Invoice Audit System and Test Coverage Improvement

An Internship Report for

CSA 625: Industry Internship / Software Project

Credits: 16

Submitted in partial fulfillment of Master's Degree

Master of Computer Applications

By

SANDHYA SAVLO CHARI

Seat Number: 2209

ABC ID: 242072293285

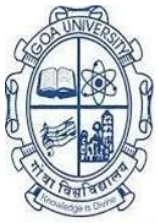
PRN: 201910067

Under the Mentorship of

Jarret Fernandes

Goa Business School

Discipline of Computer Science and Technology



Goa University

Date: 3rd June 2024

Examined by: Seal of the School/Dept

DECLARATION BY STUDENT

I hereby declare that the data presented in this Internship report entitled, “Invoice Audit System and Test Coverage Improvement” is based on the results of investigations carried out by me at Neighborly, under the mentorship of Dr. Jyoti Pawar and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will not be responsible for the correctness of observations / experimental or other findings given in the internship report/work. I hereby authorize the University/college authorities to upload this dissertation on the dissertation repository or anywhere else as the UGC regulations demand and make it available to any one as needed.

Sandhya Chari

Date: Signature and Name of Student

Place: Goa University Seat no: 2210

COMPLETION CERTIFICATE

This is to certify that the internship report "Invoice Audit System and Test Coverage Improvement" is a bonafide work carried out by MS Sandhya Savlo Chari under my mentorship in partial fulfilment of the requirements for the award of the degree of Master of Computer Application in the Discipline of Computer Science and Technology at the Goa Business School, Goa University.

Pramod Divakarla

Date: 06th June 24

Signature and Name of Mentor

Signature of Dean of School

Date:

Place: Goa University

School /Department Stamp

Internship Offer Letter

neighborly

September 22, 2023

Ms.Sandhya Savio Chari
H.No 444-B, Chinchmala, Poriem, North Goa - 403505.
sandhya.at.18@gmail.com
8830736146

Dear Ms. Sandhya Savio Chari,

Neighborly Global Capability Center LLP is pleased to have you on board as an Intern. The duration of this internship is **6 months** starting from January 08, 2024 to July 05, 2024.

You are eligible for a monthly stipend of **INR 30,000** subject to withholdings/deduction of tax at source under prevailing regulations.

Neighborly Global Capability Center LLP subjects you to be bound by all employment rules, regulations, policies, code of ethics issued by the Organization from time to time. Furthermore, upon the successful completion of your internship and in alignment with meeting the organization's expectations, an offer letter for a full-time position will be extended to you.

Congratulations on your internship!

Best wishes,

Shekhar Manjargi
VP Engineering, India Site Lead

Acknowledgement:
I have read and understood the provisions of this letter, and I accept the internship opportunity.

Intern Signature: ______________________

Date: 27/09/2023

NEIGHBORLY GLOBAL CAPABILITY CENTER LLP
(Entity registered with Limited Liability)
Registered Office: Ground & Mezzanine Flrs, Prestige Sterling ... Nagar,

neighborly

INTERNSHIP CERTIFICATE

This letter is to certify that **Ms. Sandhya Savlo Chari**, student at **Goa Business School,** undergoing **Master of Computer Application** has successfully completed internship between **January 08, 2024, and July 05, 2024**. at **Neighborly Global Capability Center LLP**. She actively participated in several activities during the period of internship and learned skills such as React, C#, various automated testing frameworks, databases, and the Agile/Scrum processes and practices.

Thank you.

Sincerely,

Shekhar Manjargi
VP Engineering, India Site Lead
Date: June 05, 2024
Bangalore

NEIGHBORLY GLOBAL CAPABILITY CENTER LLP
(Entity registered with Limited Liability)
Registered Office: GRA-108, WeWork Roshani Arcade, Marathahalli Main Road, Lakshminarayana pura, EPIP Zone, Chinnappan Halli Marathahalli Colony, Bangalore, Bangalore North, Karnataka, India, 560037
LLPIN: ABZ-4259 | Email: neighborlyGCC@nbly.com ,Phone no: 080-37012626

Acknowledgements

I extend sincere gratitude to Neighborly for providing me with the opportunity to collaborate with experienced professionals and gain invaluable insights into their fields.

I am thankful to Mr. Shekhar Manjargi, VP and Site Leader India, for fostering a supportive environment for interns and facilitating our transition from academia to industry.

Special thanks to Mr. Pankaj Jain for organizing informative sessions with company leaders and offering consistent guidance throughout the internship. I also appreciate the assistance of Ms. Shruthi Nagraj and Ms. Shruthi P.S. during the onboarding process.

I am grateful to Mr. Pradyumna Pangarkar for his support and leadership, as well as to Mr. Pramod Divakarla, Roshan Jose and Ms. Roli Agrawal for their assistance in integrating me into the team.

Thanks are due to Goa University, Goa Business School, and the Discipline of Computer Science and Technology for facilitating this internship opportunity.

I extend my appreciation to Mr. Hanumant Redkar and Mr. Jarret Fernandes for their guidance and support.

Special thanks to Dr. Jyoti Pawar, Mr. Ramrao Wagh, Mr. Ramdas Karmali, Mr. Baskar S., Ms. Payaswini, Mrs. Tina Vaz, and Ms. Gaurpriya Chodankar for their mentorship. I also thank the non-teaching staff for their assistance.

Lastly, I am grateful to my friends and family for their unwavering support throughout this journey.

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Executive summary

This report summarizes my internship at Neighborly, the world's largest home services company, headquartered in Waco, Texas. Neighborly has grown from one brand to over 30, with 5500+ franchises globally, and reported a revenue of $4.1 billion in 2023.During my internship at Neighborly, I contributed to Two significant projects; development of an Invoice Audit Management System and the enhancement of test case generation using Chat GPT. For the Invoice Audit Management System, I automated the comparison of vendor invoices with internal data, significantly reducing manual effort and errors. I developed the backend using C# .NET. In the test case improvement project, I used Chat GPT automate the generation of test cases, tripling our test coverage and ensuring consistent test quality.

These projects enhanced my technical skills in C#, .NET, TypeScript, Jest, and database management with PostgreSQL and MSSQL. I applied object-oriented programming concepts and learned the importance of code quality, effective time management, and clear communication. This internship provided practical insights into using technology for operational efficiency, preparing me for future professional challenges in a large-scale, multinational environment.

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1. Company Overview

1.1 Bird's Eye View

Neighborly is the world's largest home services company, delivering premium service experiences across homes and businesses, primarily through franchising, headquartered in Waco, Texas. They started over 40 years ago with one brand and have now grown to own 30+ brands and 5500+ franchises across the globe. They have operations in the US, Canada, Mexico, UK, Germany, France, Austria, Portugal, Ireland, Australia, and New Zealand. The company has reported a revenue of $4.1Billion in the year 2023.

