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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER ENGINEERING

DESIGN AND IMPLEMENTATION OF A FILE STORAGE SERVICE AND A BLOG WEB APPLICATION

Internship Report Submitted to the Department of Computer Engineering, Faculty of Engineering and Technology, University of Buea, in Partial Fulfilment of the Requirements for the Award of the Bachelor of Engineering (B.Eng.) Degree in Computer Engineering.

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Academic Year: 2021/2022

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Dedication

This work is dedicated to my late father, Mr. Meh Abraham Ughe, and my lovely mother, Mrs. Chu Emilia Embi.

Acknowledgment

I am most grateful to the almighty God for giving me the strength and courage to continue, even when I thought all hopes were lost. Without him, none of these would have been possible.

I would like to express my profound gratitude to the Faculty of Engineering and technology for awarding me a spot to study and pave the way towards a carrier in IT.

I will also want to express my gratitude to those who assisted me in any means in the completion of this work

I owe appreciation to my academic supervisor, Dr. Tsague Aline who went out of her comfort zone to guide me through reporting my internship.

My Mother and My late father (May his soul continue to rest in peace) for being a full support system throughout my journey of becoming what I have always wanted to become.

My uncle, Mr. Damian Kedzeh and wife, for providing me with the resources I needed especially during my internship period.

My brother, Celestine, who has never relented on assuring that my tuition and that I have the necessary resources to study

My sister, Glory for guiding me through a successive path in the university.

I was honored when the Assistant technical manager of Go-Groups, Mr. Arrey Frank, offered me an internship and had Mr. Banlon Jones guide me in learning the required stacks used in the company.

List of Figures

List of Abbreviations

API	Application Programming Protocol
FET	Faculty of Engineering and Technology
Ltd	Private Limited Company
REST	Representational State Transfer
SaaS	Software as a Service
UI	User Interface
UML	Unified Modelling Language
CSS	Cascading Style Sheet
HTML	Hyper-Text Mark-up Language
PHP	Hyper-Text Pre-processor
CI	Continuous Integration
CD	Continuous Delivery

CHAPTER 1: GENERAL INTRODUCTION

1.1 The Internship

1.1.1 Definition of Internship

An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest.

An internship gives a student the opportunity for career exploration and development, and to learn new skills. It allows the employer to bring new ideas and energy into the workplace, develop talent and potentially build a pipeline for future full-time employees.

An effective internship must attain the following:

- Consists of a part-time or full-time schedule work that includes no more than 25% clerical or administrative duties.
- Provides a clear job/project description for the work experience.
- Orients the students to the organization, its culture, and proposed work assignment(s).
- Helps the students develop and achieve learning goals
- Offers regular feedback to the student interns.

An internship can last for a week or one year. There are paid internships, unpaid internships, and internships that offer course credit.

There are virtual and onsite internships. My internship was an onsite one and not a paid internship but we were given monthly stipends (What is an internship, 2022).

I started my internship in July 2021 and ended in February 2022.

1.1.2 Goals and objectives of the internship

The goals and objectives of my internship include:

- To gain real work experience
- Get background knowledge and explore the industry.
- Develop self-understanding, self-discipline, maturity, and confidence.
- Develop good networking and interpersonal relationship skills.
- Gain experience in developing, maintaining, and scaling software.
- Corporate with different technical departments to produce specific products.

1.2 The company

1.2.1 About Go-Groups Ltd

Go-Groups Ltd is one of the leading software companies in silicon mountain, Buea Cameroon. It was founded in 2012 and registered as a Private Limited Liability in 2014 with head office in Buea. Go-Groups Ltd provides software as a service (SaaS) and is known to be the best solution provider when it comes to the management and operation of higher institutions and universities. They are a value-added service (VAS) provider to MTN Mobile Money Cameroon, Orange Money Cameroon, UBA Bank Visa Services.

Go-Groups Ltd has built applications in the transport, e-commerce, taxation, and academic sectors. Go-Student being its first product has recorded a lot of success in some leading universities and higher institutions in the country.

Over the years, Go-Groups Ltd has expanded its services to other domains in E-Commerce with its products, PayamGo, a payment aggregator which is used to handle payments on all the applications built by the company.

GoWaka is the latest product released by the company in February 2021. (About Go-Groups: Go-Groups Ltd, 2022)

Go-Groups Ltd uses technologies, frameworks, and programming languages such as Angular, Java, spring boot, PHP, Ionic, Laravel, Docker, TDD and micro-services in developing their applications.

1.2.2 Organizational structure of Go-Groups

Go-Groups Ltd is managed by a general manager, Michael A G Boyo. The Administrative Manager, Mr. N Lewis Che, Technical Manager, Mr. Tanko Edward T, and Finance Manager, Dr. Nde D Nguti.

The figure below illustrates the organizational structure of the company.

Figure 1 Top management staff and co-founders (Our Team: Go-Groups, 2022)

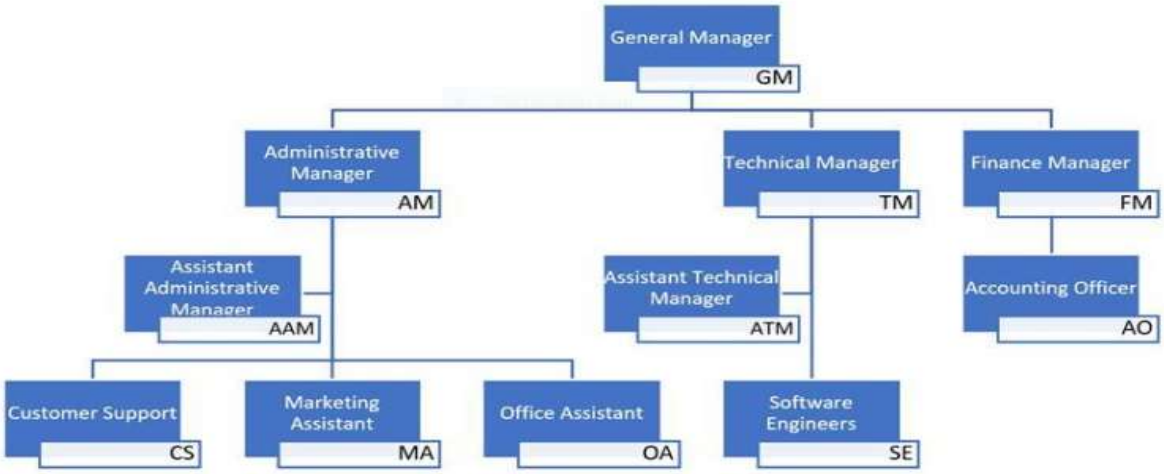

Figure 2 Organizational Structure of Go-Groups

1.2.3 Objectives of Go-Groups

Go-Groups Ltd has as primary objective to provide solutions to local problems using local talent. Observation of societal problems is done, the data collected and analysis performed on this data and solutions proposed using well defined scientific principles, methods and procedures.

Below are the specific objectives of Go-Groups Ltd:

- Train Individuals in modern technologies needed to solve societal problems through the Go-Groups summer school where students from different universities undergo training on frontend and backend technologies.

