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DUDE TIME TRACKING SYSTEM

Thesis

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ABSTRACT

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Name of thesis DUDE TIME TRACKING SYSTEM		
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<p>The thesis focuses on building a login system for DUDE (Do Unlimited Extended). The main goal was to build a login system for the use of DUDE, which would help track the working time of the students in the DUDE room or those who are working from home. The result of login system was formed in accordance with the aim of the DUDE instructor. In this project, the main goal of the DUDE instructor was adding and deleting new users, tracking their time, viewing their activities, and receiving their working reports in Excel form and other functional goals. There were a few non-functional goals, for instance, a simple user interface, reliability, and security.</p> <p>The initial phase of the thesis deals with the analysis requirements regarding the relevant issues and technologies. These include the tools and technologies that will be used to build the system. The second stage of the thesis work deals with the planning and implementation of the login system. In the implementation stage, the system was designed, and developed. At the last stage of the thesis work, the writing of the thesis report started as the system development tools had been successfully tied together and the system was ready for testing.</p>		
Key words API, CSS, JS, login system, Material UI, Node.js, PostgreSQL, React, REST API, time tracking system		

CONCEPT DEFINITIONS

DUDE

Do Unlimited Extended

UI

User Interface

OS

Operating System

MS-DOS

Microsoft's existing Disk Operating System

ORDBMS

Object-Relational Database Management System

HTML

Hypertext Markup Language

CSS

Cascading Style Sheets

MUI

Material User Interface

SQL

Structured Query Language

API

Application Programming Interface

REST API

Representational State Transfer Application Programming Interface

ACID

ACID is a set of characters of database, that consists of Atomicity, Consistency, Isolation and Durability.

GUI

Graphical User Interface

ABSTRACT

CONCEPT DEFINITIONS

CONTENTS

1 INTRODUCTION 1

2 REQUIREMENT ANALYSIS 2

3 TOOLS AND TECHNOLOGIES USED FOR BUILDING THE LOGIN SYSTEM 3

3.1 Development Tools..... 3

 3.1.1 Visual Studio Code..... 3

 3.1.2 Google Chrome..... 4

 3.1.3 Windows PC..... 5

 3.1.4 ElephantSQL 5

3.2 Development technologies..... 6

 3.2.1 Cascading style sheets..... 6

 3.2.2 Material UI..... 7

 3.2.3 JavaScript..... 8

 3.2.4 React..... 8

 3.2.5 Node.js..... 9

 3.2.6 Express Framework..... 10

 3.2.7 PostgreSQL Database..... 10

 3.2.8 REST APIs 11

4 IMPLEMENTATION PROCESS FOR THE LOGIN SYSTEM 12

 4.1 Planning..... 12

 4.2 Designing 14

 4.3 Developments..... 16

 4.3.1 Frontend 16

 4.3.2 Backend 21

5 TESTING OF THE SYSTEM 24

6 CONCLUSION..... 25

7 REFERENCES..... 26

APPENDICES

FIGURE

FIGURE 1. REST client sending an HTTP request to REST server (adapted from Altexsoft 2022)...	11
FIGURE 2. The use case diagram for DUDE login system	13
FIGURE 3. The Class Diagram.....	14
FIGURE 4. Login component design in wireframe tool.	15
FIGURE 5. Frontend project folder structures.....	17
FIGURE 6. Login page of the DUDE login system.	18
FIGURE 7. Current working status of a normal user.	19
FIGURE 8. Admin dashboard with user's real-time data.	20
FIGURE 9. User-specific view of the selected user	21
FIGURE 10. Folders and files structure of DUDE backend project.....	22

CODE

CODE 1. Inline style of using CSS	7
CODE 2. Command to install MUI to the file (mui.com 2023).	7
CODE 3. Using ready-to-use Collapse component from MUI.	8
CODE 4. Single page Application in React by importing a React reusable component.	9
CODE 5. Code inside the backend project.....	23

1 INTRODUCTION

Time tracking software as a service is a basic requirement at any workplace as the number of businesses and organizations increases drastically. With the significant development of Information Technology (IT), it is easy to build any kind of system required for small to large sized organizations. Regular activities and routines can be easily automated with the help of computers which frees a good amount of time for humans to work in productive tasks. It saves a large amount of time when the problems are given to the computer to solve. There are many time tracking software out there in the market. One can simply subscribe to the paid version of one of these complex software programs which are made on a generic basis targeting a large number of users from different areas or fields. Users have to learn to use these tools to perform the basic task as the system consists of a large number of unnecessary or irrelevant features. Thus, a large amount of time has to be spent just to familiarize with these tools. Hence, for a small business, it could be challenging to make the adaptation to the generic software.

At DUDE, activity tracking of students is challenging as there is no simple way of doing so. Traditional ways of reporting hours are not an ideal solution as the data can be easily misplaced and it is hard to perform calculations and keep track of these data. If teachers want to visit the past data for research purposes, then it is even more difficult to find accurate data and perform calculations. Thus, the need for a custom time tracking solution is what DUDE needs at the moment with flexibility based on requirements and yet simple to use by teachers and students.

The DUDE login system is a tracking software that is built to track the time of the students working on DUDE projects which is simple to use and yet very powerful. The system simply tracks the activities of the student and provides the tracked information with the necessary calculations to the administrators. The main aim of this system is to offer accurate data and save human resources simultaneously. DUDE instructors can also see the activities of the students who have been working remotely, the active time of the student on the platform and the total hours that the student has spent until the date.

2 REQUIREMENT ANALYSIS

Analysing the requirements is the first and essential stage of building any system. This stage involves meeting with the client and gathering and documenting the system's requirements. It is essential to analyse the functional and non-functional requirements of the system and to ensure that the system meets all the needs of the user and is of high quality. The analysis also involves identifying the stakeholders who would interact with the system, such as normal users and admin and determining their needs and expectations from the system.

Functional requirements are necessary to be defined to outline the system's capabilities, such as user authentication, tracking of time, data storage and retrieval and UI design. It is essential to have a requirement to be specific, measurable, and testable to ensure that the system meets the requirements of the user. Non-functional requirements, such as data security, the performance of the system and scalability are also to be considered during the requirement analysis. For instance, the system should be designed to prevent unauthorized access to the system and data and be ensured that data confidentiality is highly maintained. In addition to that, the system is required to perform optimally providing fast and accurate data processing and to be scalable to handle the growing number of users and data without compromising the performance.

3 TOOLS AND TECHNOLOGIES USED FOR BUILDING THE LOGIN SYSTEM

The topic discusses the main tools and technologies used for the development of the system. It is important to understand the functions of every tool and how they are working together to create a whole system. While developing a web application, it is necessary to choose the right stack development tool to receive a high-quality result (smart draw 2023). Development of web-based platform means to develop the server and user interface. User interface sends requests to the server and receives the data as a response from the server. Web development takes place on the server side and the client side, which means sending requests to the server and receiving the data as a reply from the server (smart draw 2023). These activities are well connected and communicated during the development of the web applications. In this section, a concise overview will be taken into the popular stacks that are used to build the system, as well as the functions of the technologies and the tools used by those technologies.