Like most companies, Neighborly has an official mission statement and vision; however, unlike other companies, we also have a Code of Values that each employee is urged to follow and know by heart and with heart. The Code of Values serves as a set of universal guidelines by which we strive to adhere, from the bottom of the organization all the way to the top. In fact, any meeting of three or more employees of Neighborly begins

with a reciting the Code of Values. (Neighborlybrands website, n.d.)

The brands are broadly classified into three categories, Repair, Maintain, Enhance.

1. Repair: Undertakes work that involves repairing. Generally, tends to be nonrepeating work.
2. Maintain: Undertakes work that involves maintenance and usually are jobs that repeat over time.
3. Enhance: Services that provide enhancements and like repair, tend to be nonrepeating.

The GCC is part of the CTO Organization which looks as shown below:

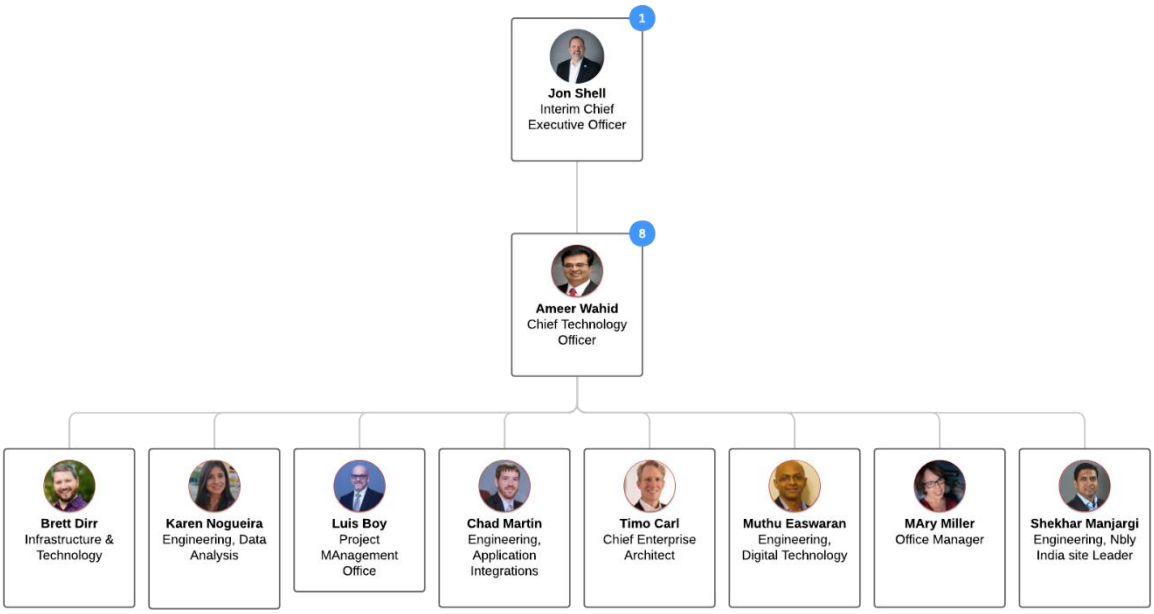
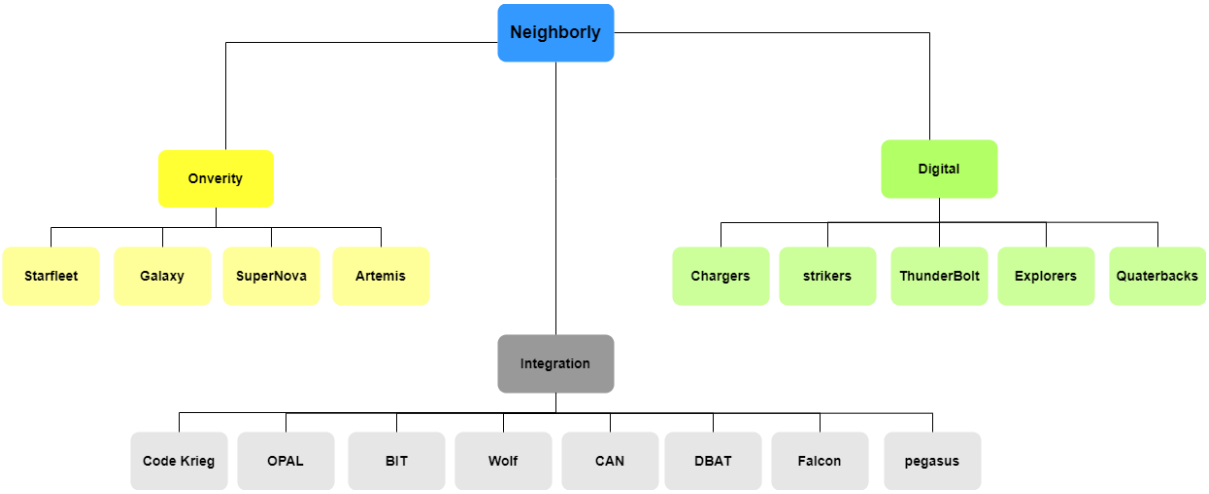


Figure 1: CTO Organization

Further, the team at the Neighborly India GCC looks like follows:



1.2 Products

Onverity

Neighborly has acquired 30+ brands. Some of these brands use some third-party Field Service Management (FSM) apps and Point Of Sale (POS) apps. The brands need to pay to avail these services, and secondly, the brand does not own user data in the strictest sense of the word. Neighborly, therefore decided to come up with a Field Service Management / Point of sale system of their own.

Onverity is a field service management system that manages companies' field operations: scheduling, dispatching, workorder management including leads, estimates, and invoices. This application is used by various users like neighborly admin, concept admin, business unit admins, business unit operator. These users are responsible for the creation of leads, estimates, workorder, managing various setting for the brands, adding invoicing details and other brand specific needs. Onverity also acts as a point of sale, allowing the brands to generate estimates and invoices, and execute the payment for the generated invoices and where sales taxes may become payable.

When the brands decide to use Onverity as their FSM/POS a few positive changes happen for Neighborly from a business perspective. The fees that were being paid for third party software now come to neighborly, so another revenue stream is available apart from royalties. Next, the brand since is a child entity of neighborly, owns all the user data, be it customer data, workorders, estimates, leads etc. This large amount of data allows the company to run effective data analytics to improve on business metrics and gain insights into key factors that can help improve the functional efficiency of the business.

Currently, Onverity have onboarded three brands: Dryer Vent Wizards, House Master Services, and Five Star Painting (in User Acceptance Testing). Next brand in line to be onboarded is Mosquito Joe.

There are multiple scrum teams for Onverity which take care of various facets of the application.