- Reduce unemployment in the country by providing employment opportunities for young graduates and direct integration opportunities for students who successfully complete the Go-Groups summer school.
- Foster the vision of making Buea the technology hub of central Africa through the Silicon mountain initiative by championing the use of modern technologies and best engineering practices compared to the likes of start-ups in Silicon Valley.

CHAPTER 2: INTERNSHIP ACTIVITIES

2.1 First day at Go-Groups

Tuesday 21st of July 2021 was officially my first day of internship at Go-Groups which was characterized by a meeting with the staff and the Technical Manager, Mr. Tanko Edward T, who made an elaborate presentation of Go-Groups as a whole and how our stay as interns will be for the next six months.

He made us understand that we, interns, were there to learn the different technologies used by the company and also contribute to projects they began working on and start new projects. We were told the senior developers and any other staff were open and ready for assistance at any time. We were told that our contribution was very important and was encouraged to bring our new ideas.

A brief introduction of the name and job description of staffs was stated. Then the daily activities conducts and the schedule was laid out to us the interns.

We were also told what was expected from us as interns and also what we were to expect from the company. And lastly, the interns were separated into two groups, the Front-End team, and the Back-End team. We were to learn all the technologies used by the company, associated with the chosen team.

I chose the frontend team and was expected to learn Angular for 3 months, which is the frontend framework used in the company.

There were six persons, including me, in the Front-End team and 8 persons in the Back-End team. After the meeting, which lasted for about 2 hours, from 8 am to 10 am, we were told to resume work the following week. We were given one week to get everything ready, ensure our laptops are working perfectly well, buy headsets and some other requirements we may need. The company bought headsets and repaired the laptops of some persons who couldn't afford to.

The members of the Front-End team were to learn angular for three months by watching a paid udemy course bought by the company, after which we will build a capstone project to test our level. We were given access to the company's udemy account and we spoke with the instructor of the course.

2.2 Technical Supervisor

The technical supervisor I was assigned to was Mr. Banlon Jones, who is the sole DevOps Engineer

at the company. Mr. Banlon graduated from the University of Buea in the year 2018/2019 with a BTech in Computer Engineering specialty Software Engineering from the College of Technology, University of Buea. He has a 3-year hands-on working experience both in Douala and Buea

Though being a DevOps Engineer, his technical skills range over several technologies like Java, Spring Framework, Spring Boot, Spring MVC, Database design, Docker, Cloud computing, Angular, Testing, and much more. He is eager for knowledge, down to earth and relatable.

2.3 Department

I was posted to the technical department of the company, which is responsible for the developing, testing, and maintaining of applications. This department is headed by Mr. Tanko Edward.

2.4 Tasks assigned to me

In the course of my internship, I was assigned three 3 projects to work on, which were: Product catalog, File storage service, and Blog wep application.

The product catalog: project was to test our knowledge of the angular framework. It was built with angular and spring boot. My task for this project was to work with team members and other interns who were: Babi Beulah and Kouo Nzoko Sulaymane, in completing user stories, which were:

- Creating a user account, User story 1
- Creating product category after login, User story 2
- Creating products, User story 3
- Editing products and category, User story 4

The File Storage service: An angular and spring boot application that will serve as a central application for all the files of the different applications owned by Go-Groups. Tasks assigned to me for this project include:

- Produce the UI design of the entire system on Figma, User story 1

- Login UI and implementation, User story 2.
- Design the main content of the dashboard, User story 3.
- Implement the logic to delete a file, User story 4.
- Implement the logic to rename a file, User story 5.
- Implement the logic to create a file and to move a file to another directory, User story 6.

Blog UI: Angular and spring boot application to enable publishers to create and sell their books or articles to readers. Tasks assigned to me for this project:

- Complete the user's authentication which includes the creation of a user account and login.
- Protecting routes based on the different roles of the user, reader, publisher, or admin.
- Implement the edit profile functionality.

2.5 FILE STORAGE SERVICE

2.5.1 Project Description

The need to have a centralised application that manages all uploaded files used by different applications or micro services.

The need to manage file sharing**.** An application can upload a file and other applications can share or use that file. There will be no need for the other applications to upload again.

The need for migration or the need for application portability**.** Applications can be migrated from one server to another without the worry of where the files are located because no matter the server you access, the files will be there.

The figure below shows an explanation of file sharing between applications in Go-Groups using the File storage service.

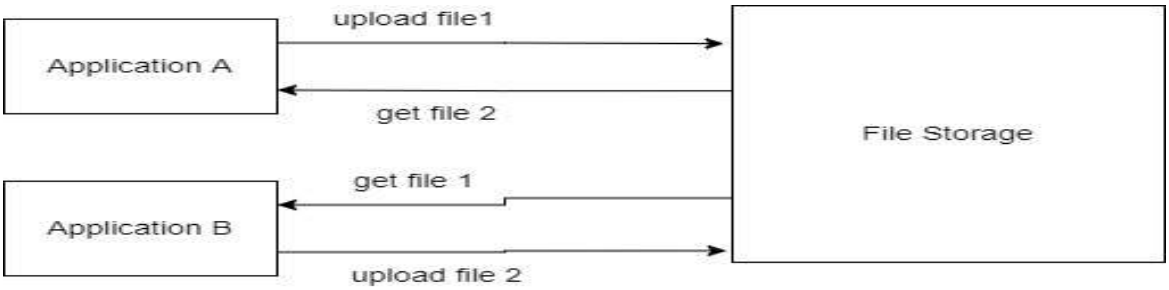

Figure 3 File sharing between applications using the file storage application

Due to the above reasons, this enterprise application was put forth to provide a central application to store all the files of the different applications used in Go-Groups.

2.5.2 Technologies used

The following technologies were used in the development process:

- **Angular:** This is a TypeScript-based open source web application framework.

BLOG UI frontend is built with angular version 12.

- **TypeScript:** This is a strongly typed programming language that builds on JavaScript, giving a better tooling at any scale.
- **HTML:** HTML is the standard mark-up language for documents designed to be displayed in the web browser.
- **CSS:** This is a style sheet language for describing the presentation of a document written using html.
- **Bootstrap:** Bootstrap is a free open-source **CSS** framework directed at responsive, mobile-first front-end web deployment.
- **Angular material:** Angular material is a UI library component developed by Google for Angular developers. It helps to design the application in a structured manner.
- **JAVA:** This is a class-based, object oriented programming language designed to have lesser implementation dependencies.
- **Spring boot:** This is an open-source Java-based framework used to create micro service applications.
- **Microsoft Teams:** Microsoft team is a collaborating platform which provides services for working teams to be able to stay informed, organized and connected all in one place.

2.5.3 Methodology

The File storage application was built based on the **agile software development methodology.**

Agile software development methodology is an iterative, time-boxed, people-oriented and result-focused approach to software delivery that builds software incrementally from the start of the project instead of delivering it all at once near the end. Agile is a term used to describe software development approaches that employ continual planning, learning, improvement, team collaboration, evolutionary development, and early delivery. (what is agile, n.d.)

Below is a pictorial representation of the agile methodology.

