TITLE

SHOP EZ E-COMMERCE USING MERN STACK

TEAM MEMBERS

1. Shoban Babu
2. Shaik Imran
3. Shaik Kaif
4. Sowmya

1 INTRODUCTION

This e-commerce marketplace is developed under the supervision of Jinnarsoft. It is a startup software company who develops web and mobile applications for local and international clients. Jinnarsoft created this project for a local client who uses this application to make a platform exclusive for university students who want to start their entrepreneurial journey.

In this project the client desired to present an e-commerce platform where only student register as seller. They can sell their products or services to another user from general people. Those general people can register as normal buyers but cannot register as seller.

The main aim for this type of platform is to reduce the dependency of students on the job market and to encourage them to start their business. It also provides students with a suitable platform where they do not have to compete with big established businesses and get suggestions for business related documentation or if necessary, get mentorship from a business organization. Also, it will bring new innovative products or services to the market and create more jobs in the future. For this the client needs an e-commerce website and Jinnersoft is developing this project. Under their supervision a part of this project is developed by me.

To create this e-commerce, The MERN stack technology was selected. For the past few years it has become more and more popular in the web developer community by surprising other stack technology such as LAMP, PERN, due to its most developer-friendly & highly customizable React Admin Template, testing tools and big community support from their developer (1).

This thesis illustrates how this technology can be used to develop and to test the project. Also, the use of its associate plug in and libraries and their functionality

has been described. This paper has been divided into five chapters: are Requirement, Design, Results, Discussion and Conclusions.

In the requirement chapter the type of criteria and the method that has been used to develop the project, the reason to select this method and analysis of each requirement are explained. The design process of the project UI, functions and libraries that has been implemented to create it and finally testing the overall project is described in the design chapter. In the result chapter the final output of this project and the demonstration of the whole project view are shown. The analysis of the project output, discussion about the project limitation and possible solutions to overcome this limitation and my role and contribution to this project are described in the discussion chapter. Finally, in conclusion the summary of the whole project from beginning to end is given.

2 REQUIREMENTS

Before starting this project work, the client gave us certain requirements for this project. Due to this, the application mainly targets a specific education community so there are some requirements that must be fulfilled. Those are:

1. Only students over 18 years old can register as seller and they need to prove their studentship.
2. An easy and modern responsive UI is needed to engage the student in the platform.
3. Fast responding server
4. Scalable database

2.1 Requirement Analysis

After analyzing the requirements, various possible solutions to handle this requirement had arisen. Of those solutions some were rejected due to complexity to the user and security issue.

2.1.1 Registration system

Although the application targeted mainly the student community, all types of users can use this platform for purchasing products or services. This makes the registration system much more complicated because the registration system must be developed in the way that the system can identify students and validate them.

First to validate the student, the student ID with QR code was considered to be uploaded into the system. If there is student information, then it would be easy to request the student data from their institute to verify it. But some institutes do not provide this QR coded ID card, and they also do not want to share their student data to third party organizations. Also, numerous times uploaded images might be blurry and hard to read. Therefore, after analyzing this the final

decision was that the student's email will be used as a verification method and also it will fulfill the requirement.

2.1.2 Easy and Modern Responsive UI

As per the requirement, an easy method to navigate and modern user interface for the project was needed. Since most of the targeted audience are young students. Also, the project had to be made responsive to all devices such as desktop, mobile and tablet.

To fulfill this requirement, the front-end of the project was focused on. Some frameworks had been searched where the project could get the most customizable lay out. Also, the type of framework that has more community support on the internet was chosen.

After considering all these factors the React framework was chosen for improving the UI of the application. It is free and open source. Because it is developed by Meta, formerly known as Facebook, new updates are always released by their company developer (2). Also, because it is open source, it can get lots of support from developer communities all around the world. It is a JavaScript library mainly used for front end development.

React also utilizes another framework Bootstrap which is a CSS framework and also free, open source enrich with plenty of customizable layouts. Also, it has community supports on the internet (3).

2.1.3 Fast Responding Server Side

To run all operations smoothly in backend, the client asked to build a fast responding server side. There are several technologies such as Laravel, Django, Ruby on Rails and Express. But among all expresses, the framework of Node js is fastest (4).

Node itself is an open-source and cross-platform JavaScript runtime environment. It is used to write JavaScript in command line for server-side scripting. With Express, which is a framework of Node js, it can put much more functionality by using its build in function like “**auth**” “**error-pages**” in the application back end (5).

2.1.4 Scalable database

To provide a scalable database to the client’s project, the MangoDB was chosen. Aside from scalability, MangoDB is much more user friendly and flexible than MySQL (6). In the project, many users may upload their data for example an image or file, in this case MangoDB has InsertMany() API for rapidly inserting data, prioritizing speed over transaction safety wherein MySQL data needs to be inserted row by row(7).

2.2 Method

After analyzing the entire requirement for the project, it was decided to develop the entire project with the MERN stack method. Because it uses uniform programming language JavaScript, our project was simple and fast.

3 DESIGN

In this chapter, the entire development process from start to finish is elaborated. This chapter first and foremost discusses pre planning such as designing the page, IDE selection, version control. Secondly, the implementation such as front end logic, backend logic, database logic is discussed.

3.1 Project Planning

Before starting any project, it is mandatory to plan its UI. In this case, the project must have three types of user categories. One is an admin who controls the entire project, a seller or a student who sell their products and a buyer or a normal user who can see the products and order the product from the site.

3.1.1 Project Design Planning

The admin, seller, and buyer each will have their own accounts and each account has their restrictions except the admin who will control the site.

Initially the admin only uploads the product so the admin had the order page where they can monitor the order, products to create a product and edit a product, the user page to monitor or remove the user, chats pages used to check the message from the user, analytics is to check the sell graph of every month and log out is to logout from the account.

After completing registration in the system, sellers or students can also sell their products. When sellers log in their account, they will see their profile where they can upload their products and see the history of their products.