- Starfleet – Leads, estimates, workorder, dispatch
- Galaxy – Customer, configuration, notification, synchronization, product catalogs, analytics
- Artemis – invoice, billing
- Supernova – field application

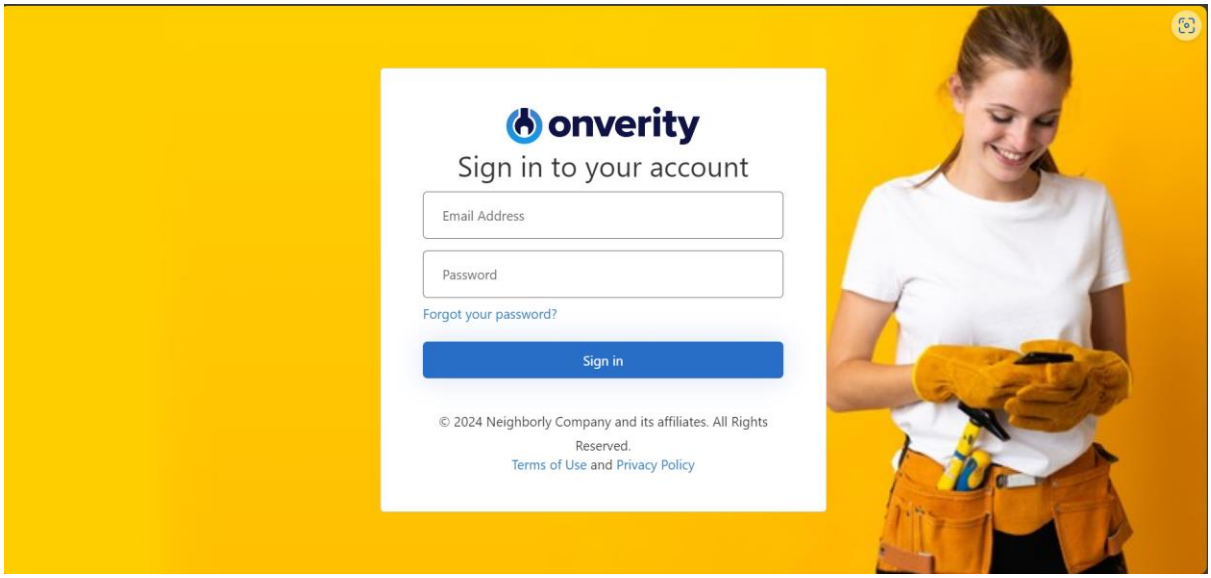


Figure 2: Landing Page of the Onverity Web application.

1.3 Sections in the Organization

At a larger level, the operations of the GCC are classified into four main verticals: Onverity, Digital, and Integration Apps, and Data & Analytics. Apart from these, they also have a Systems, Quality Assurance, and Project Management teams, which work in collaboration with all other teams to provide support and enhance the functions of other teams.

1.4 Digital

Digital team manages all the platforms that interact with our customers, homeowners that request for home services provided by franchise.

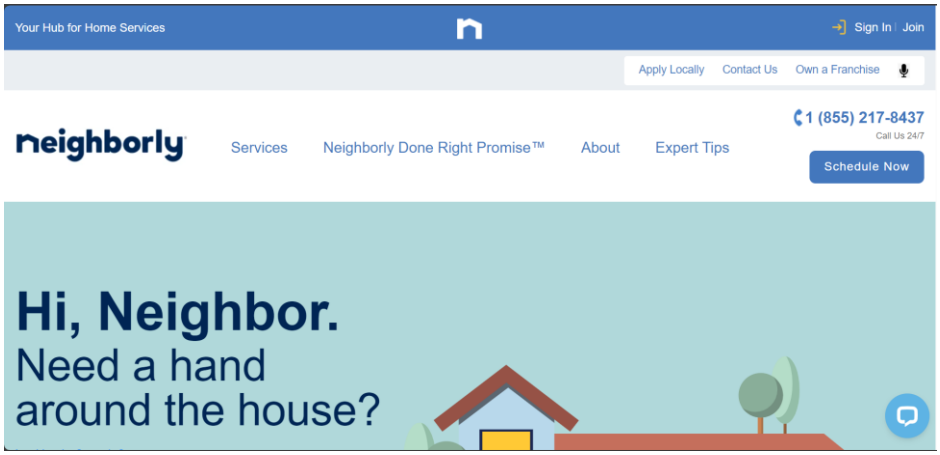
Neighborly has several brands that have been acquired and operate under its umbrella. Each brand has different website which has its own distinctive look and feel. Digital aims at migrating all brand websites onto a unified platform while providing a consistent, personalized experience for Neighborly's web and mobile needs.

Migrating all brands to single platform will help better management of brand customers. while ensuring consistent look and feel across all the websites

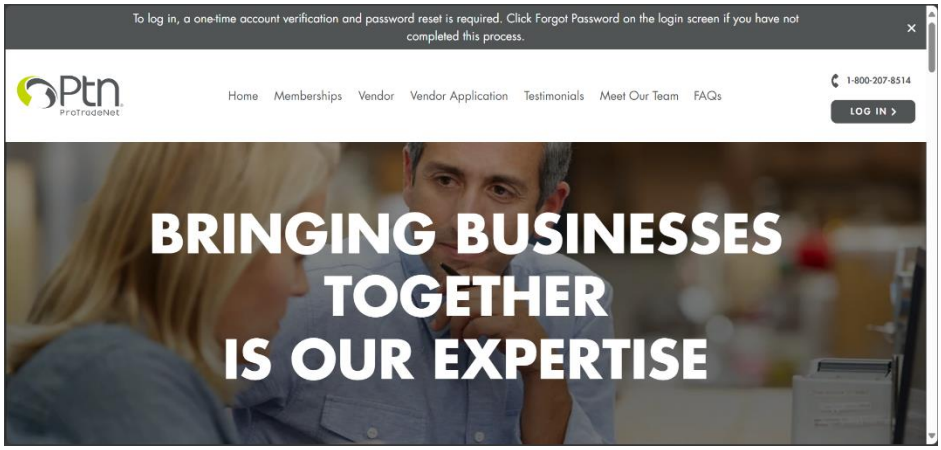
will help customers identify brands belonging to neighborly and transition them to multi brand customers.

Summary of the Websites Involved:

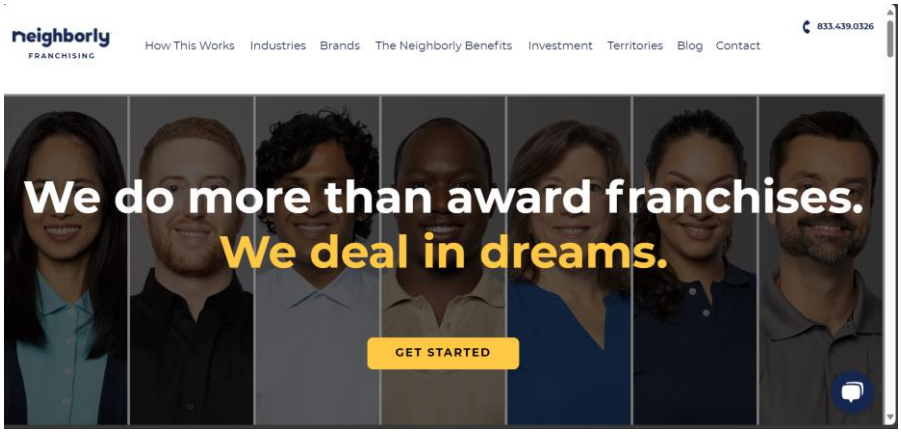
Neighborly Corporate Website (www.neighborly.com): Primary website for brand information, customer engagement, and service offerings.