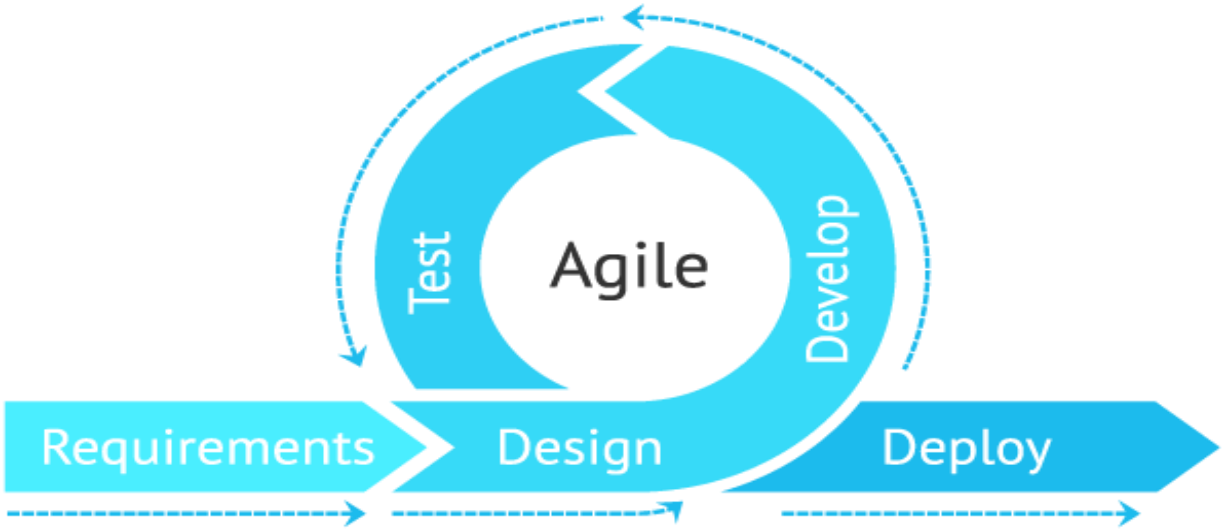

Figure 4 Agile development life cycle (Parvzhub, 2022)

2.5.4 System requirements

Project requirements are a specification of what should be implemented. They are descriptions of how the system should behave, or of a system property or attribute. For the implementation of the File storage enterprise application, the functional and non-functional requirements are described.

- **Functional requirements**

Functional requirements are product features or functions that developers must implement to enable users to accomplish their tasks. Functional requirements describe system behaviour under specific conditions. The functional requirements for File-storage include:

- Applications should be able to login.
- Applications should be create, update and delete a file.
- Applications should be able to zip a file.
- User should be able to move a file from one directory to another.
- Applications should be able to rename a file.
- Applications should be able to download a file.
- Applications should be able to view file details.

- **Non-functional requirements**

Non-functional requirements describe how a system must behave and establish constraints of its functionality. The non-functional requirements for File-storage include:

- **Security**

  File storage will be storing a lot of user private data; hence, the system has to be highly secured to prevent unauthorized access to the application and stored data.

2.5.5 System design

System design involves the transformation of user's requirements into a suitable form as earlier mentioned in the previous project.

Use case diagrams

Use case diagrams help us demonstrate the different ways a user interact with the system.
This enables us identify the different actors of the system, the goals our system enables the actors to achieve.

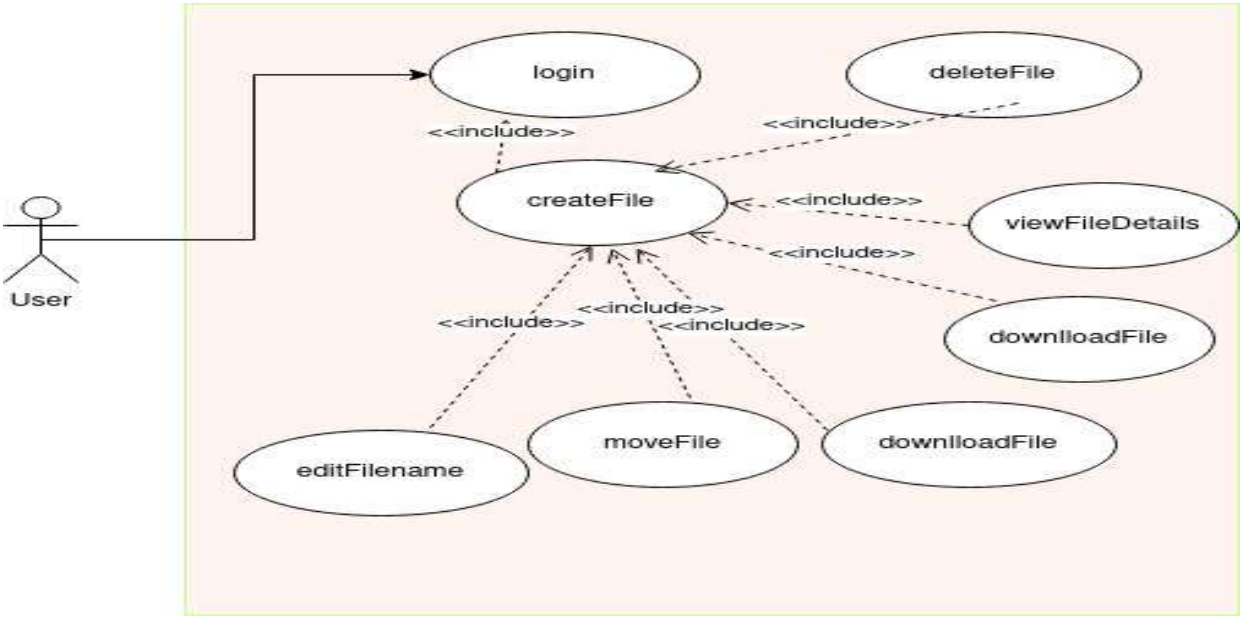

Figure 5 Use case diagram of the system

Class diagrams

A class diagram in the unified modelling language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, methods and the relationship amongst objects.

It is the main building block of object oriented modelling.

Below is the class diagram of the entire system.

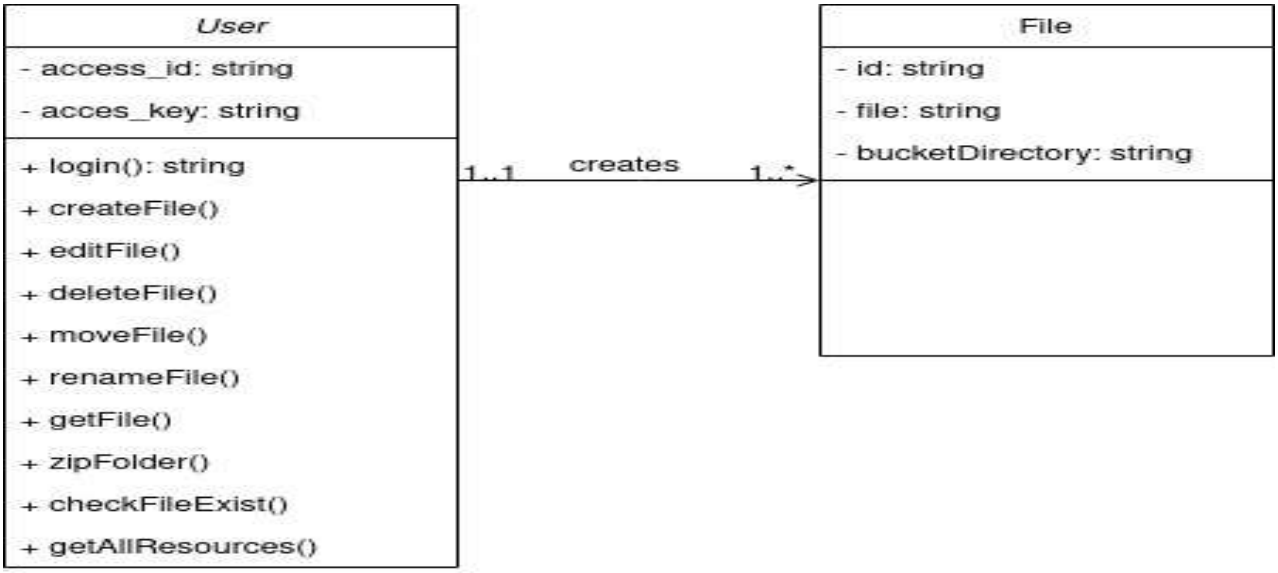

Figure 6 Class diagram of the system

Sequence diagrams

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place.