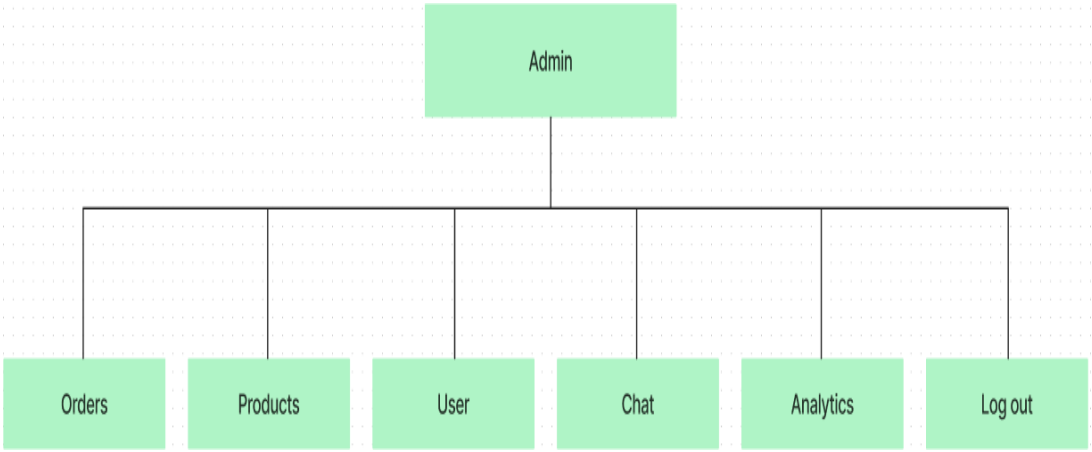


Figure 1: Admin page design

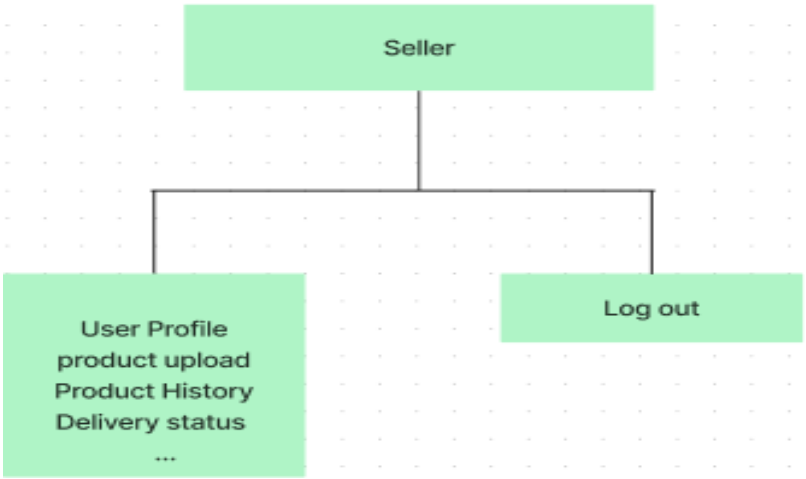


Figure 2: Seller page design

For buyers or general users if they log in, they are directed to their user profile. They also have a product page where they can see their order history. If Buyers update their profile page they can see the buyer's products exclusively.

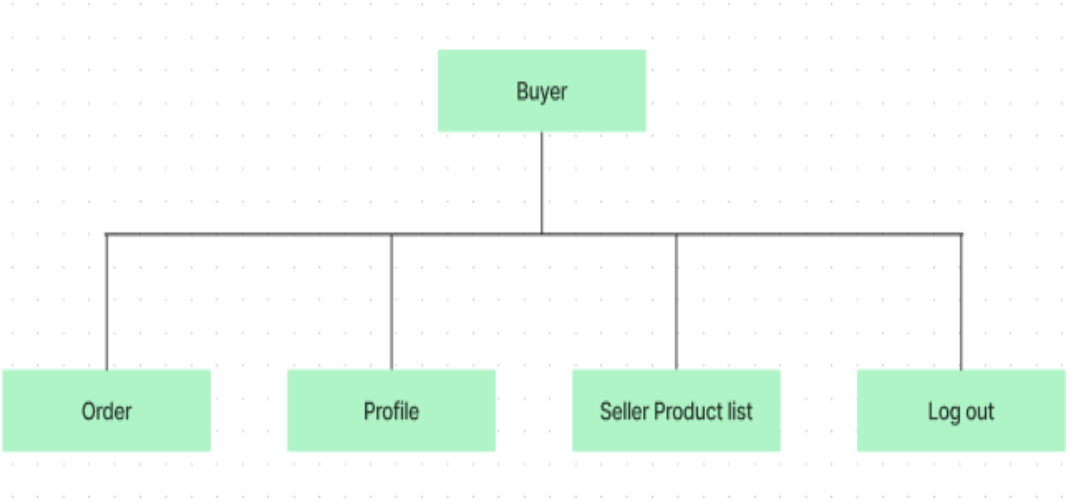


Figure 3: Buyer page design

3.1.2 Developer Environment

The right selection of development environment makes the entire project development process smoother. For web application there several IDEs right now. But for this project, Visual Studio code is selected. The main reason for choosing is that it is easy to navigate and there are plenty of extensions which helped to execute the code more smoothly. The list of extension of VS code that has been used is given below.

1. ES7+ React/Redux/React-Native snippets: Extensions for React, React-Native and Redux in JS/TS with ES7+ syntax. Customizable. Built-in integration with prettier font.
2. Babel JavaScript: VSCode syntax highlighting for JavaScript.
3. Live Preview: Hosts a local server in workspace to preview the webpages on.
4. vscode-icons: Icons for Visual Studio Code

3.1.3 Git version Control

To collaborate in a project with other developers, a version control system was required. There are many versions of control systems such as Git, AWS CodeCommit and Azure DevOps. In this project the Git version system was used.

In this project Git was initially installed by using command **“git init”**. Then the status of code was checked using code **“git status”**. Then the code using code **“git commit”** and **“git push”** was committed and pushed**.** At the time of Git commit the version name was mentioned so that the next time whenever the previous code is needed, it could be retrained. The Git cloud service called “**github**” was used which is one of the popular Git cloud services.