Pro-Trade-Net (www.protradenet.com): B2B platform connecting businesses and vendors with a focus on secure transactions and vendor management.



franchisee Onboarding (https://franchise.neighborly.com**):** Portal for new franchisee onboarding, including applications, resources, and training.



Neighborly Mobile App: Mobile application providing similar functionalities to the corporate website with additional mobile-specific features like push notifications and location services.

1.5 Integration Apps

The Integration Apps is the core function that deals with integrating brands that have been acquired by Neighborly by moving all the necessary data into the data lake and all other systems wherever required. They work closely with the Brand Owners and other stakeholders to learn the how the brand operates, what their needs are and then translate them into technical requirements, to be fulfilled by the respective team.

BIT interact with representatives of the brands to understand their processes, the kind of data they have and the profile of their customers, the kind of loads they handle generally etc. The next step is to get the brand to fill a contract management template. The filled template is verified by BIT and if any discrepancies are found, the brand is then made to rectify them. This template is then fed into a database called FranConnect. The data is then copied from the FranConnect into FranForce database which is the primary database for Brand Data such as Customers, Workorder, invoices, payments and such.

From FranForce, this data must be migrated to the Onverity Database using APIs by transforming it as required by the API payload structure. This data is then verified for correctness and integrity and if there are any lapses, they are corrected before the data goes into the production database.

The teams associated with this function are critical to business of the company as they deal with many of the data operations and make it readily available for other functions to use without which, their functioning would be much harder.

1.6 Data & Analytics

The Data & Analytics team works with the rest of the organization to help identify key improvement metrics based on all the data available in the Data lake

1.7 Quality Assurance

The quality assurance team is of absolute importance as they make sure that all products and services that are being delivered are fully functional and have no bugs, as bugs in production lead to loss in reputation and revenue.

2. Tasks Handled.

As a part of the internship, I first had to learn some basics of the tech stack being used in the company. This mainly consisted of C# .NET, Entity Framework Core, Unit Testing, Design Principles and Design Patterns. After I completed the initial study, I was assigned to design and implement an Invoice Audit Management System.

2.1 Invoice Audit System

The main Aim behind this project was to ease the work of the scrum master. The organization consists of several internal teams along with that it also has some vendor teams that work on company's internal projects. Some members' work duration is project based, some on month based. At the end of the month the vendor teams send their invoice to the neighbour. Now the scrum master's job is to check the invoice and billable hours and make sure that it tallies with the internal data.

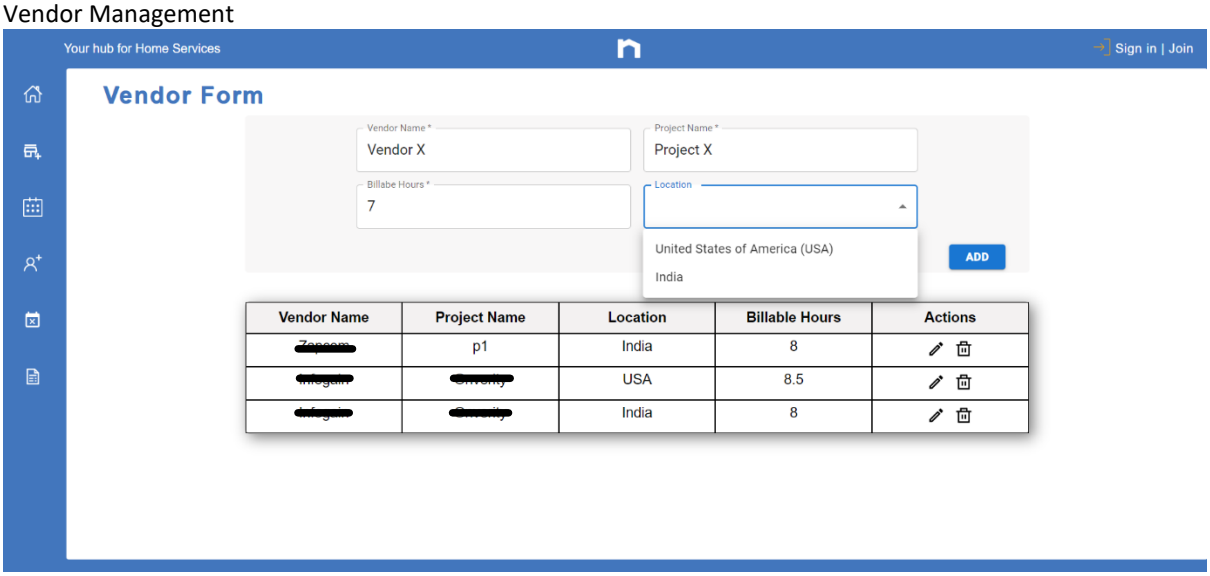
Previously this work was done manually by the scrum master by comparing the vendor's invoice with the data from the ADO which was then exported to an excel file.

This manual work was very time consuming and could also lead to human error. To overcome this, we have implemented the Invoice Auditing system.

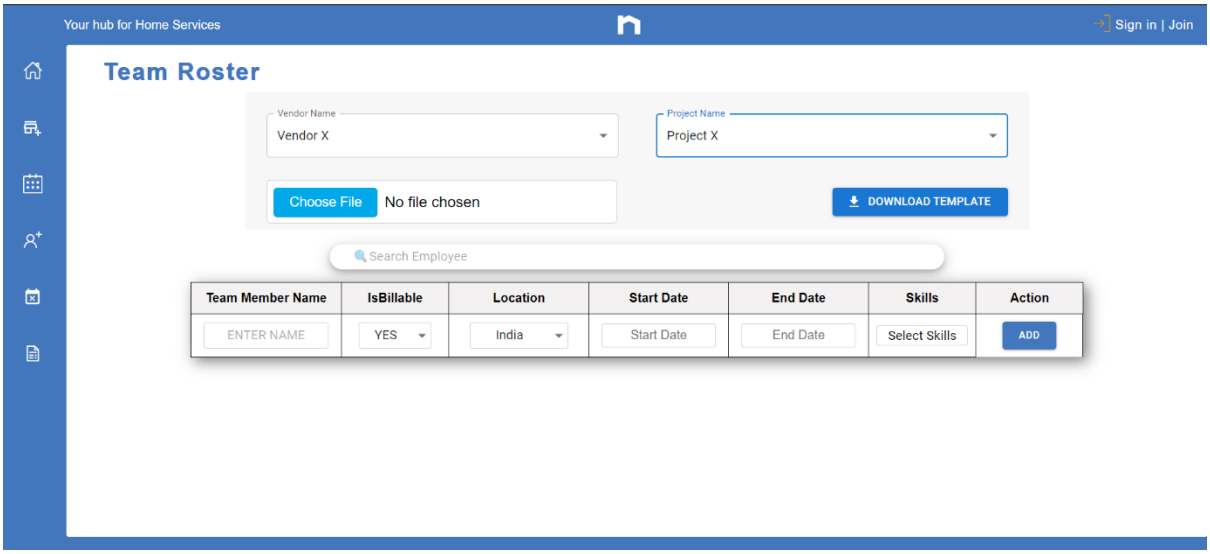
Invoice audit is a software that accurately and efficiently compares invoiced hours to expected billable hours of a given month for each team member while considering leaves, billable status, billing cycles, and working days etc.