Below are the sequence diagrams for the system.

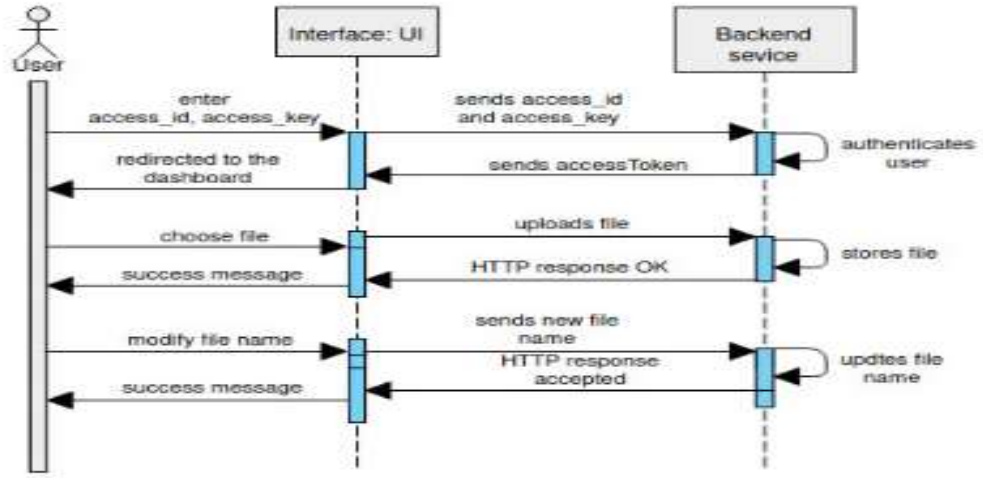

Figure 7 Sequence diagram for authentication, create file and modify file

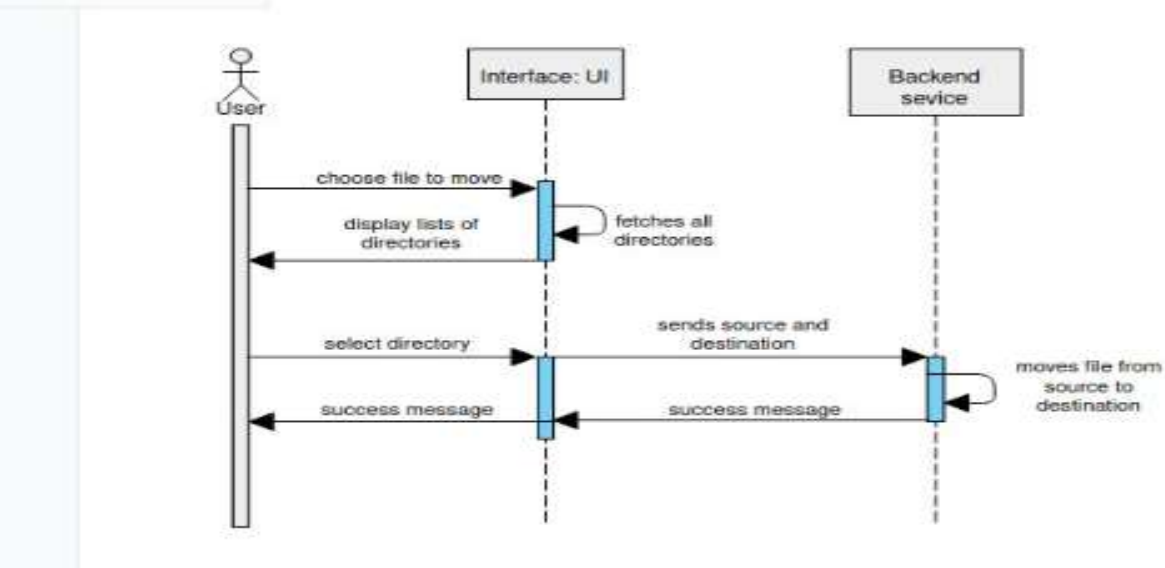

Figure 8 Sequence diagram for move file

2.5.6 Development process

As already mentioned above, the development process used was agile methodology.

There are several frameworks which could be used in agile development, the most popular are scrum, extreme programming, and lean and dynamic software development method.

The scrum approach was used for the development of the File Storage application.

Scrum breaks down the development process into stages called sprints or iterations.

A sprint is a short, time-boxed period during which scrum team works to complete a number of tasks. The activities of a sprint include:

- **Sprint Planning:** A sprint for the application lasted for 1 week. Before each sprint, a sprint planning meeting was held. The features to be implemented were decided during this meeting and the discussions on how to achieve them were made.
- **Daily Scrum:** A daily scrum or stand-up meeting was held every day for 15 minutes the purpose of the Daily Scrum is to inspect progress of every team member toward the Sprint Goal.
- **Sprint Review:** At the end of the 1 week set for each sprint, a meeting was held for the team to show what was achieved during the sprint. The purpose of the Sprint Review is to inspect the outcome of the Sprint and determine future adaptations.
- **Sprint Retrospective:** Sprint retrospectives were held immediately after the sprint review. Sprint retrospectives are important to improve quality and effectiveness.

The process was overall advantageous as it helped us deliver the work on time and with a better quality.
The project was managed and hosted on GitLab.

2.5.7 Results

This section shows the user interface for some pages of the application.