3.1 Development Tools

Development tools are software applications or programs used by developers to create, design and maintain websites and web applications. Google Chrome browsers offer integrated tools that let developers inspect the website (MDN contributors 2023). The development tools are essential for the developers to streamline their work, improve their productivity and achieve better results in their development projects (MDN contributors 2023). Most of the tools are specialized for some specific programming languages. For example, React is a well-known framework of JavaScript amongst developers, while other tools are more of a general purpose. Choosing the development tools for web development depends on the specific need of a project.

3.1.1 Visual Studio Code

Visual Studio (VS) code is a lightweight yet still powerful source code editor that was developed by Microsoft in 2015. There are several versions released by Microsoft and the latest version available is VS Code 1.77.1 which was released in the year 2023 (Visual Studio Code 2023). It is a cross-platform that offers the coder a smooth and quick experience of the editor on different OS platforms Windows,

macOS and Linux. VS Code is widely used by developers for building web applications and cloud applications. In addition to that, VS Code supports the features for debugging the code, automatic syntax correction or formatting the code and highlighting the syntax errors. The editor is highly extensible and offers a variety of extensions that are available in the marketplace and the coder can use more than one coding language. VS Code also has Git as an extension which is popularly used for version control purposes (Microsoft 2023). VS Code is one of the most common tools that this generation's developer uses. The editor can be used by downloading it on the system or by browsing online (VSCode Dev n.d.). Later in this thesis, the thesis report will discuss more about the programming languages that are written in VS Code to build the system in sub-topic 4.3.

3.1.2 Google Chrome

Google Chrome is one of the most known web browsers that is developed by Google. "Google Chrome is a cross-platform browser" (Moreau 2022). It can be used on different devices, for instance, the computer, mobile and other devices. Google Chrome is as simple as any other default web browser, such as Firefox and Safari. Moreover, it provides many features that make internet browsing much faster and secure. It provides a clear and simple UI, which makes it easier for the users to navigate and customize the features on the browser (Moreau 2022).

It also offers many extensions that help the developer personalize the internet browser experience allowing it to add different functionality. It is also considered to be the best choice because of the developer integrated tools it offers (Chrome 2023). The developer console provides a wide range of tools and features that makes it a great tool for debugging and testing the code online (Moreau 2022). At the same time, it also allows the developer to modify HTML and CSS code through the console developer tool. Google Chrome allows the developer to run the web application locally. It helps the developer to see how the actual website will look (Chrome 2023). While using Google Chrome, it is strongly recommended to use the latest version for smooth use and can be used only by downloading it to the device (Chrome 2023).

3.1.3 Windows PC

Windows is a well-known operating system that Microsoft had created. It was first released in 1985 and had a simple GUI as an example of an extension of MS-DOS (GFCGlobal.org 2023). An operating system is an essential tool when it comes to using a computer (Tikkanen 2023). Windows is well known for its UI which is extremely user-friendly. Its compatibility with its software and versatile features makes it suitable for both personal and business use. It supports multiple programming languages. Some of the standard tools that are used by the developer on the Windows are Note-pad editor, PowerShell, and Command Prompt. Windows offers a wide range of development tools (GFCGlobal.org 2023). For instance, Visual Studio Code is popular amongst developers. It also provides powerful security features that helps protect against cyber threats (GFCGlobal.org 2023). Windows Defender is a built-in antivirus software that provides real-time protection from malware and other cyber related threats (Computer Hope 2022). Moreover, Windows notifies and provides regular updates to ensure that the users have access to the latest security features and solutions (Computer Hope 2022).

3.1.4 ElephantSQL

“ElephantSQL is a PostgreSQL database hosting service” (84codes-ElephantSQL 2023). ElephantSQL is cloud-based database server that provides fully managed PostgreSQL instances in the cloud within couple of minutes. The software offers an easy to follow and intuitive user interface for creating, managing and monitoring the databases. As a cloud-based software, ElephantSQL offers automatic backups as well as multi-zone redundancy for high availability and durability of data. ElephantSQL makes it easy to scale up and down of PostgreSQL instances (84codes-PaaS 2023). elephantSQL provides a security feature to data, for instance, SSL encryption that ensures that data is kept safe and secured while transiting. In addition to that, ElephantSQL is integrated with other services and platforms, for example, Heroku, AWS and Google Cloud, which makes it easier for the developer to build and deploy web applications that rely on a PostgreSQL database backend (84codes-ElephantSQL 2023).

3.2 Development technologies

Web components are built by combining different kinds of technologies that are used for building websites. The technologies are used to build and display a fully functioning UI that is interacted by the end-users. The most common technology used for web development is JavaScript (Orient Software Development Corp 2023). Many programming languages are referred to as development technologies. The technologies are used to build dynamic and fully functioning websites and web applications. Because of the high demand for the use of technologies in web development, the complexity of building a website has increased with an increase in the technologies needed (Orient Software Development Corp 2023). This chapter introduces the technologies that are used to build the system and their functions in building a website.

3.2.1 Cascading style sheets

CSS stands for Cascading Style Sheets and is a simple yet powerful language. CSS is used to design web pages with improved appearance and make them readable. It is used to redefine the web pages in terms of looks, designs and display of the elements varying the size of the screen generated by the HTML elements (Tutorials Point 2023). The difference between HTML and CSS is that HTML is a markup language that is used to define the structure of web pages while CSS is used to style the structure or elements created by HTML. CSS can be used to build web applications in three different ways Inline, Internal and External. Inline is used by adding the style attribute within the HTML elements. Internal is used by including `<style>` element within the head section of the HTML and external is used by creating a separate file in a format for 'filename.CSS'. `<link>` element is used to import an external CSS file to the HTML (W3Schools 2023). The developer prefers to use an external file to add CSS. However, while building a login system, an inline style has been used (Code 1). Code 1 illustrates the inline styling.

```
<div
  style={{
    position: "absolute",
    top: 8,
    right: "16px",
    fontSize: "16px",
```

```
...style  
  }}  
>
```

CODE 1. Inline style of using CSS

As shown in code 1, inline CSS style are done on the HTML element directly. From this inline styling <div> element will be in absolute position with 16 pixels of the font size. <div> is HTML element. An inline CSS defines styles to an element separated by commas. An inline CSS is being used to offer unique styling for a single <div> element.

3.2.2 Material UI

Material UI/MUI stands for Material User Interface. MUI is an open-source frontend UI library of React components that was implemented by Google's Material Design system. MUI is the most powerful and essential tool to develop a website having React as a main JavaScript framework. However, it is possible to use MUI with all the JavaScript frameworks (Sinha 2022). MUI is an alternative to CSS for web developers. It can be used to build the React components using the MUI ready-to-use components such as button, input field, accordion and app bar. MUI is a pre-built component and is still customizable as required by the developers. Developers can change the design and appearance of MUI components, by changing the colour or size to make a web page unique (Victory 2022). Moreover, MUI is used to build responsive sites. MUI can be installed in a React project by running a simple npm command in the terminal (mui.com 2023). Code 2 shows the installation of Material UI library using npm command.

```
npm install @mui/material
```

CODE 2. Command to install MUI to the file (mui.com 2023).

The npm command can be used to install all the dependencies that are offered by MUI. To use MUI components in React applications, the components can be simply added by importing to the component file. For instance, if a button is needed then, it can be imported from the dependencies offered by MUI (Sinha 2022). Code 3 shows the usage of Collapse component in the React component. As shown in code 3, MUI components can be used in any building React application.

```

<Collapse>
  <Wrapper>
    <div></div>
    <StyledIconButton>
      <CloseIcon/>
    </StyledIconButton>
  </Wrapper>
</Collapse>

```

CODE 3. Using ready-to-use Collapse component from MUI.