3.1.4 List of Package and Framework

For the backend Node js was used in this project. Some necessary node packages needed to be installed for the add backend and frontend functionality. The list of Node package is given below.

1. Install npm version 16.17.1. A library and registry for JavaScript software packages. For package management the npm was needed in the project(8).
2. Install npx version 8.15.0. A npm package runner which allows run some npm package without even installing it(9).
3. Install react version 17.0.2. A JavaScript library for building user interfaces.
4. Install bootstrap version 5.1.3. A front-end framework for developing responsive, mobile first projects.
5. Install react-bootstrap version 2.2.1. A Bootstrap 5 components built with React.

6. Install react-dom version 17.0.2. It serves as the entry point to the DOM and server renderers for React(10).
7. Install react-router-dom version 6.2.2. It contains bindings for using React Router in web applications.
8. Install redux version 4.1.2. One of the most important package because helps to write applications that behave consistently, run in different environments (client, server, and native), and are easy to test(11).
9. Install mongoose version 6.2.8. A MongoDB object modelling tool designed to work in an asynchronous environment.
10. Install multer version 1.4.5. For uploading files.
11. Install nodemon version 2.0.15. To develop Node.js based applications by automatically restarting the node application when file changes in the directory are detected(12).
12. Install nodemailer version 6.9.1. To help to send mail by node application. In this case we use this package to send OPT to user email(13).
13. Install jsonwebtoken version 8.5.1. To create web token for login purpose.
14. Install dotenv version 16.0.3. To load environment variables from a .env file into process.env.
15. Install bcryptjs version 2.4.3. To help to create hash passwords to improve security(14).
16. Install Axios version 0.26.1. To provide Promise based HTTP client (PUT, GET, DELETE) for the browser and Node.js(15).
17. Install helmet version 5.1.1. To provide security for Express apps by setting various HTTP headers.

Several other packages were used to create the project, but the ones above are most important. All the names of the packages and their versions can be found in the package. json file in the project folder.

3.2 Implementation

In this section the implementation of the code is discussed. The whole project file is divided mainly between frontend and backend part. In the frontend the UI of the project and in the backend the functionality of the project have been developed.

The frontend is divided into several file that are public, for example src or node module. The src file is the most important because all the page components are in there. In the public file the default image has been stored in the project slider and an uploaded image from the user will be stored there. The Node module is an auto generated folder and package json is also auto generated where all the frontend packages are displayed. The details about frontend are discussed in section 3.2.1.

The backend also divided into many folders and the most important are config. This one connects the database and gives us status about the connection. controller folder control all the operation of the pages, middleware used to the login operation, model declares all the pages required value, route have route instruction of the pages, seeder folder have demo data, utils have all the necessary function commend. The details about the backend operation are discussed in 3.2.2 section.

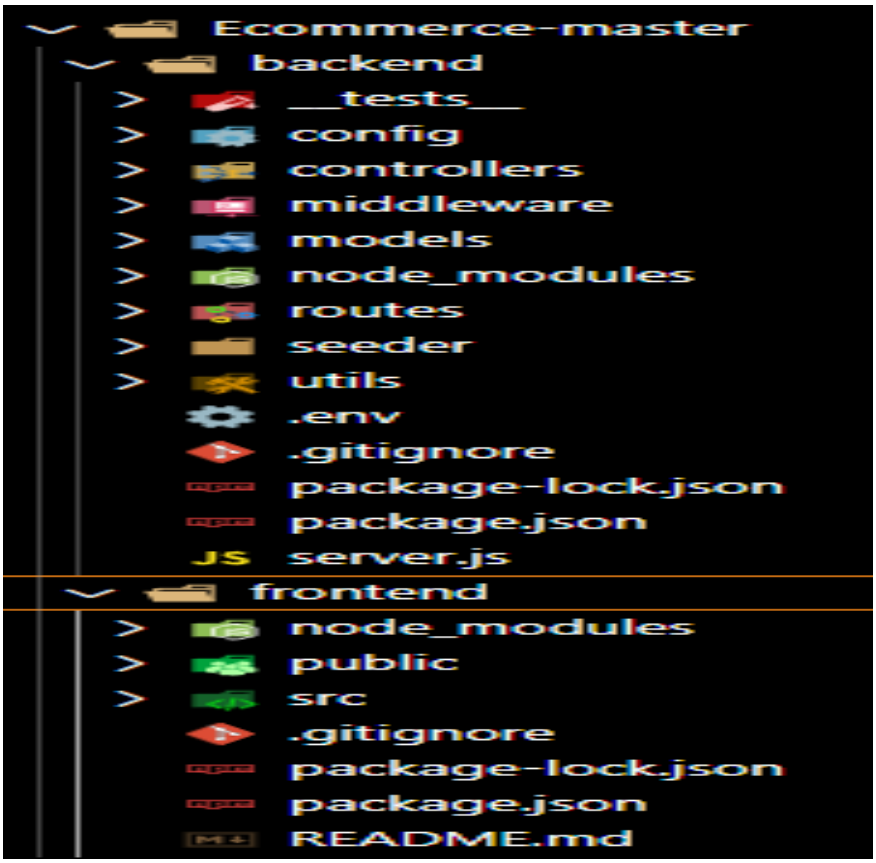


Figure 4: Project file structure

3.2.1 Front End Implementation

In this project the frontend is divided into three sperate users (admin, seller, buyer) and separate components were created for each of them to make it simpler. All the pages and their components and utils are stored in the “src” folder. But because of the huge number of components, the state management package Redux was used and configured for global page management. The “Login page” is discussed in detail so that readers can understand the Redux application in project components.