Figure 9 Login screen

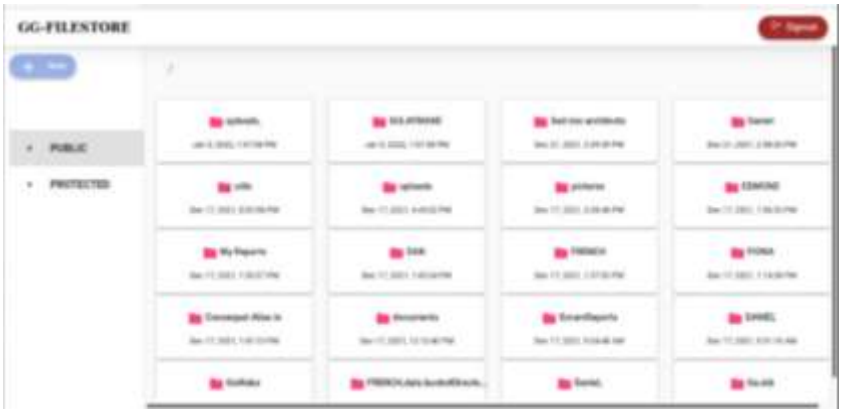

Figure 10 Display of resources in the Public directory

Figure 11 Create file page

Figure 12 Rename file page

Figure 13 File detail page

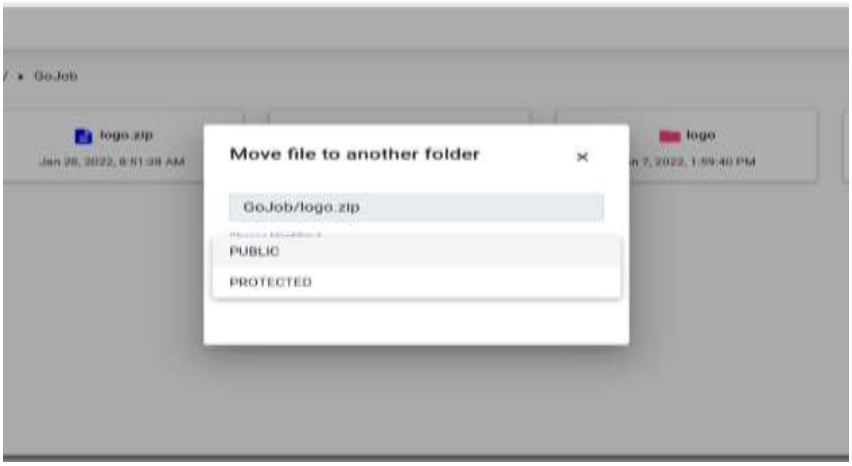

Figure 14 Move file page

2.6 BLOG web application

2.6.1 Description

Blog web application is an application which provides a platform for users (publishers) to create an account, publish articles and other users (Readers and Publishers) also create an account and purchase the articles.

In this project, I worked in the frontend on authorisation and authentication. A user can buy articles only when authenticated and only users of certain role (READER, PUBLISHER, and ADMIN) can have access to certain resources.

2.6.2 Technologies used

- **Angular:** This is a TypeScript-based open source application framework. The BLOG web application was built with Angular version 12.
- **Spring:** Was used for creating the APIs.
- **Bootstrap:** This is a free open-source **CSS** framework directed at responsive, mobile-first front-end web deployment.
- **TypeScript:** This is a strongly typed programming language that builds on JavaScript, giving a better tooling at any scale.
- **HTML:** HTML is the standard mark-up language for documents designed to be displayed in the web browser.
- **CSS:** This is a style sheet language for describing the presentation of a document written using html.
- **Github:** Was used to host the code and manage collaboration between the frontend and the backend.
- **MYSQL:** This a relational database management system. Was used to create a local backend for the development process.
- **Swagger:** This is an interface description language for describing RESTful APIs.

2.6.3 System requirements

Project requirements are specifications of what should be implemented. They are descriptions of how the system should behave. Below are the functional and non-functional requirements for the implementation of the BLOG web application.

➢ **Functional Requirements**

Functional requirements are features that must be implemented by developers to enable users accomplish their tasks.

For the implementation of BLOG web application project.The functional requirements I worked on include:

- **Authentication management**
  - A user should be able to create an account either as a READER or as a PUBLISHER.

- Users should be able to login after they create their account.

- **Authorization management**
  - The user dashboard should show or hide features based on the role of the user.
  - The Reader dashboard should not have features that are specific for a publisher and the reader and publisher should not have features specific for the admin.
- **Profile management**
  - Users should be able edit their names and emails.

➢ **Non-Functional Requirements**

- **Security**

  Since the application will be storing user's data, the application has to be much secured to prevent unauthorised access.
- **Maintainability**

  Resolving faults should be done with ease.
- **Scalability**

  The application should be flexible enough to allow the addition of newer features based on user's feedback.
- **Usability**

  The application should be effective, engaging, error-tolerant, efficient and easy to use.

2.6.4 System Design

This involves the transformation of the user requirements into some suitable form which helps the developer in coding and implementation (Ian, 2016).

It moves the focus from problem domain to solution domain. For this application, the unified modelling language is used, which gives a set of notations needed to visualize, specify, construct and document the artefacts of our software system.

Use case diagram

Use case diagram demonstrate the different ways a user can interact with the system. It helps us know the different actors of our system.

The diagram below shows the different actors of our system and the various actions they perform.

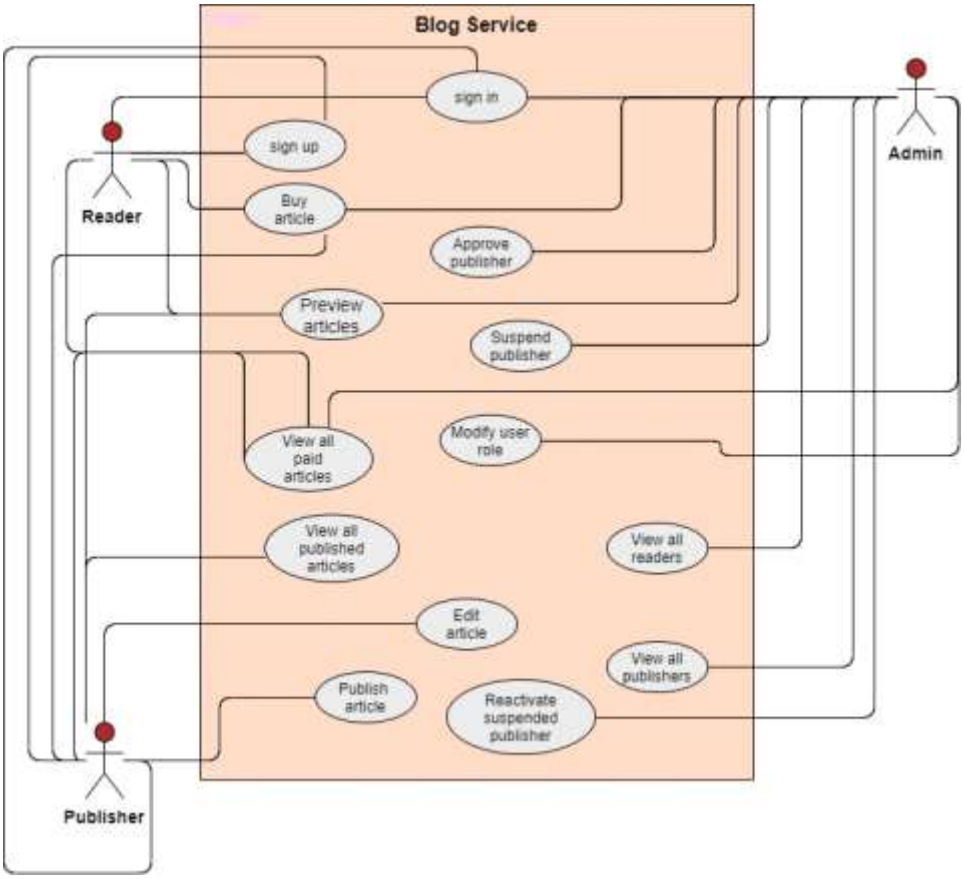

Figure 15 Use case diagram of the Blog web application

Class Diagram

A class diagram in the unified modelling language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, methods and the relationship amongst objects.