3.2.3 JavaScript

JS stands for JavaScript. The programs written in JS are also known as Scripts. JS is a powerful web development technology that is popular amongst the web developers. JS is a safe programming language to build websites. JS is used with HTML to add the functions to its elements. Thus, JS is fully integrated to HTML and CSS (JavaScript.info 2023). It can enable the change in reaction to the user actions. For instance, it can be programmed to display a picture when a button is clicked.

JS is mostly known as a programming language for web development. However, non-browser environments also prefer to use JS because of its simplicity. JS is a dynamic programming language that was first created to build dynamic and lively websites (Mozilla 2023). It is an object-oriented programming language which is based on prototype-based and still supports OOP paradigms that is offered by class syntax. Moreover, JS is also a programming language that is used to communicate to the server. It is usually done by sending a request to the local server from the client-side to get the required information (JavaScript.info 2023).

3.2.4 React

React is a front-end library based on JS. React is open-source library used to build interactive UI efficiently in less time. While building a website in React, the application is built by creating React components that are reusable and independent. React was first created in 2011 by Facebook to manage the user base and provide better user experience and responsive UI with the components that are reusable. React is used to build single page applications, where it loads a single page HTML document. It only reloads the content that needs updating using JS without having to load a full page (Herbert 2022). It is recommended to use JavaScript Syntax Extension (JSX) to create React elements, which is the combination of HTML and Extensible Markup Language (XML). JS is used to render the data to the desired

site. Due to high flexibility, ease and speed of the development, it has grown its popularity amongst the developers. In addition to that, the use of virtual Document Object Model (DOM) makes the performance of an app smooth and fast compared to the regular DOM (Deshpande 2023). Code 4 illustrates a piece of simple React application.

```
import React from "react";
import Container from "./container";

function App() {
  return (
    <div className="App">
      <Container />
    </div>
  );
}

export default App;
```

CODE 4. Single page Application in React by importing a React reusable component.

As shown in code 4, the application is built by writing JSX component in React. The third-party libraries are imported on the top of the file and the component itself is exported to be used in the other part of the application. It is easy to write frontend application using React. React bases codes are easy to understand and follows the clean code convention (Deshpande 2023).

3.2.5 Node.js

Node.js is an open-source and powerful platform based on the JS that was created on Google Chrome's JS V8 Engine. Node.js was created by Ryan Dahl in 2009. It uses an event-driven non-blocking input/output models which makes it efficient and light weight. It is used to build networking and server-side applications such as video streaming platform and single page application. The code for Node.js is written in JS that can be run on the runtime on available OS (Tutorials Point 2023). The APIs that are built in the Node.js library are asynchronous, which could be used to build high-performance and real-time applications that can handle large volumes of requests with low latency (Tutorials Point 2023, Node.js - Introduction). Node.js provides built-in support for HTTP and its protocols, which helps build web servers and web applications quickly. Thus, HTTP is considered a first-class

citizen (Nodejs.org n.d.). The packages and libraries that are available through the Node Package Manager (NPM) ease extending Node.js functionalities (Nodejs.org n.d.).

3.2.6 Express Framework

Express.js is an open-source and free web application framework based on Node.js. Express was created to design full-stack robust web applications quickly and efficiently by using the HTTP utility to create an API (Expressjs.com 2023). Express organizes the app architectures on the server side and supports rendering. As Express is based on Node.js, both technologies work side by side to support the backend of a web application. Being one of the most popular web frameworks, it is used by large numbers of developers to build scalable, robust, and secured web applications. One of the key benefits of Express.js is its routing capabilities (Code Academy 2023, what is Express.js). The routes defined for web applications with Express.js are easy to handle and incoming requests respond with the appropriate data. Another benefit of Express is that it supports middleware. Combining both routing and middleware, the developers can perform the operation on the functionalities such as request/response cycle (Code Academy 2023, what is Express.js). Middleware can be used to handle authentication, error handling and logging.

3.2.7 PostgreSQL Database

PostgreSQL is a powerful open-source object-relational database management system (ORDBMS) that is well known for its advanced functionalities, such as scalability and reliability. PostgreSQL was first built in 1986. Because of its integrity and correctness, PostgreSQL is used as primary data storage by the developer to build web or mobile applications. PostgreSQL is known for supporting advanced data types. In addition to that AWS which is known for its cloud services supports PostgreSQL with a fully managed database service through Amazon Relational Database Service (ARDS) (Amazon Web Services 2023). PostgreSQL provides strong features including Multi-Version Concurrency Control (MVCC). It also has a feature like write-ahead logging, which makes it fault tolerant. Because PostgreSQL is based on ACID compliance, it highly supports foreign keys, joins and other stored procedures in different languages (Amazon Web Services 2023). Moreover, PostgreSQL runs on all the major OSs that are available. PostgreSQL supports different types of data. For instance, text, sound, video and image (Tutorials Point 2023, PostgreSQL - Overview).

3.2.8 REST APIs

A REST API also known as RESTful API is an Application Programming Interface. REST refers to Representational State Transfer. It is an architectural style that is used to build web applications that can be accessed over the Internet. REST API is one of the simplest ways to access web services. REST technologies use less bandwidth which is why it is preferred over Simple Object Access Protocol (SOAP). The main objective of REST API is to send requests to the server and get data as a response from the server to the browser. The type of request used by REST API is an HTTP request. A request is sent from the client side to the server side in the form of a URL as HTTP for GET/POST/PUT/DELETE. The response from the server can be any type of data such as HTML, XML, image, or JSON (Altexsoft 2022).