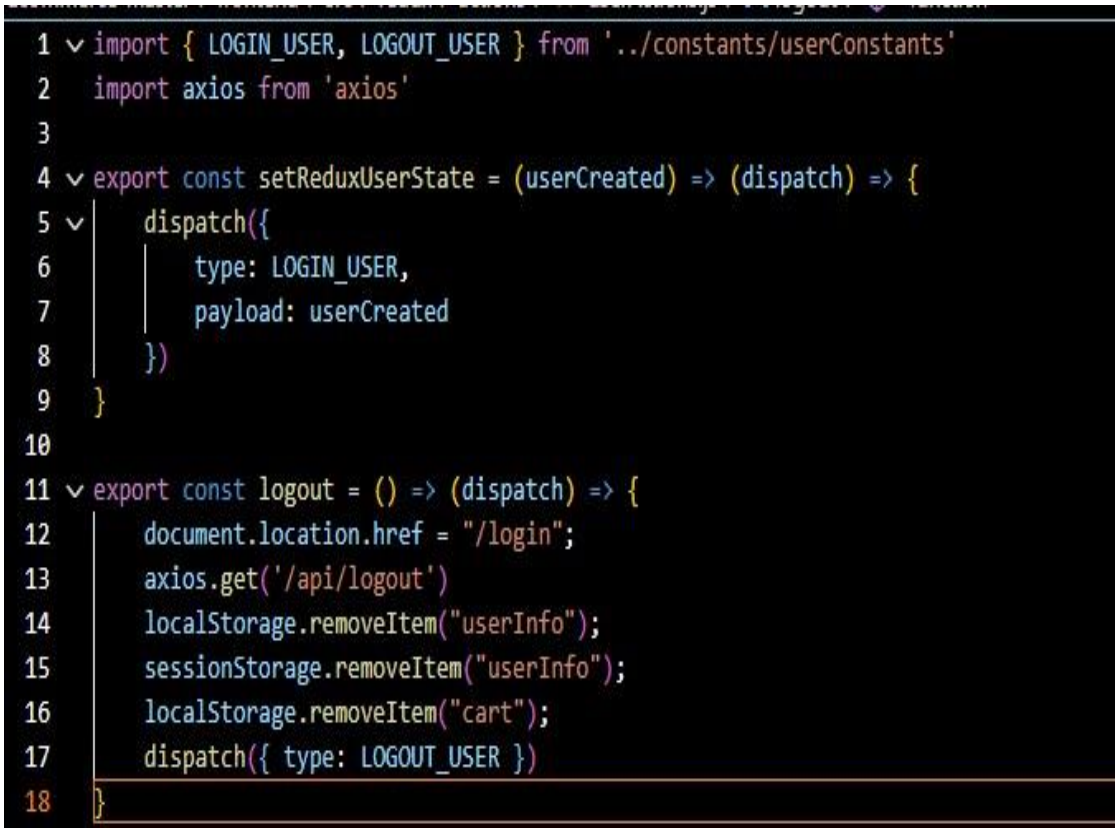
For simplicity a login page and login page component were created separately. In the log in page, the component contains all the Bootstrap elements, objects, and condition and from the login page when the user signs up and logs into their account and “loginUserApiRequest” function is created and POST the data to

/api/user/login. By this backend folder the function gets the email and password and if the validation is successful the token with data is stored into “userinfo” and if the process fails, then an error massage is passed in payload and takes the user to a corresponding route which is the log in page and shows an error message in there.

```
axios from "axios";
{ useDispatch } from "react-redux";
{ setReduxUserState } from "../redux/actions/userActions";

loginUserApiRequest = async (email, password, doNotLogout) => {
nst { data } = await axios.post("/api/users/login", { email, password, doNotLogout });
(data.userLoggedIn.doNotLogout) localStorage.setItem("userInfo", JSON.stringify(data.userLoggedIn));
se sessionStorage.setItem("userInfo", JSON.stringify(data.userLoggedIn));
eturn data;

LoginPage = () => {

nst reduxDispatch = useDispatch();

rn <LoginPageComponent loginUserApiRequest={loginUserApiRequest} reduxDispatch={reduxDispatch} setReduxUserState={setReduxUserState} />


default LoginPage;
```

Code Snippet 1: Login page function

To stay logged in in the user profile all the time until user logs out “Redux” was used. A constant variable in the Redux constant folder was created. Then this constant was passed to the action and reducer file. In the reducer file the state of the component changes according to the action. If “userinfo” changes due to get api/logout then action will be changed and the reducer will also change the state immediately, otherwise it keeps the same state all the time.



```
import { LOGIN_USER, LOGOUT_USER } from '../constants/userConstants'
import axios from 'axios'

export const setReduxUserState = (userCreated) => (dispatch) => {
    dispatch({
        type: LOGIN_USER,
        payload: userCreated
    })
}

export const logout = () => (dispatch) => {
    document.location.href = "/login";
    axios.get('/api/logout')
    localStorage.removeItem("userInfo");
    sessionStorage.removeItem("userInfo");
    localStorage.removeItem("cart");
    dispatch({ type: LOGOUT_USER })
}
```

Code Snippet 2: Redux-user-action

```
import { LOGIN_USER, LOGOUT_USER } from '../constants/userConstants'

export const userRegisterLoginReducer = (state = {}, action) => {
    switch (action.type) {
        case LOGIN_USER:
            return {
                ...state,
                userInfo: action.payload
            }
        case LOGOUT_USER:
            return {};
        default:
            return state
    }
}
```

Code Snippet 3: Redux-user-reducer

The Bootstrap and the React-bootstrap package were also used to create the UI. With Bootstrap the header and footer layout were created using classes such as Row, Col, Carousal.

```
1  import { Container, Row, Col } from "react-bootstrap";
2
3  const FooterComponent = () => {
4    return (
5      <footer>
6        <Container fluid>
7          <Row className="mt-5">
8            <Col className="bg-dark text-white text-center py-5">
9              Copyright &copy; Best Online Shop
10           </Col>
11         </Row>
12       </Container>
13     </footer>
14   );
15 };
16
17 export default FooterComponent;
18
```

Code Snippet 4: React-bootstrap in Footer Component.

3.2.2 Backend Implementation

The backend was created with Node js and its framework Express js. To establish client and server communication the HTTP communication protocol was created. Mainly four protocols were used to create communication.

The route of a page is being called by using this request. Each route serves a different purpose, and each route can be accessed by a particular user. Some of the routes and corresponding pages activity is listed below in Table 1.