It is the main building block of object oriented modelling. (What is class diagram?, 2022)

Below is the class diagram of the entire system.

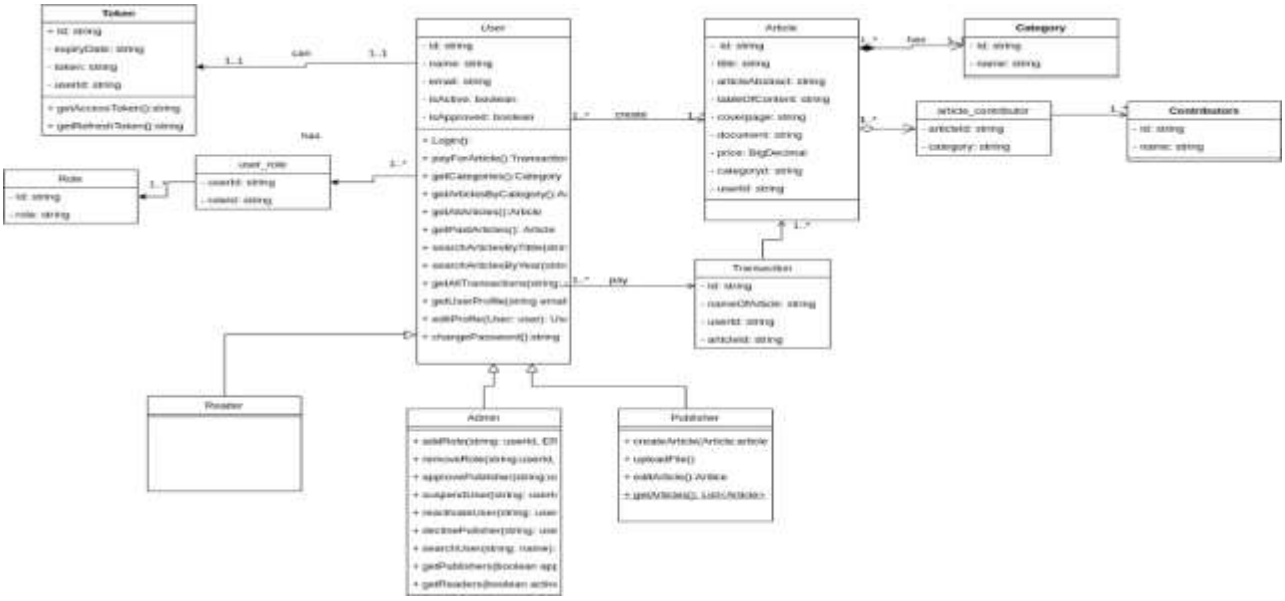

Figure 16 Class diagram of the Blog application

Sequence diagram for authentication

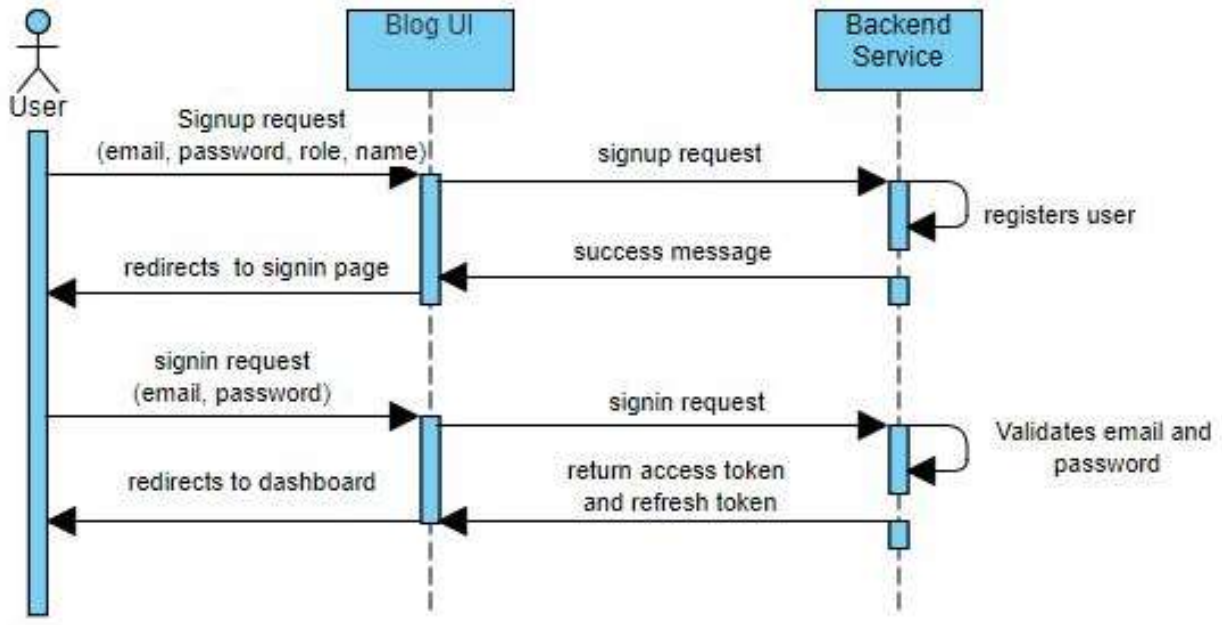

Figure 17 Sequence diagram for authentication for Blog web application

Sequence diagram for edit profile

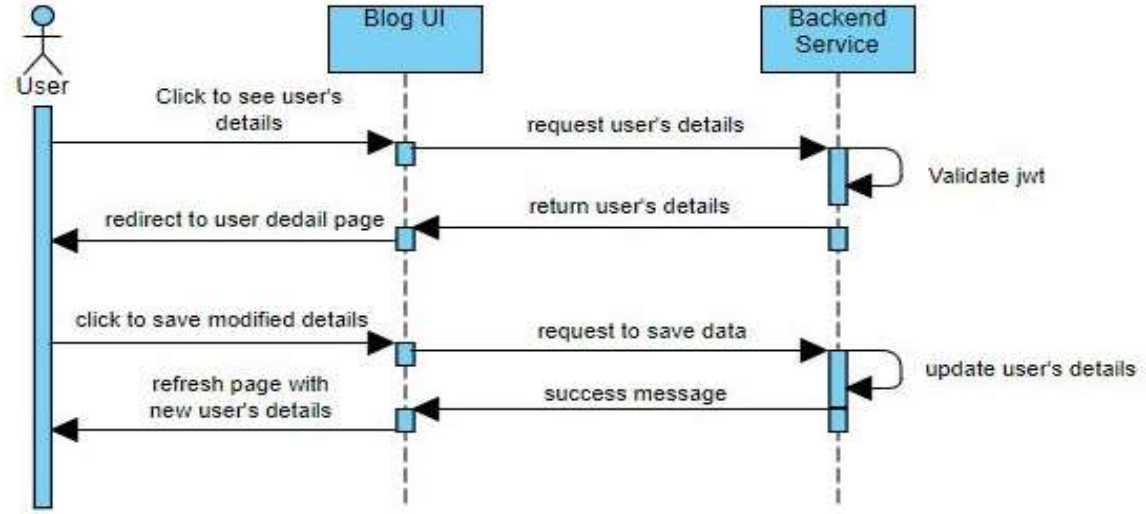

Figure 18 sequence diagram for edit profile

2.6.5 Development process

Just like the File storage service of **section 2.5** above, The Blog web application followed the agile development methodology.