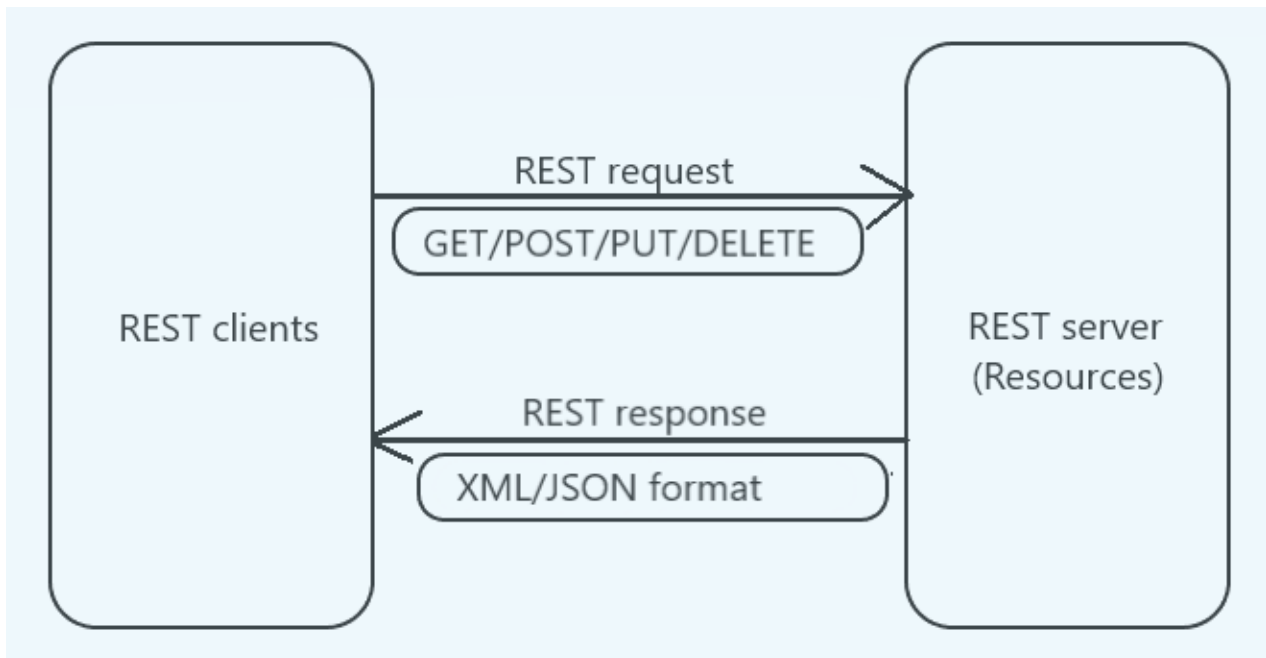


FIGURE 1. REST client sending an HTTP request to REST server (adapted from Altexsoft 2022).

As shown on figure 1, it is clear that the main key elements of REST API are a client, a server and resources. A client is software that runs on the computer and from where communication is initiated. A server is a data storage that gives access to the data through the use of an API. A resource is data that the server provides to a client as a response (Altexsoft 2022). The REST client and REST API communicates through a uniform interface no matter the types of devices being used. In this process, a unique identifier will be assigned to all the resources. In addition to that, the REST client's approach to the API layer through a proxy server that acts as a router to provide the gateway between the client and server (Altexsoft 2022).

4 IMPLEMENTATION PROCESS FOR THE LOGIN SYSTEM

This chapter focuses on building the login system, which was created using the PERN (PostgreSQL, Express, React, Node.js) stack. The purpose of building the system was to develop a web application that combines the most used JS technologies, PERN in this case. The web application is the online time tracking system that could be used to keep track of time by the students working in DUDE. The website development process allows the readers to understand the relation between the JS technologies. For example, how the PERN stack is working together to create a whole working system. However, it is essential to note that the website is being built to provide the automatic time tracing service for DUDE and in addition to that, for the learning purpose and completing the thesis. The idea of making a login system came from being in a project team in the DUDE and being a remote worker. As a remote worker, I was forced to use the manual Excel sheet for keeping track of my working hours. The development of the system started with planning and designing, and the final result was a ready-to-use full-stack web application after the development stage.

4.1 Planning

Initial investigation and research are important steps in building a web application. Without a well-defined goal and proper setups of structured paths, it is hard to achieve the goal on time and in the proper manner. Thus, early proper planning is an important key to any successful system development (December 2022). The DUDE login system was planned together with the DUDE instructor and the author. The goal of the platform and the need for the development were measured along with the DUDE instructor. Thus, the requirements and features to be developed were well explained and noted down before actually starting to plan further for the actual development of the platform.

The platform is used for tracking the working hours of all users working on the DUDE project. The administrators of the platform or teachers should be able to track the history of the users and be able to download past data. The following use case diagram (Figure 2) shows functionalities authorized for a normal user and an admin.

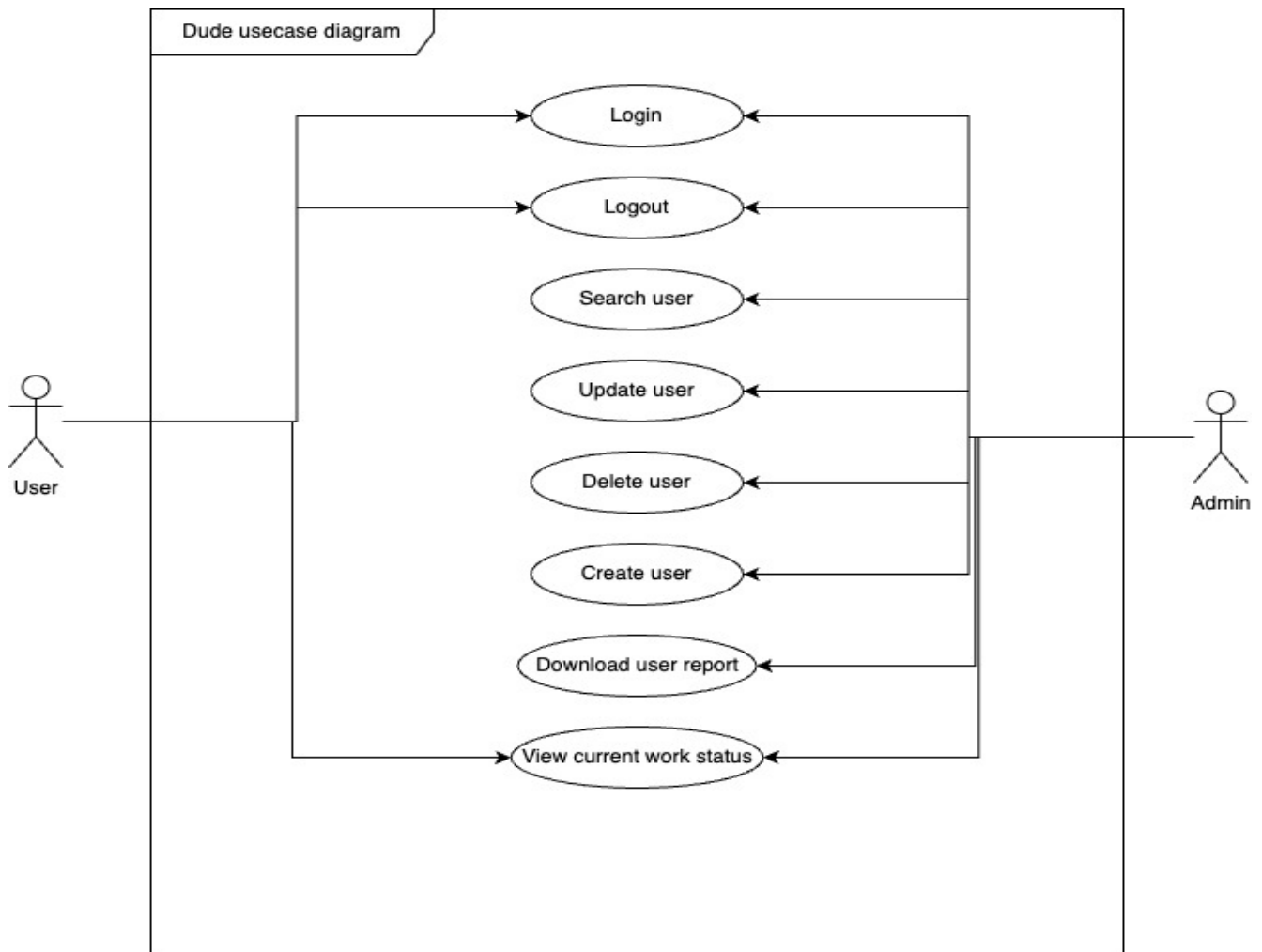


FIGURE 2. The use case diagram for DUDE login system

As presented in Figure 2, normal users have minimal features in the platform and are able to log in and log out while admins have access to more features including viewing user's data and being able to know past history and current status of the users.