Table 1: Route command table

Route	**Purpose**	**Access**
router.get("/", getUsers)	Get user information	Admin
router.delete('/:id', deleteUser)	Delete user	Admin
router.get("/search/:searchQuery", getProducts)	Search product	Public
router.post("/seller/product", create-Product);	Product creation	Seller
router.patch("/seller/setSold", setSold);	Mark as sold	Seller
router.put("/delivered/:id", up-dateOrderToDelivered);	Update delivery	Admin
router.get("/admin", getOrders);	Check the order	Admin

Specific pages are assigned with a controller. Each has different functionality and condition(16), depending on the condition response status change. Some re-sponse statuses are shown below in Table 2.

Table 2: HTTP status Table

Status	**Function**
res.status(400)	Bad Request
res.status(201)	Created
res.status(500)	Internal Server Error

With this the authentication for different users was created. Middleware “JSON web token” was used for this authentication. If a visitor wants to log in protected by jwt protocol, it will create an access token and send it to database. If the token match with the jwt secret key is set by the admin, it will give a desired access token and the user can be logged in.

```
const jwt = require("jsonwebtoken")
const verifyIsLoggedIn = (req, res, next) => {

    try {
        const token = req.cookies.access_token
        if(!token) {
            return res.status(403).send("A token is required for authentication")
        }

        try {
            const decoded = jwt.verify(token, process.env.JWT_SECRET_KEY)
             req.user = decoded
             next()
        } catch (err) {
            return res.status(401).send("Unauthorized. Invalid Token")
        }

    } catch(err) {
        next(err)
    }
}

const verifyIsAdmin = (req, res, next) => {

    if(req.user && req.user.isAdmin) {
        next()
    } else {
        return res.status(401).send("Unauthorized. Admin required")
    }
}

module.exports = { verifyIsLoggedIn, verifyIsAdmin }
```

Code Snippet 5: Middleware for verify token.

Code Snippet 6: Token generate function

The POSTMAN application has been used to test the api before calling in front end(17). Here, http://localhost:5000/api/categories were used to get a request to see the response from the api. Here local host 5000 was used because the application backend runs in port 5000.

With this request JSON format data can be obtained from the database. It's a very handy tool when the api is tested.

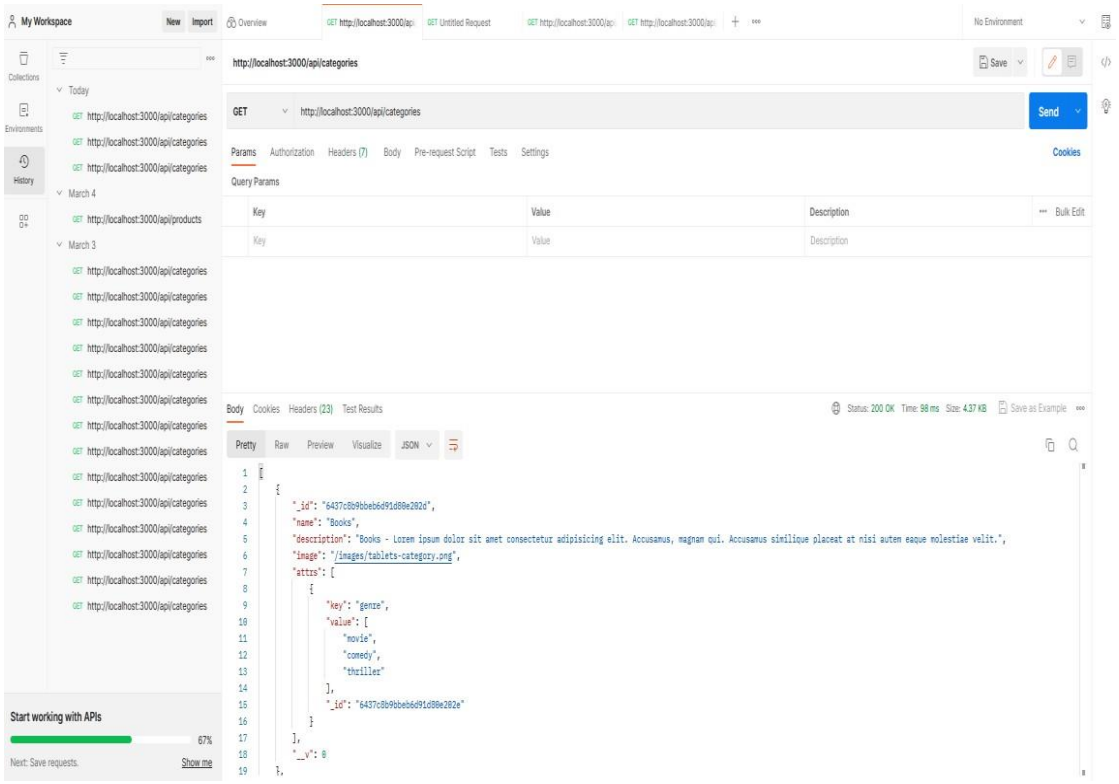
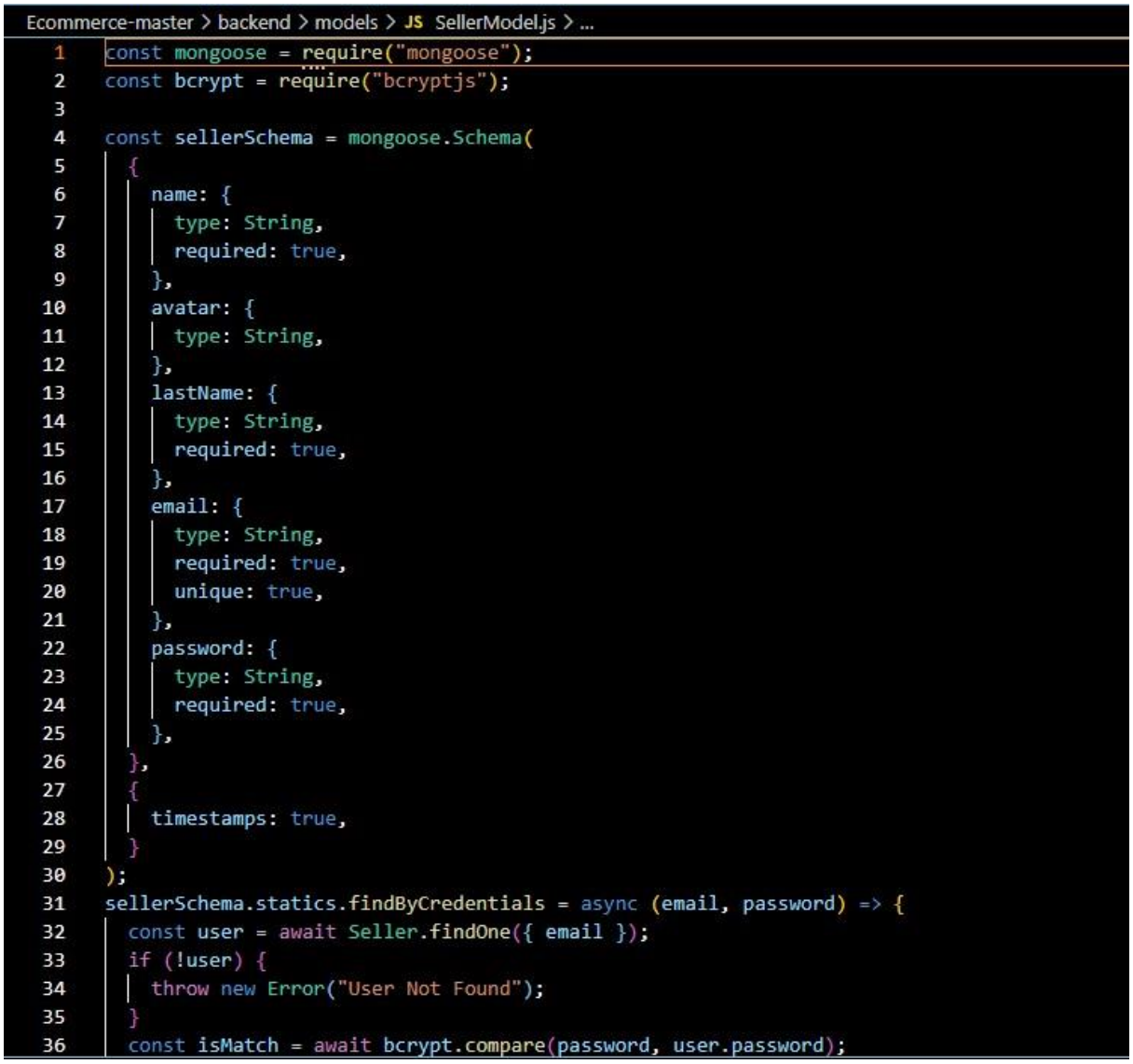