This project consists of 5 main modules:

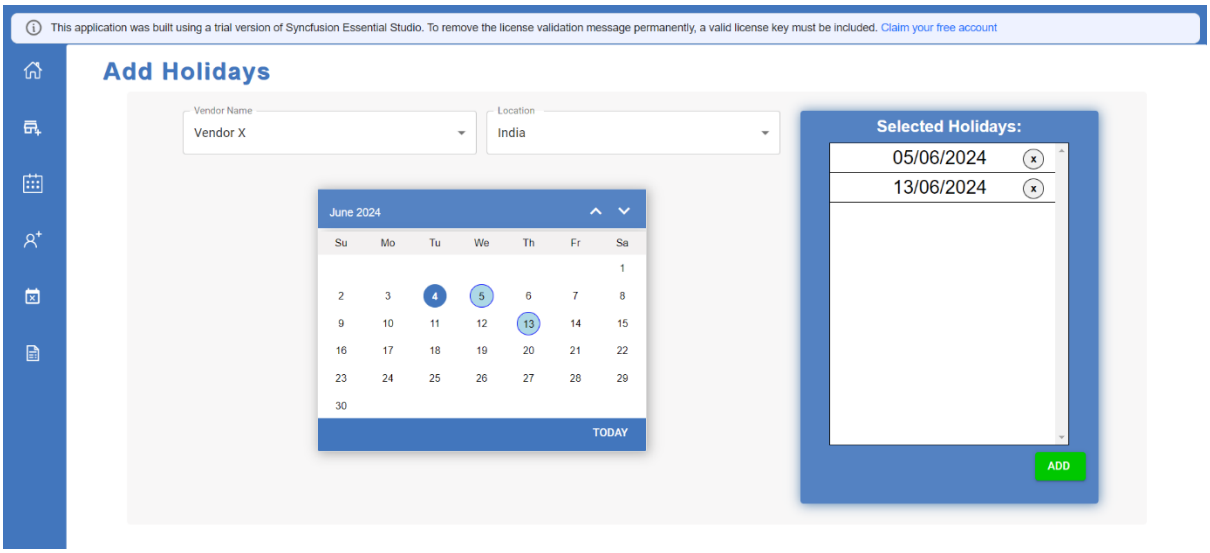
- Vendor Management



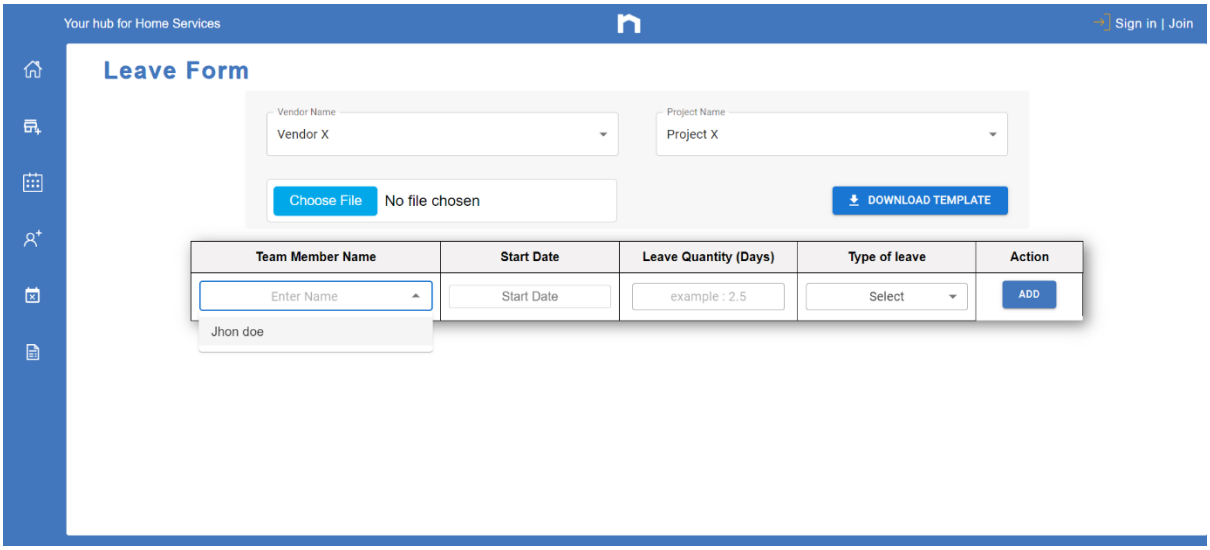
- Team Member Management



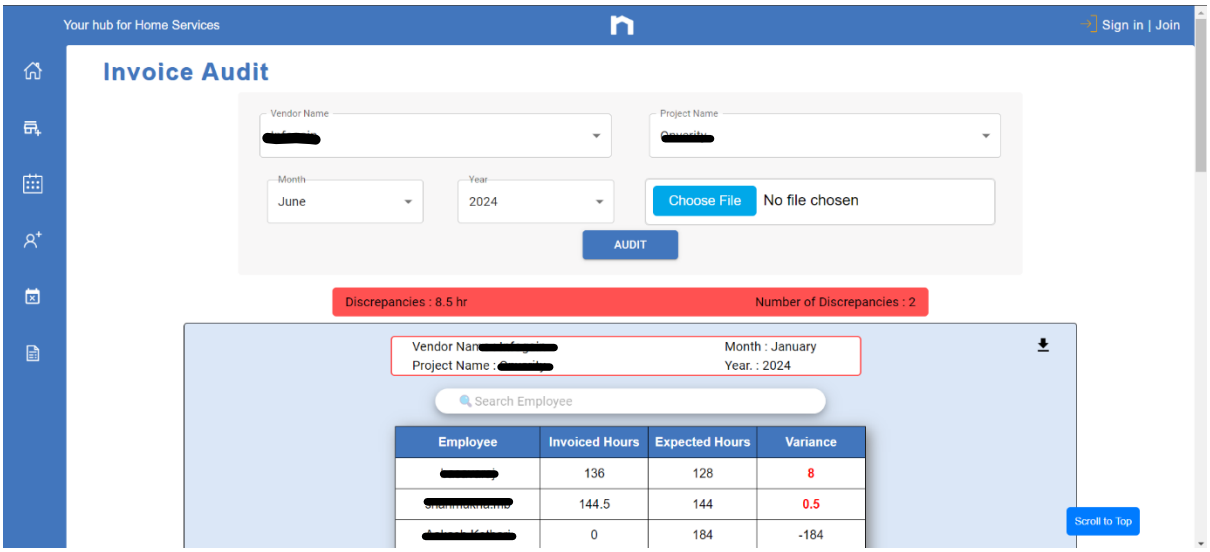
- Holiday Details



- Team Member Leave Management



Vendor Invoice Auditing



2.2 Sections I have worked on.

I worked Mainly on the backend part. Backend part was built using C# dotnet as for database we use Postgres database which was later migrated to MSSQL. We used swagger for Api testing.