After the use cases for each user role are defined, visual representation of user objects is designed in the form of the class diagram to understand the relationship between them. Class diagram describes the attributes of each object and describes their operations which helps to understand the behaviour of each object (Lucidchart 2023). The DUDE project consists of two objects, user and report. Each attribute of the object and their types were defined in the Class diagram as illustrated in the figure 3 below.



FIGURE 3. The Class Diagram

As shown in Figure 3, User and Report are two main elements in the system. The relationship between User and Report is one-to-many as User has multiple report entries. Relationship of Report to the User is defined by id of the User object.

A simple approach of building applications was taken to build the DUDE login system. With only two objects definition and direct relationship between the objects with foreign key references, it made not only simple but easily understandable, maintainable, and scalable as per the future needs.

Report and user objects have their own unique identifier. Both objects have timestamps to track the creation time of the instance of the object. Users have basic information tracked including encrypted passwords. Where reports are based on only timestamp values as they are used for tracking the login and logout time of the user and track the working hours based on the timestamps. Timestamps are important attributes of the DUDE login system as it is a time tracking platform for the users.

4.2 Designing

Web application design is the process of crafting and arranging the contents in a most meaningful way to be presented to the outside world. A proper design of the web applications makes any web platform intuitive and enticing for the users (Hotjar 2022). The contents are meaningless regardless of their quality if not presented well. Web design process consists of choosing the right tools to build visual components, finding the inspiration for the contents, selecting correct elements that can be properly

placed in the right place within the web app, visual looks of the elements and responsiveness to multiple screens or devices.

The author used a basic form of website design tools for building the DUDE login system. Components were sketched on a paper to understand the need of different kinds of elements and their placements. After the sketches were done, a basic wireframe tool was used as a draft to get the development going. The elements were added inside the wireframe tool to build a framework of the platform. Figure 4 illustrates the login component design in the wireframe tool.

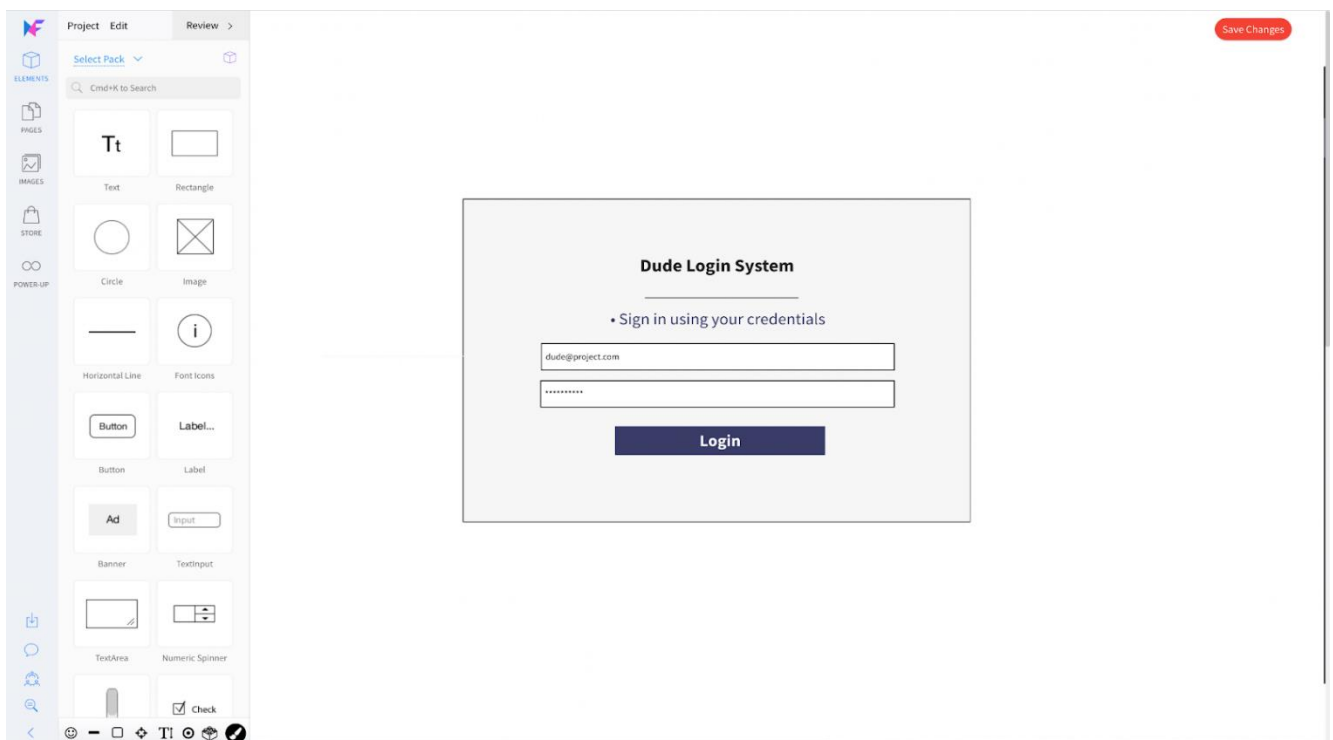


FIGURE 4. Login component design in wireframe tool.

As shown in Figure 4, Component wireframes were designed using a third-party platform. These wireframes give visual drafts of the components which are used to build the frontend components.

The designs from the third-party wireframe were copied into the real application using the design component library, such as Material UI. Components in the DUDE login system is built using the Material UI tool which is a ready-to-use component library for React (mui.com 2023). Material UI provides a larger number of components for building web apps.

4.3 Developments

This section includes the development processes of the DUDE login system. The project development was broken down into 2 different sections, frontend development and backend development.

4.3.1 Frontend

Frontend development of the web application is the process of designing and building the user interface of the application. Users of the application are able to see the contents and interact with the elements rendered on the webpage and perform all the actions available to them. Users are able to interact with features of the platforms via buttons, forms, inputs, images and other interactive elements (General Assembly 2023). The development of the front-end application is done with the help of HTML, CSS, and JavaScript.

DUDE frontend components are built using the Material UI design library and codes were typed in a Visual Studio code editing platform. The boilerplate of the app was created by using the create-react-app library which created basic layouts and necessary files to get started with. Front-end repository consists of all the files and folders needed for the front-end project. Figure 5 shows the folders and file structures of the DUDE frontend project created initially by the create-react-app library and later extended by the author.