Figure 5: Postman GET request.

3.2.3 Database Implementation

From the database MangoDB and its object model Mongoose was used to create the database section. A model was created to define the architecture for specific pages in the data base. Generate-schema was used to convert JSON Objects to MySQL Table Schema. It gives a better format in the database.

When someone creates an MangoDB account then an environment key is also created for database and it puts in an .env file. Also, the api secrete key and URL can be obtained which is also used to connect the database with the application. When the data is being pushed in the database, a unique id with all the data and date is uploaded in the database.



Code Snippet 7: Model of Seller

Using this ID, the seeder dami data is being pushed in the database. It helps to test if the demo data is stored in the database or not.

The bcrypt package is used to manage to encrypt the original password. This process is called hashed algorithm which changes the password in a hashed format so other people cannot read it.

A config file is also created which shows the connection status. An async function is used because everything is asynchronous when it comes to the data base.

```
const ObjectId = require("mongodb").ObjectId

const orders = Array.from({length: 22}).map((_, idx) => {
    let day = 20
    if(idx < 10) {
        var hour = "0" + idx
        var subtotal = 100
    } else if(idx > 16 && idx < 21) {
        var hour = idx
        var subtotal = 100 + 12*idx
    } else {
        var hour = idx
        var subtotal = 100
    }
    return {
        user:ObjectId("625add3d78fb449f9d9fe2ee"),
        orderTotal: {
            itemsCount: 3,
            cartSubtotal: subtotal
        },
        cartItems: [
            {
                name: "Product name",
                price: 34,
```

Code Snippet 8: Function to Store Data in Database

```
const bcrypt = require("bcryptjs")
const ObjectId = require("mongodb").ObjectId;

const users = [
    {
    name: 'admin',
    lastName: 'admin',
    email: 'admin@admin.com',
    password: bcrypt.hashSync('admin@admin.com', 10),
    isAdmin: true,
  },
  {
    _id: ObjectId("625add3d78fb449f9d9fe2ee"),
    name: 'John',
    lastName: 'Doe',
    email: 'john@doe.com',
    password: bcrypt.hashSync('john@doe.com', 10),
  },
]

module.exports = users
```

Code Snippet 9: Bcrypt hash Operation

3.2.4 Deployment

For deployment “Render” was used. This is a cloud service where developers can build and run their applications (18).

It is very easy to deploy the application in this site. A new “gitignor” file was created and “.env” was written. Then a “personal access token” had to be created in Github and the entire project uploaded in the Github repository.

After that the Github account was linked in Render and a live server in the render application was created. After putting necessary credential, the project was deployed in the live server using a unique link created by Render.

The link of the live server is given below.

Back end live server: https://backend-wyqt.onrender.com

Front End live server: https://frontend-o6mi.onrender.com/

4 RESULT

In this chapter the project is demonstrated and described.

