter Verwey