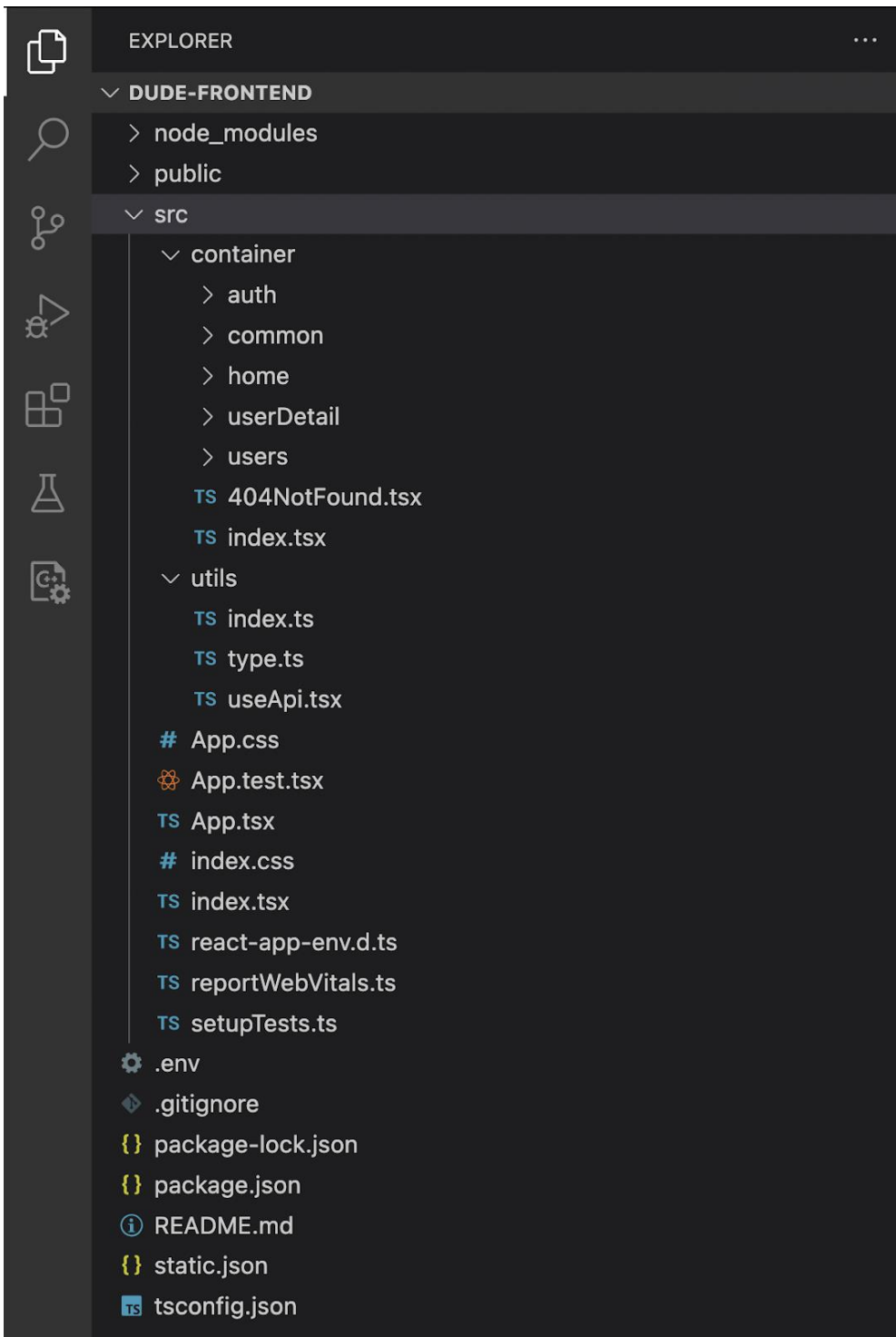
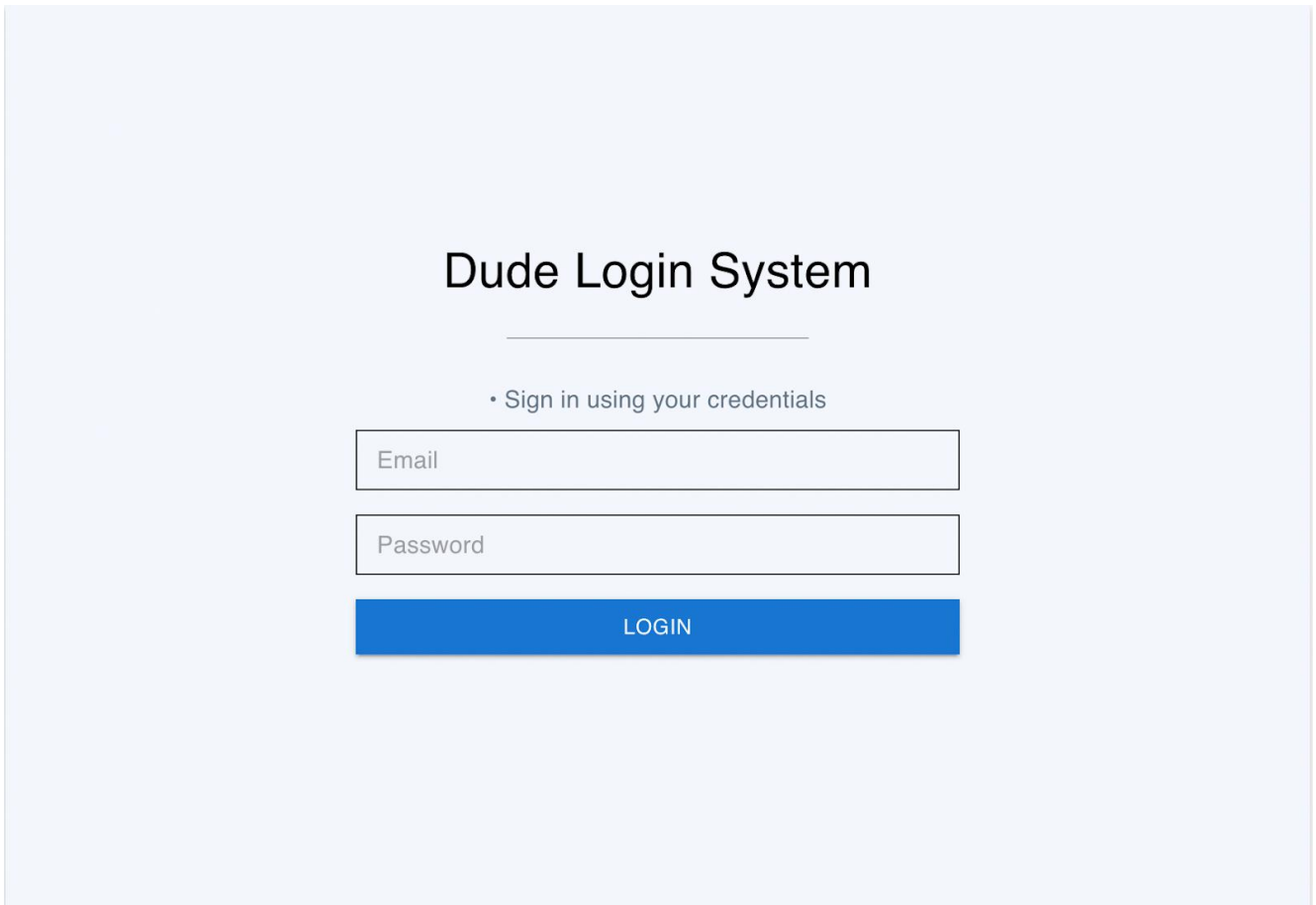


FIGURE 5. Frontend project folder structures.

As shown in Figure 5, the folder structure of the DUDE front-end project consists of the necessary files and folders related to the user interface only. All the files inside /src folders are the components and needed helper files while the files outside the /src folders are for facilitating and running the frontend server.

DUDE project consists of multiple views on the front-end side of the applications. When users are redirected to the homepage of the application, a simple login page is shown where users can input their login credentials, for instance, email and password. After hitting the login button, the users are authenticated and authorized in the backend side of the application based on the provided credentials. Authorized users are redirected to a separate view of the application where they are able to see their data regarding working hours. Figure 5 illustrates the login page of the DUDE login system.