Vendor invoice Auditing module is a key part of our system that lets users upload and analyse invoice data from Excel files. It compares the hours on the invoices with the expected hours calculated from other parts of our system. It flags issues like hours billed for non-billable team members, work done on weekends, or hours that go over the daily limit. It also creates detailed reports about these discrepancies, giving managers useful information to act.

2.3 My Schedule

I worked on this project from 16th January to March 13, Monday to Friday, from 9.30 to 6.00 taking up to 1 PI (program increment) i.e. 4 Sprints.

2.4 Types of task and Hands on Experience

While working on this project I was assigned the task of creating database tables for the whole project using a code first approach. code-first approach, which is part of the Entity Framework in .NET, allowing me to define the database schema using C# classes. I created 5 such classes.

The next task was to create classes that interacted with these database tables/ classes. They were called repositories. I created a repository for team members, which was one of the key tables.

In the Vendor invoice Auditing module, the task was to parse an excel file into the backend and compare its data with our systems data. We used the EP plus library to parse the file.

2.5 Relation to classroom learning

C# .net is a highly object-oriented framework. Concepts like design frameworks, inheritance, polymorphism, interfaces were highly used in our projects. We had learnt these concepts in object-oriented programming class using java. Also, we used Postgres SQL database which is a relational database. We learnt similar commands in our database design class using Oracle DB. The MVC structure (Model View Controller) that we had used in our backend, we had learnt it in theory for web development course.

2.6 Testcase improvement using ChatGPT.

The project aimed to automate test case generation by utilizing ChatGPT to automatically create test cases for various parts of the codebase, thereby minimizing the time and effort needed to manually write test cases.

currently developers must spend a lot of time writing each test case by hand. This means they must understand the code well and think of all the different situations it might face. This manual effort often leads to inconsistencies in the quality as different individuals may have varying levels of expertise and attention to detail. Moreover, manual test case generation can overlook edge cases and uncommon scenarios, resulting in potential gaps in test coverage. The repetitive nature of this task also means that valuable time is lost that could have been used for other important tasks.

But with ChatGPT, things get easier. ChatGPT is like a smart helper that can make test cases automatically. It can quickly generate comprehensive test scripts that cover a wide range of scenarios, including edge cases that might be missed in manual processes. This automation ensures consistency in test case quality and format across different modules, enhancing overall test coverage and robustness of the application. This means we get better test cases in less time. Plus, we can easily add these new test cases into our testing process, so everything runs smoothly without us having to do much.

2.7 our approach:

To execute this project, we were given a Digital website repository.it was written in pure typescript with html and CSS. The testing framework used was jest. we started by identifying important application flows like lead-flow etc. we generated the test cases for those files first. then we moved to files that had a test coverage of less than 30% and finally we generated test cases for the code lines initially missed. By using that approach were able to improves the test coverage by 3x.

2.8 Hands-On experience

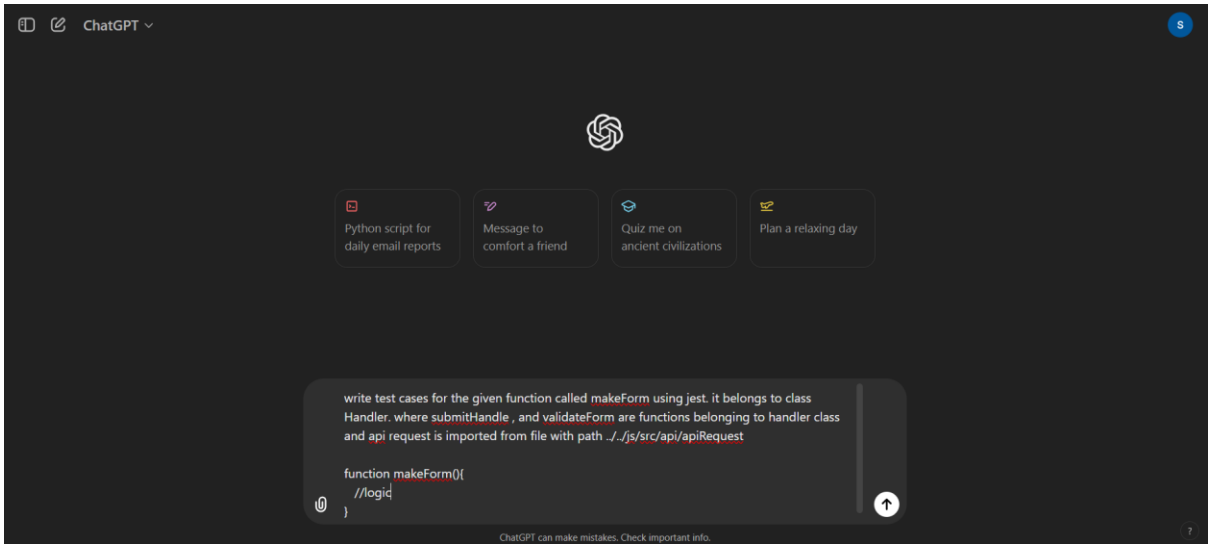
1. Effective Prompt Engineering

Clarity and Specificity in prompts: The quality of test cases generated by ChatGPT greatly depended on the clarity and specificity of the prompts. Detailed and well-structured prompts led to better outputs.

Iterative Refinement: Iteratively refining prompts based on initial outputs was crucial to achieving accurate and relevant test cases.