2.6.7 Results

This section shows the user interface of some of the pages.

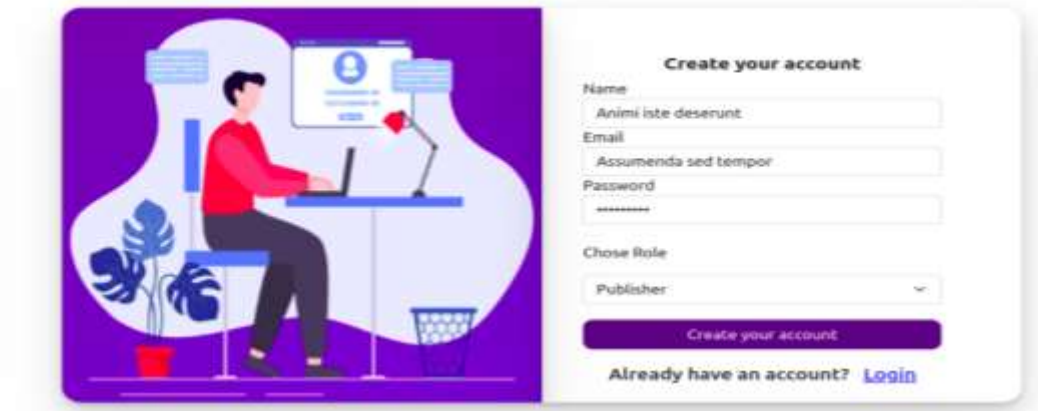

Figure 19 Signup page

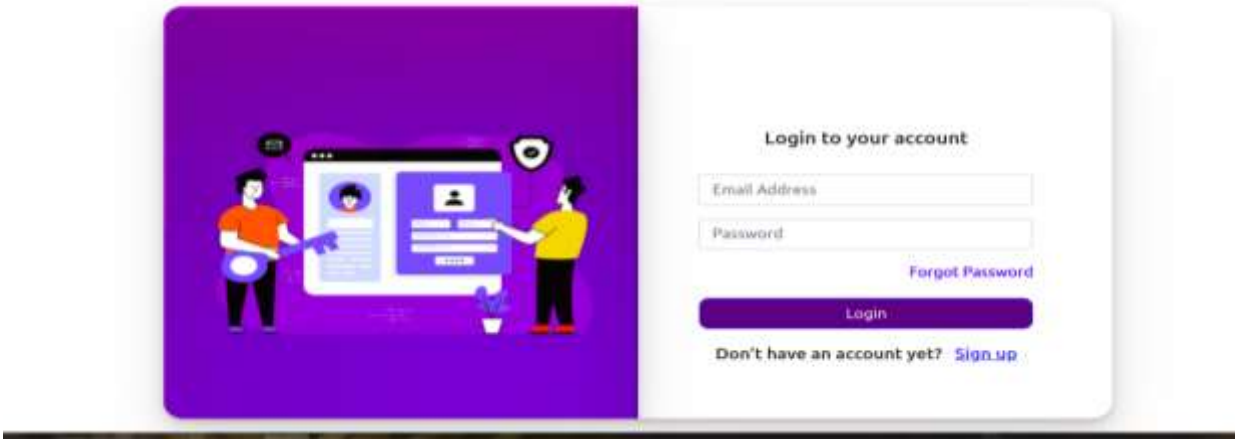

Figure 20 Login page

Figure 21 Reader's dashboard with fewer functionalities

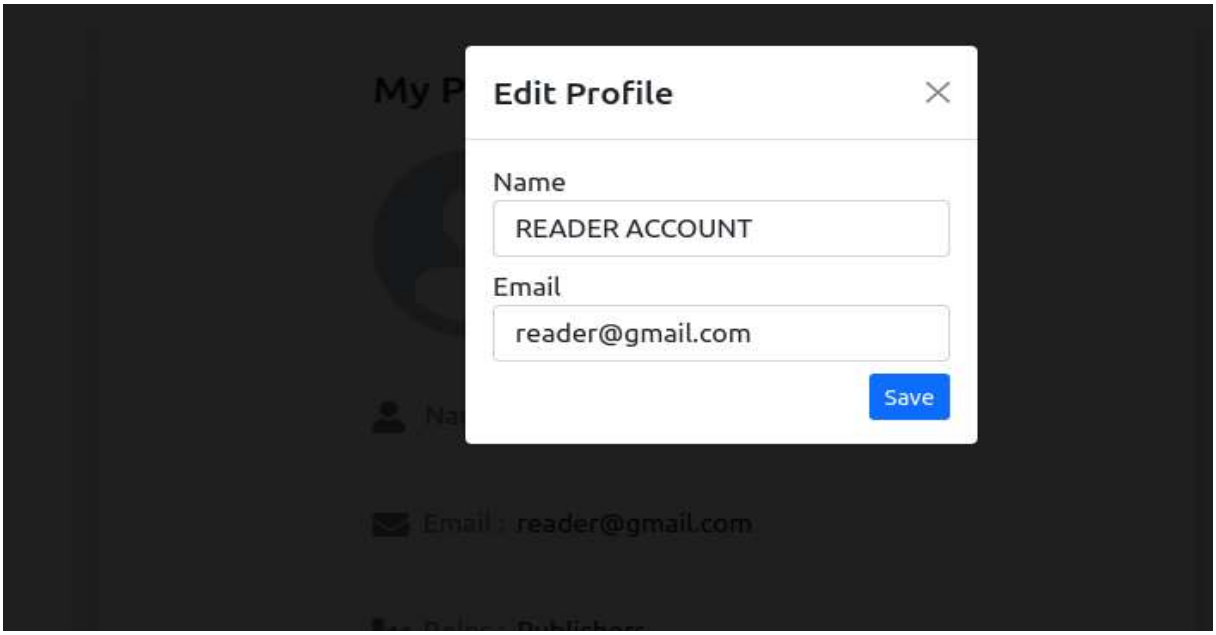

Figure 22 Edit profile page

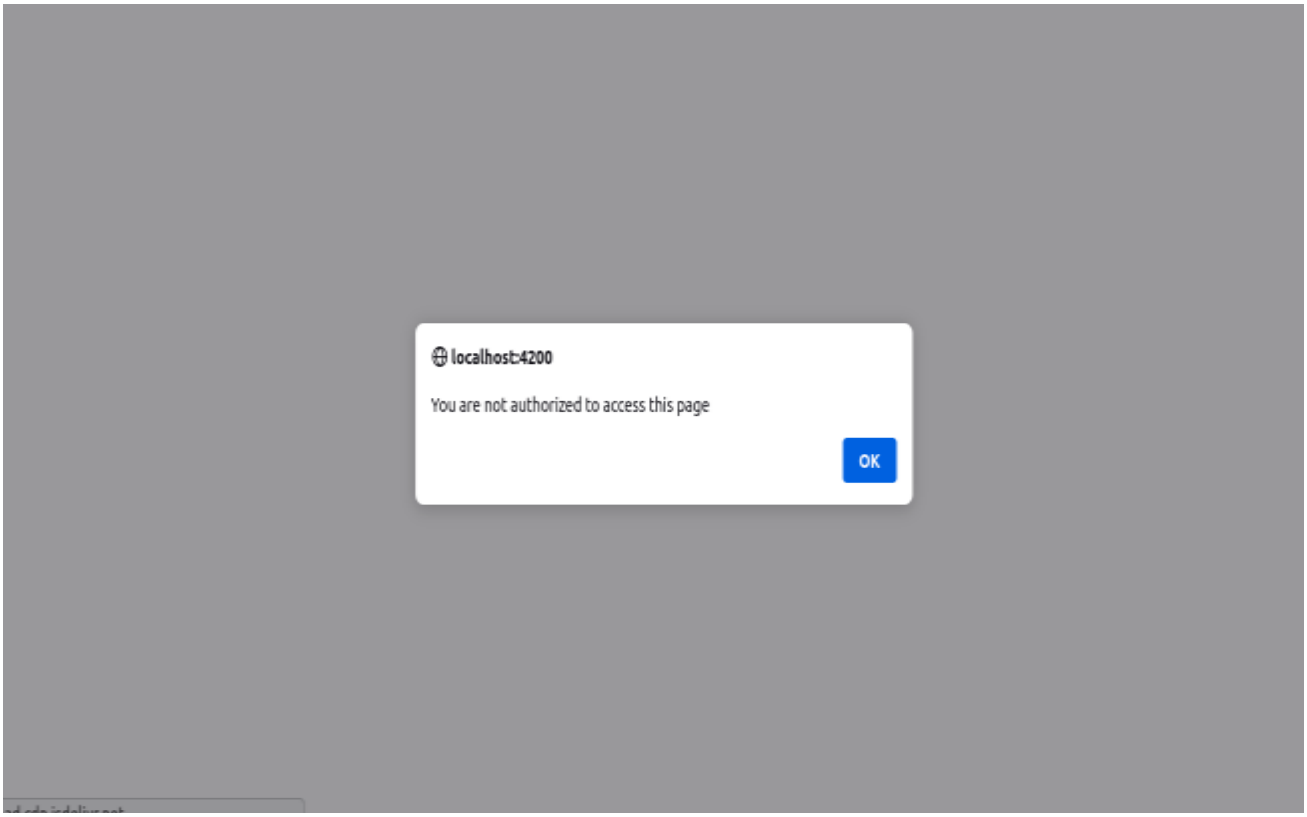

Figure 23 When a user tries to navigate to a page he is not authorized

CHAPTER 3: EXTRA-CURRICULAR ACTIVITIES

Go-Groups carries out a couple of extracurricular activities which revolve around learning and leisure.

During my stay in Go-Groups, I participated in three months of learning activity and a series of outings.

3.1 Saturday Retrospect Meetings

We had training sessions every Saturday the different technologies used in the company, such as:

- **Restful Web Services** which was led by Eng. Dieudonne Dengun, held in the office.

  The main aim was to introduce to the interns what Restful web Service is and the different methods associated with it.
- **Jason Web Token** which was led by the Technical Manager, Eng. Edward Tanko, held in the office.

  This was to introduce the interns in the use of jwt tokens for secure authentication and information sharing within the applications.
- **Agile Software Development** which was held in the office and led by the Administrative Manager, Eng. Lewis C Ngwa.

  This was to introduce the interns with the agile software development, the methodology used by the company in the development of software applications.
- **Containerization and CI/CD**

  This was led by Eng. Semi Clayton, which was to introduce interns to deploying an application with docker.

  In the course of the training, a guide on how to setup docker on our system, was given to us.
- **Balancing Work Life and Studies** was led by the Assistant Technical Manager, Eng. Arrey Frank.

  He gave us about 8 points for managing work and studies simultaneously
- **Version Control and Git**

  This training session was held in the office and led by the Assistant Technical Manager, Eng. Arrey Frank.

He explained what git is and how to setup a github account.

He explained the very few differences between github and gitlab (which is what is used in the company).

- **Microservices** led by Eng. Dieudonne Dengun, He explained what microservices is and how the company is gradually switching from monolithic to microservices.

  He also explained the advantages of using microservices over monolithic severs.

3.2 Lauch and Outings

The company gave us money on some days for launch and we went to a restaurant and had a meal together. We, the interns, also organised an outing, which was approved by the company. We all went to a restaurant, ate and shared ideas on our personal issues, had fun as well.

CHAPTER 4: DIFFICULTIES AND CHALLENGES ENCOUNTERED

Challenges are a great way to learn. During my internship, I faced a couple of challenges which helped strengthen me in the field.

Some of the challenges I faced and how I overcame them include:

- **Internet Connection**

  Internet connectivity is an essential aspect in software development. To be able to install frameworks and download software dependencies, search solutions to some problems on Google, push codes to Gitlab, require an effective internet connection.

  Internet connection sometimes hindered project development as it was not available or available but with low bandwidth.