The image shows a login page for the 'Dude Login System'. The title 'Dude Login System' is centered at the top in a large, bold, black font. Below the title is a horizontal line. Underneath the line, there is a bullet point followed by the text 'Sign in using your credentials'. Below this text are two input fields: the first is labeled 'Email' and the second is labeled 'Password'. Both fields are white with a thin black border. Below the password field is a blue button with the word 'LOGIN' in white, uppercase letters.

FIGURE 6. Login page of the DUDE login system.

A user can easily login to the system by providing an email address and the password created by the DUDE administrator (FIGURE 6). Providing credentials to login performs two actions on the backend side of the application. First, user authorization is checked to identify the permission of the user whether the user is an administrator or a normal user.

A normal user with non-admin permission is redirected to the view where the user can see the current working status in real time. A logged-in user can see the current live timestamp as well as see the button to log out of the current session to end the working hour. Figure 7 represents the working hour of the currently logged-in user.

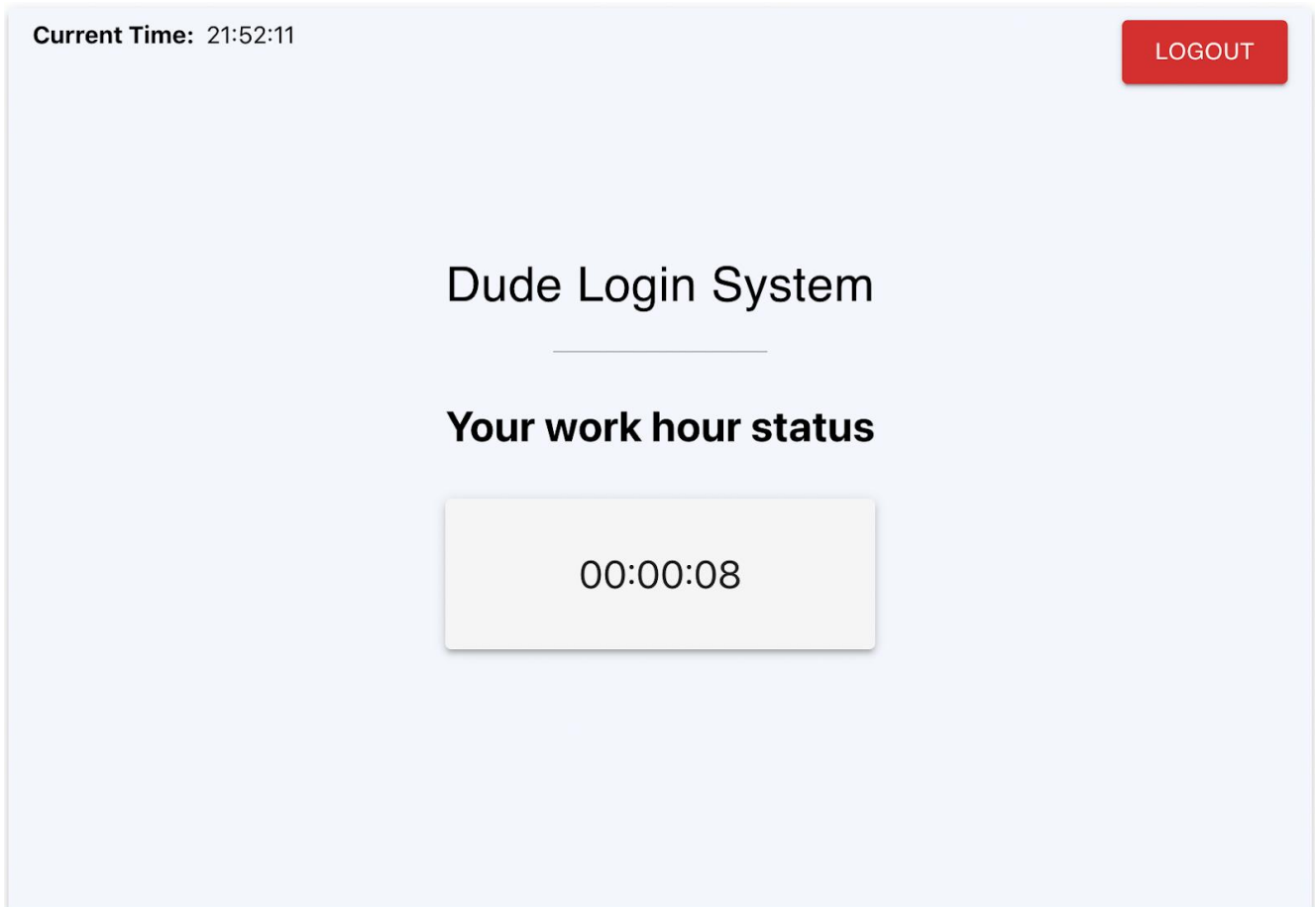


FIGURE 7. Current working status of a normal user.

As shown in Figure 7, a user is redirected to the working status view of the application upon successfully logging in. The user can view the current live time and real-time status of the working hour. A red button is shown to log out of the application and end the working time.

Administrator of the project is redirected to the dashboard view page where the admin can view all the available users and their tracked data. Admin can search other users and view the list of users with basic information along with the working status. Figure 8 below shows the view of the admin where the user can see a list of the available users.

The screenshot shows the 'Dude Project' admin dashboard. On the left is a dark sidebar with 'Users' and 'My Session' options. The main content area has a search bar with 'Search from 3 users' and a 'Create user' button. Below is a table of users:

Email ↓	First Name	Last Name	Is Admin	Is Working	
test@test.com	Test	User	No	Yes	View
muskan.dangol@centria.fi	Muskan	Dangol	No	No	View
admin@centria.fi	Dude	Admin	Yes	Yes	View

FIGURE 8. Admin dashboard with user's real-time data.

As shown in Figure 8, admins can view a list of available users, see the basic information of each user and be able to filter the user in the search box.

Current admin has the My session section in the left navigation bar to view the current status of their spent time in the system. In the user list table, each user has a call-to-action button to view the user detail which redirects the current admin to the user-specific view. User-specific view consists of the features to update user information, delete the user, view the working status report, filter the report by date range and export the filtered report in CSV format. Figure 9 shows the user-specific view of the selected user.

The screenshot shows the 'Dude Project' interface. On the left is a dark sidebar with 'Users' and 'My Session' options. The main content area displays the profile for 'Dude Admin' (admin@centria.fi), who is 'Working today'. A 'Total hours until now: 56.54 Hrs' is shown. Below the profile is a 'Download Report' button, a 'Total: [3.34 Hrs]' indicator, and date selection fields for 'Start Date' and 'End Date', both set to '2023-05-15'. At the bottom, a table lists session details.

Created On	Login Time	Logout Time	Total hours
2023-05-15	2023-05-15 21:51:53	-	1.02 Hrs
2023-05-15	2023-05-15 18:37:39	2023-05-15 20:56:43	2.32 Hrs

FIGURE 9. User-specific view of the selected user

As shown in Figure 9, Admin can view the working status of the selected user and export the report within the selected time range by clicking the Download Report button.

4.3.2 Backend

Backend part of the web application is considered an engine of the application which performs all the actions and operations that users cannot see directly on the application (Martin, 2023). While the front-end side of the application handles the user interface, the back-end side handles the business logic, background processes and communication between the user interface and humans by providing relevant content requested by the users.