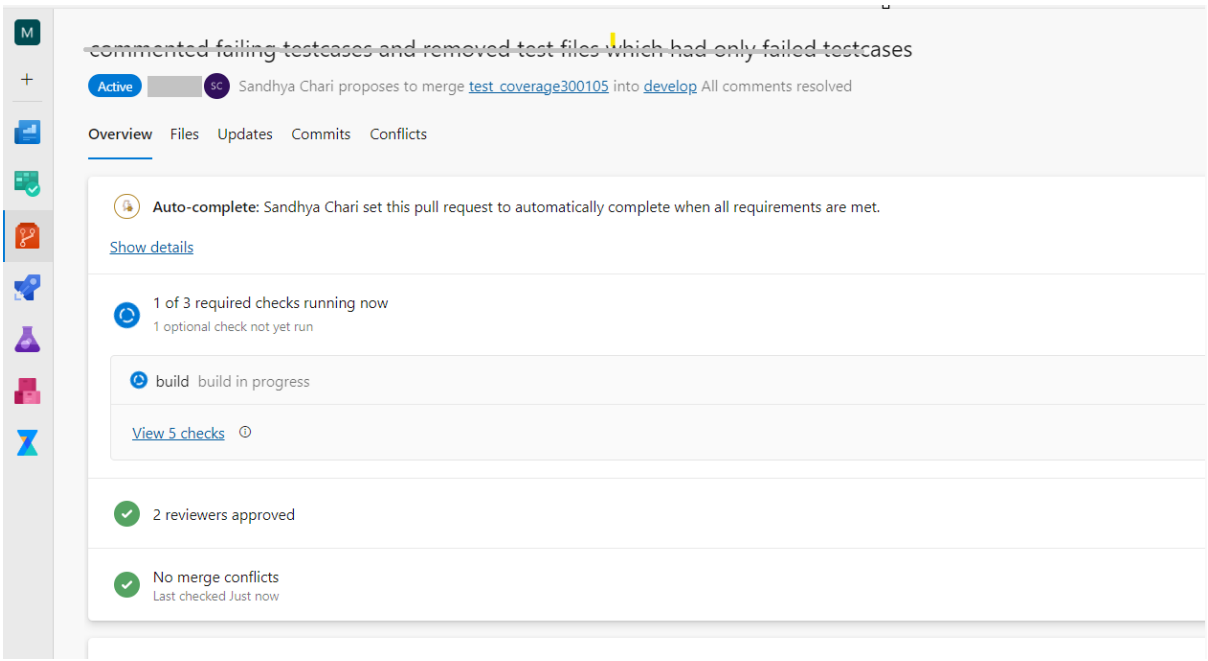
Validation: Despite ChatGPT's efficiency, human oversight was necessary to validate the test cases and ensure they met required standards and covered all relevant scenarios.

Error Handling: Some generated test cases needed adjustments for better alignment with real-world use cases and to handle unexpected errors gracefully.



CI/CD pipeline

One of the responsibilities while working on the corporate project was to push the changes made into the local branch to develop. we cannot directly push into develop. For that we were needed to make a pull request to develop branch which needs to be approve by At least two of the fellow developers. after the pull request was made the CI/CD pipeline would run some checks like build test, test coverage, conflicts etc. and give feedback. if the checks are successful and the reviewers have approved then only, we could push to develop.



Sonar Cloud:

After our PR have been approved, we can see the changes in test coverage in sonar cloud interface. We can see the test coverage for individual files as well as the lines of the code in that files that have not been tested.

This was an initial task given to us as a part of digital team.it was given to us so that we could get a hang of unit testing using jest and using chat GPT to speed up writing code. We were assigned to reporting with whom we had daily standup at 11 to report our progress.

ChatGPT and prompt engineering was introduced to us in machine learning classroom. Whereas in object-oriented programming classroom we learnt about version controlling with is extensively used in all projects of our organization. We also learnt about unit testing and CI/CD concept in software engineering subject.

2.9 Clickstream analysis

This project is a proof of concept (PoC) that focuses on collecting clickstream data from a website. Clickstream data tracks every click made by visitors on the website. This is an ongoing project which we have jus gotten started with.

As of now we have created a repository in Azure DevOps, installed required libraries that our project will use and configured it to use build tool called webpack.

2.10Hands-0n learning:

Webpack is a build tool that can bundles multiple JavaScript module into Single file. We configured webpack file for our project, our project. Will be written in typescript, so we had to configure webpack to convert typescript files into JavaScript first before bundling.

3. Key learning:

3.1 Programming Languages:

- **C#:**

  programming language developed by Microsoft. It is widely used for developing various types of applications, including web, desktop, mobile, and gaming applications. C# is known for its simplicity, type-safety, and object-oriented programming features.

- **Typescript:**

  TypeScript is a superset of JavaScript developed by Microsoft. It adds static typing and other features to JavaScript, making it more scalable and maintainable for large-scale applications. TypeScript code is transpiled to plain JavaScript for execution in web browsers or Node.js environments.

3.2 Frameworks:

- **Dotnet:**

  .NET is a software framework developed by Microsoft. It provides a comprehensive set of libraries and tools for building and running applications on various platforms, including Windows, macOS, and Linux. .NET supports multiple programming languages, including C#, F#, and Visual Basic.

- **Jest:**

  Jest is a JavaScript testing framework designed to ensure correctness of any JavaScript codebase, offering a simple API and built-in features like snapshot testing, mocking, and coverage reporting. It integrates seamlessly with various JavaScript libraries and frameworks, making it a popular choice for both front-end and back-end testing.

3.3 IDE

- **Visual Studio:**

  Visual Studio is an integrated development environment (IDE) developed by Microsoft. It provides comprehensive tools for building various types of applications, including web, desktop, mobile, and cloud-based applications. It offers features like code editing, debugging, testing, and collaboration tools

- **Visual Studio Code:**

  Visual Studio Code is a lightweight, open-source code editor developed by Microsoft. It supports various programming languages and offers features like syntax highlighting, code completion, debugging, and Git integration.

3.4 Other Tools

- **Sonar Cloud**:

  Sonar Cloud is a cloud-based code quality and security platform. It analyses code for bugs, vulnerabilities, code smells, and other quality issues, providing actionable feedback to developers to improve code quality and maintainability.

- **Crown Peak:**

  Crown Peak is a cloud-based digital experience platform that offers comprehensive content management and digital marketing solutions. It allows businesses to efficiently manage, optimize, and deliver personalized content across various digital channels.

- **ChatGPT**:

  ChatGPT is an advanced language model developed by OpenAI, designed to generate human-like text based on given prompts. It can assist with a wide range of tasks, from answering questions to providing creative writing help.

- **Codium**:

  Codium is a plugin designed to enhance productivity by integrating AI tools like ChatGPT directly into code editors, enabling automated code and test case generation. It streamlines the development process by providing intelligent coding assistance and improving test coverage efficiently.

- **Swagger:**

  Swagger is a tool for designing, documenting, and testing APIs. It allows developers to define API specifications using a YAML or JSON format, which can then be used to generate interactive API documentation and client SDKs.

- **Webpack:**

  Webpack is a powerful JavaScript module bundler that compiles and bundles multiple modules and assets into a single output file or smaller bundles. It is commonly used to streamline the development process by handling dependencies, optimizing assets, and enabling advanced features like hot module replacement for faster development cycles.

During my training, I learned that things which seem easy in theory can be complicated in practice, and complicated things can sometimes be made easier. In the corporate world, writing simple code means following strict rules for naming and formatting. Instead of using basic if-else statements, we often use more complex OOP concepts for better security.

The OOP concepts we learned in college were just the beginning. We also learned about important design patterns and how to use OOP to build these patterns. Interacting with databases became easier with EF Core ORM and the code-first approach, which lets us work with database tables as if they were objects in our code.

Writing code is important, but writing good quality code is even more crucial. We need to ensure that the code is well-structured and usable. This is done using tools like code quality checkers, linters, and different types of tests such as unit tests and smoke tests. Additionally, build tools and CI/CD pipelines help maintain high code quality and ensure smooth integration and deployment.