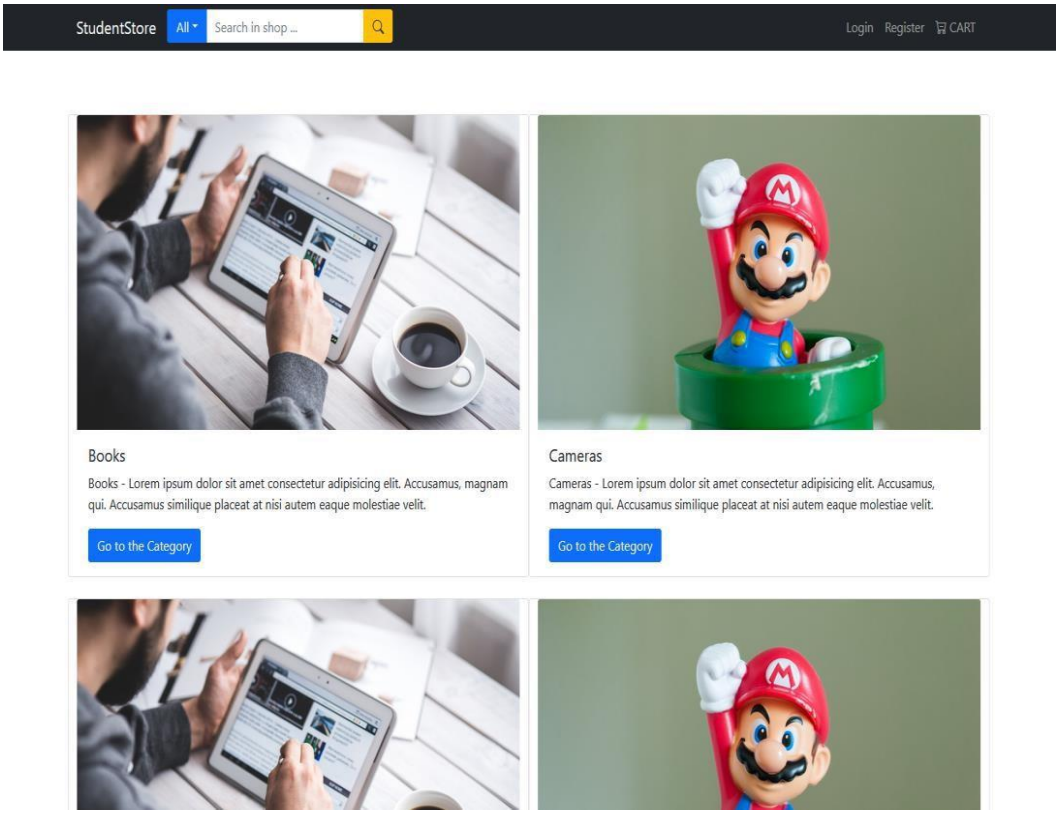


Figure 6: Home page

The home page (Figure 6) displays all the products of the seller and buyer. It also shows the login and registration and cart option.

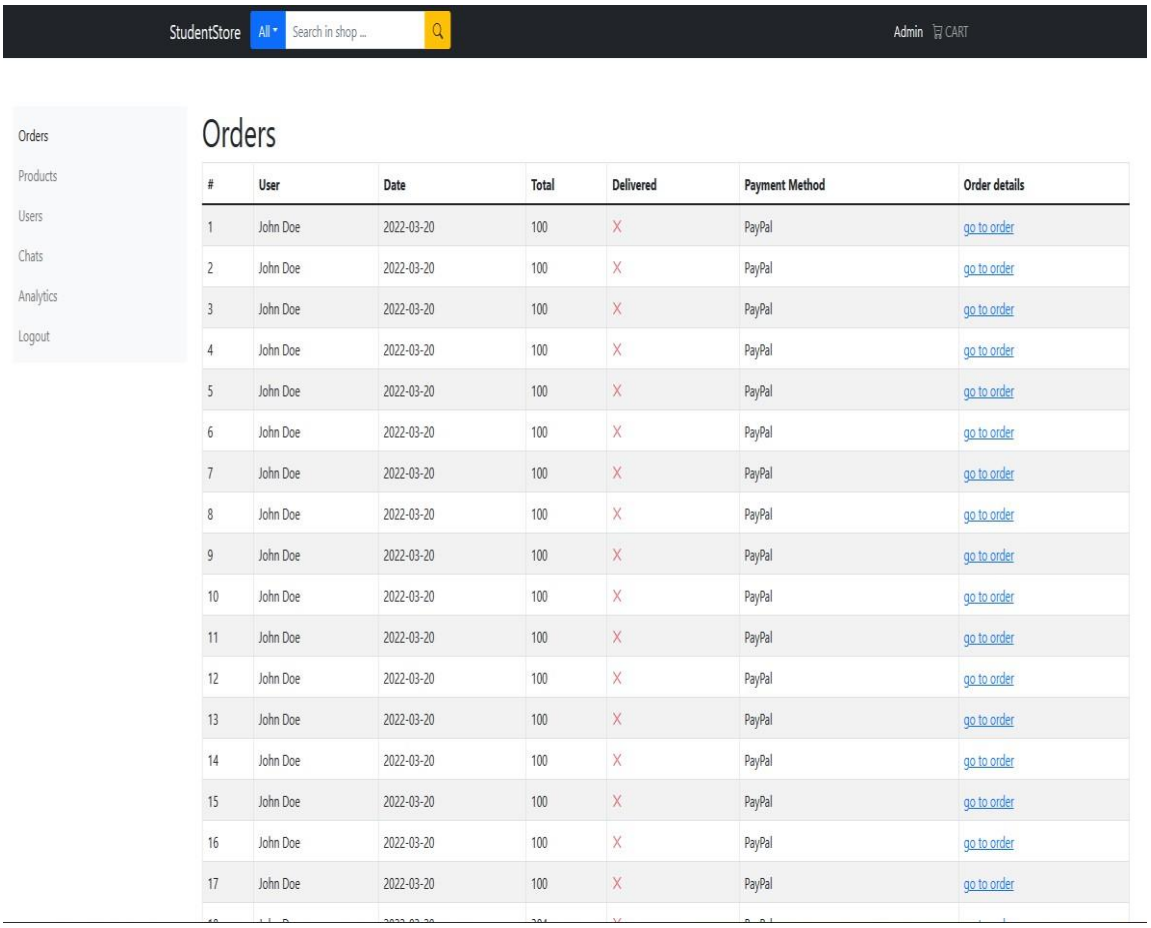


Figure 7: Admin Home page

When the admin logs in (Figure 7), then they will see the several options: order list, product, user, chat, analytics and log out. In the order list the admin can see all orders from the site, in the product menu the admin can upload the product, in the user option the admin can create and delete a user, in the chat option the admin can see the message of the user, in the analytic option the admin can view the buy and sell cart and the logout option is for log out.