The DUDE backend application is built using Node.js JavaScript server-side programming language and powered by Express framework. The backend system communicates with the data stored in PostgreSQL databases hosted in a third-party service, Elephant SQL via a connection pool created within the application. The backend system codes are stored in a separate project repository which consists of

only backend-related codes. Figure 10 illustrates the folders and file structure of the DUDE backend project.

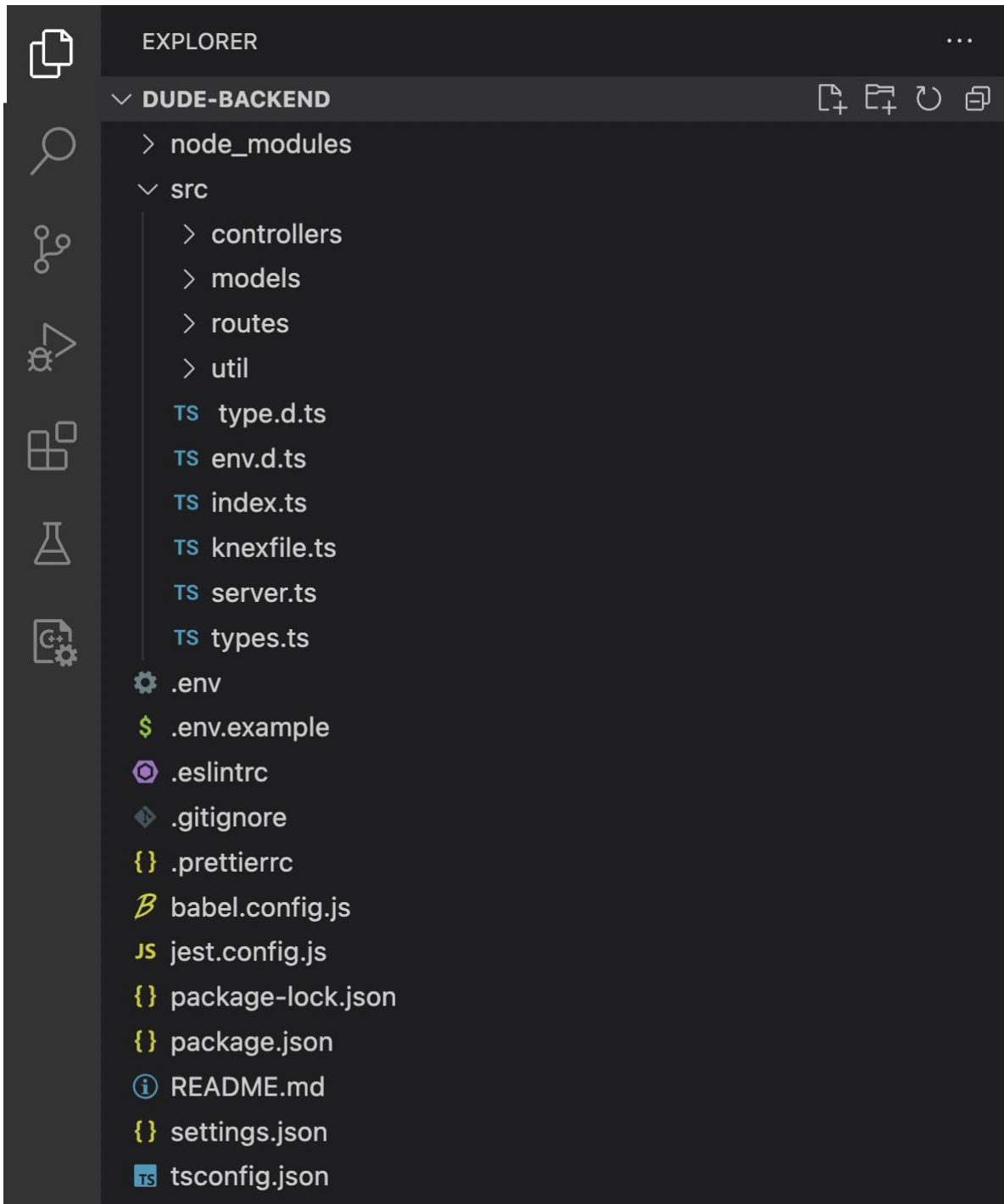


FIGURE 10. Folders and files structure of DUDE backend project.

As shown in Figure 10, the DUDE backend project consists of the folders and files as a separate project hosted in a separate repository. The business logics are separated inside the /src folder. Outside the /src folders are the files and folders for facilitating the deployment and running of the servers.

All folders and files inside /controllers folders are business logic for performing actions requested by the user. Folders inside /models consist of the database queries for reading and writing into the database based on the requests from the controller functions. /routes consist of the path of the API endpoints which are used to make HTTP requests from the client. Finally, /util folders consist of the files that include helper functions used in different parts of the application. Code 5 shows the code written inside the backend project to perform certain actions when the user requests from the user interface.

```
const getUserByEmail = async (req, res, next) => {
  try {
    const { email } = req.params;
    const users = await User.getUserByEmail(email);
    res.status(200).json(users);
  } catch (error) {
    next(error);
  }
};
```

CODE 5. Code inside the backend project

As shown in Code 5, the script inside the backend project handles the business logic based on the request made by the user from the client-side application. In the code, the user is fetched from the database based on the provided email address from the client-side application. The user data is fetched from the database and sent to the client along with the status code 200. When an error happens, the function forwards the request to another callback function to handle the error within the application.

5 TESTING OF THE SYSTEM

Testing is the process of finding the problems or errors in the applications by simulating the behaviours of the application with the help of testing tools and frameworks (Hamilton 2023). Testing is an important stage of application development as it helps to build and release quality software that is reliable and high-performance. Testing the application is the final step after the features are built and before the release of the features to the public. Once the testing stage is passed, the tester gives the green light for the developers to release the features to the outside world (Hamilton 2023).

In the DUDE login system, the author performed the testing with the help of third user after the release of the beta environment of the platform. Involving the humans in application testing simulates the behaviour of real-life experience. Since the DUDE login system is a real-life project for day-to-day life, human testing was believed to be the simplest and most effective way of testing the system.

Multiple users were created and given access to the platform for login and logout of the system and the author monitored the activity of the user from login to the system and logout from the system. Users were given enough time to understand the user interface and asked to finish the testing process after the logout from the system. An admin user was also created to act as an admin of the DUDE project where the user was asked to log in to the admin dashboard, create a new user and download the report of the normal user. By monitoring the admin activities, the intuitiveness of the user interface and the simplicity of the features were tested successfully.

6 CONCLUSION

The purpose of the thesis was to build the time tracking system for the DUDE using modern web-based technologies. The system was to be used by students and teachers of the DUDE in everyday life for tracking and monitoring the working status, accessing the history and being able to download the reports in the given timeframe. With the help of advanced browser-based technology like React and Material UI, the system was built including all the required features and delivered to the DUDE administrators.

The built platform successfully tracked the working status of every user in the system and stored the data in the database for future reference. In addition, the system provided the expected results to the administrators of the DUDE. The system is believed to replace the traditional working hour tracking system. For the future development, the feature of changing the password can be added for the normal users as the system was developed using the hash password algorithms. Hash password helps to keep the data safe and secure.

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