  This issue was addressed by the company by providing a monthly internet connection even though I still had to struggle with the low bandwidth from the network operator.

  I contributed to solve this problem by using my internet subscription when I experienced low bandwidth from the network operator provided by the company.

- **Mastering the different technologies**

  The technology stack used by the company was quite many, fortunately, I had acquired some of the skills in school and the company also gave us time to learn and apply the different technologies.

  But while working on major projects, the expectation was quite high as I was not only working on real world project but also having continuous code review from my supervisor and the Technical manager. I was not just expected to write code that works, but to write code that is readable and modular.

  To be able to come up to standard and meet-up with the company's expectation, I consulted senior developers and my supervisors whenever I was stuck at a point. They were all very supportive and ready to assist me anytime and they also recommended many resources for me to study.

- **Safety**

Given the current socio-political condition in the region coupled with where I live in Buea, getting taxis to work was quite difficult. I had to stand on the road void of many people to take a taxi to work. This was a major problem as I couldn't go to work early on some days declared as 'ghost town'.

I solved this problem by squatting with a friend who lives just around the company, so I won't be needing to take a taxi to work on 'ghost town' days.

The company also stopped us from coming to work on days declared as 'ghost town' as they gave us weekly stipends for internet connection to work at home during 'ghost town' periods.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

My internship at Go-Groups Ltd was an amazing experience and I am very excited to have achieved all the goals I set at the start of the internship. I even achieved beyond my expectations. I applied all what I learnt in school, gained new skills, and also experienced working in a professional environment.

I also created new networks with interns from different schools, which I believe will play a vital role in my career in the software industry.

The main projects I was assigned to were the design and implementation of a File Storage Service and the implementation of a BLOG application.

I am happy to contribute to some major projects in the company and the projects were built to some acceptable level.

While working on the above projects, I acquired many skills such as working with version control tools, working in an Agile Development environment, team work and communication skills as well. All the above mentioned skills are vital for any software developer.

5.2 Recommendation to FET

I would like to recommend my faculty to increase the internship sessions from one to two. This will help prepare the students better for the job market by the time they graduate.

I would also want to recommend my faculty to orient the first year students about an internship, what it is and how they should prepare when the time comes.

5.3 Recommendation to Go-Groups

Considering the challenges I faced, I will recommend Go-Groups to investigate and provide a better internet connection at the office to enable the effective development of their projects.

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