Figure 8: Buyer Product List

In Buyers profile page (Figure 8) the buyer or user can see the product from the e-commerce site. From there the user can order the product and it goes to the cart.

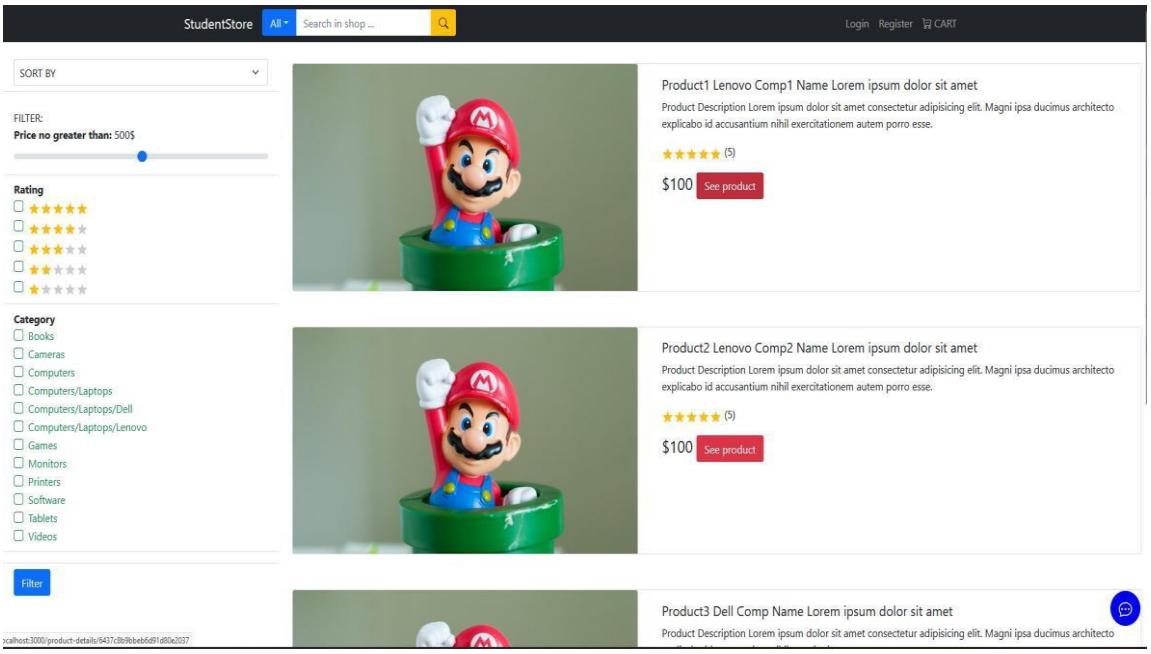


Figure 9: Product list page

In the Product list page (Figure 9) the user can sort the product base on rating and category.

5 DISCUSSION

This chapter discusses what kind of problem this project has solved and what can be learned through this process.

This project contributes mainly to front end part but some backend part work was also done. Some UI and implementation using React was designed. Log in and register page UI were created and its back-end work also done. Controller, route for user, seller and buyer were created.

From this work one can learn a lot about React package management and how a state works. By doing backend work the understanding of server-side work can be improved. One can learn how to connect front and backend in a project and what kind of package would be needed to accomplish this work.

Due to lack of time some functionality is not operational for example the, cart page. In the live server the buyer profile page is not appearing. In future this problem can be solved and this application can be published for commercial use.

There are some limitations of the project, first the authentication can be much more sophisticated. Checking the validity of the student should be developed further. A more colorful and easier UI for the application is also needed.

6 CONCLUSIONS

This project is an innovative project. The aim of this project is to create a youth entrepreneur from the university. For that a fast, easy, and modern application is required.

The MERN method has been used to complete the project successfully because it is faster than other web development stacks. In the project React was used to develop the UI and Node was used to develop the backend.

Easier UI can make this project better for the user.

Finally, this project brings a new idea and with new stack technology like MERN it can be the next hit web application on the internet.

REFERENCES

1. Best Web Development Stack 2023 Accessed 23.3.2023 https://dev.to/theme_selection/best-web-development-stack-2jpe
2. React official page Accessed 23.3.2023 https://legacy.reactjs.org/
3. The Bootstrap Blog Accessed 23.3.2023 https://blog.getbootstrap.com/
4. Express official page Accessed 23.3.2023 https://expressjs.com/
5. Express examples Accessed 23.3.2023 https://expressjs.com/en/starter/examples.html
6. MangoDb official page Accessed 23.3.2023 https://www.mongodb.com/
7. MangoDb resources Accessed 23.3.2023 https://www.mongodb.com/docs/manual/reference/method/db.collection.insertMany/
8. npm package description Accessed 24.3.2023 https://www.npmjs.com/package/npm
9. npx package description Accessed 24.3.2023 https://www.npmjs.com/package/npx
10. react dom package description Accessed 24.3.2023 https://www.npmjs.com/package/react-dom
11. redux package description Accessed 24.3.2023 https://www.npmjs.com/package/redux
12. nodemon package description Accessed 24.3.2023 https://www.npmjs.com/package/nodemon
13. nodemailer package description Accessed 24.3.2023 https://www.npmjs.com/package/nodemailer
14. bcryptjs package description Accessed 24.3.2023 https://www.npmjs.com/package/bcryptjs

15. axios package description Accessed 24.3.2023
https://www.npmjs.com/package/axios
16. HTTP response status codes Accessed 25.3.2023
https://developer.mozilla.org/en-US/docs/Web/HTTP/Status
17. Postman starter page Accessed 26.3.2023
https://www.postman.com/postman/workspace/postman-public-workspace/documentation/12959542-c8142d51-e97c-46b6-bd77-52bb66712c9a
18. Render offcial page Accessed 26.3.2023
https://render.com/