I had an opportunity to be innovative in handling a task. Our team needed to increase test coverage for our codebase, but writing all the tests manually was taking too long. we were told to use Chat GPT to help generate test cases, but chat GPT was a public domain website and did not have much context of our overall code, so we had to make corrections to incorrect cases generate by it. To make the process even faster, I used a Codium plugin that allowed us to interact with Chat GPT directly from our code editor. This approach helped us quickly generate and implement test cases, which significantly increased our test coverage in a short amount of time. As a result, our code quality improved, and we had more time to focus on other important tasks.

I also learned about my likes and dislikes. I realized that I am passionate about tasks that combine technical skills with creativity. I find great satisfaction in working with backend and C# and databases. I am less enthusiastic about repetitive tasks that don't offer opportunities for innovation or improvement. This self-awareness has helped me understand the types of projects and roles that I am most passionate about, allowing me to contribute the most value to my team.

4. Challenges

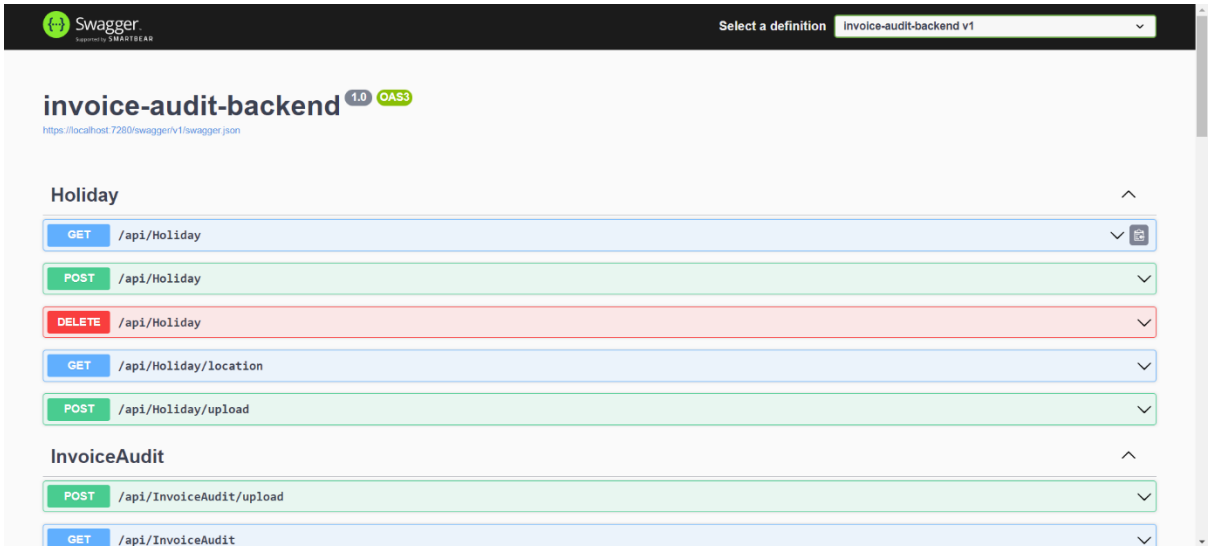
I was assigned the task of increasing test coverage, and I hadn't previously used tools like ChatGPT and Codium for generating test cases. This unfamiliarity required me to quickly learn how to effectively use these tools to work faster. Getting familiar with this tool I realized that we cannot directly copy past what testcases chat GPT gives. Since we were using ChatGPT website it did not have the context of our whole repository, so it used to give lot of errors in the results and to solve it was essential for us to understand the code first and be familiar with the testing framework. Simultaneously I was also learning that.

Another major challenge was meeting tight deadlines. In corporate specially in IT industry we must make sure that we complete our work in time, because more that often there happen to be cases where our projects requirements change drastically, and that sometimes comes to light only when the demo of that feature is made. Delaying deadlines for smaller task may delay these changes also which might affect the overall software quality in long run.

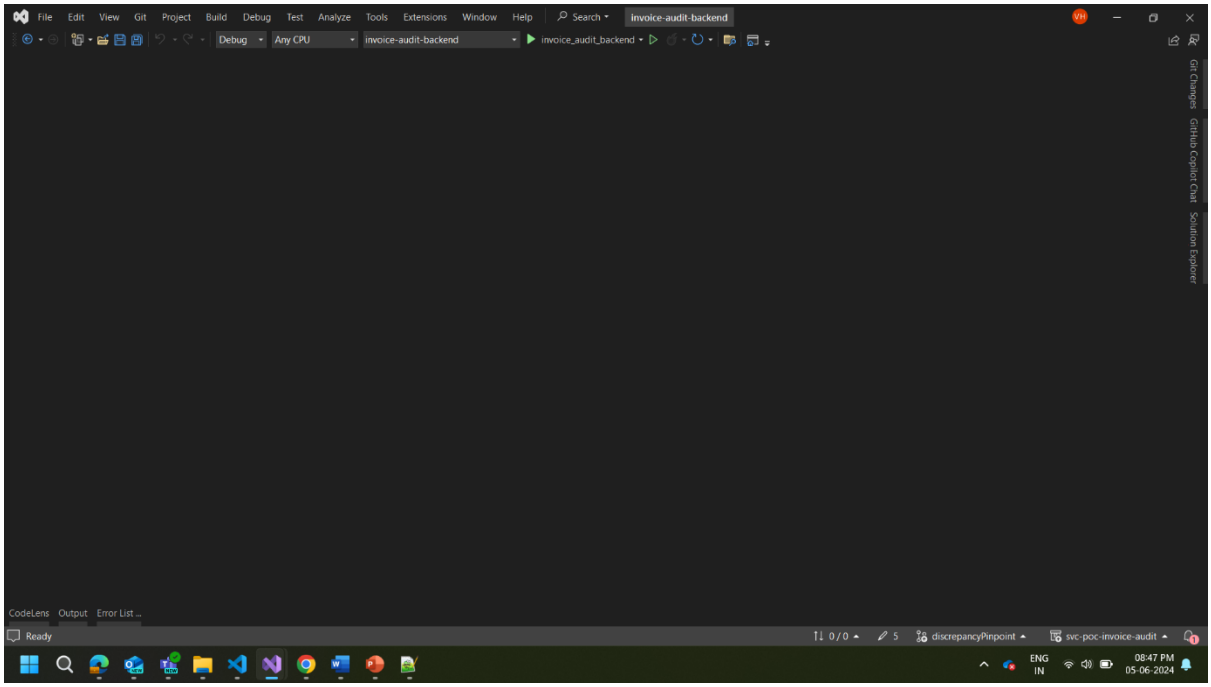
While keeping in mind the deadlines we also have additional task of learning and implementing new tools when working with unfamiliar tech stack. In today's date we cannot say that we work only on frontend or backend, we are expected to be full stack developers. I was a backend developer using C# dotnet etc. and had no idea about frontend, but when I joined Digital Team, I was expected to work on frontend as well for which I had to learn type script, CSS, html, jest and more. The tech stack you will work with will change with the requirement of the project that you are part of.

Appendix I

Testing of Apis in swagger

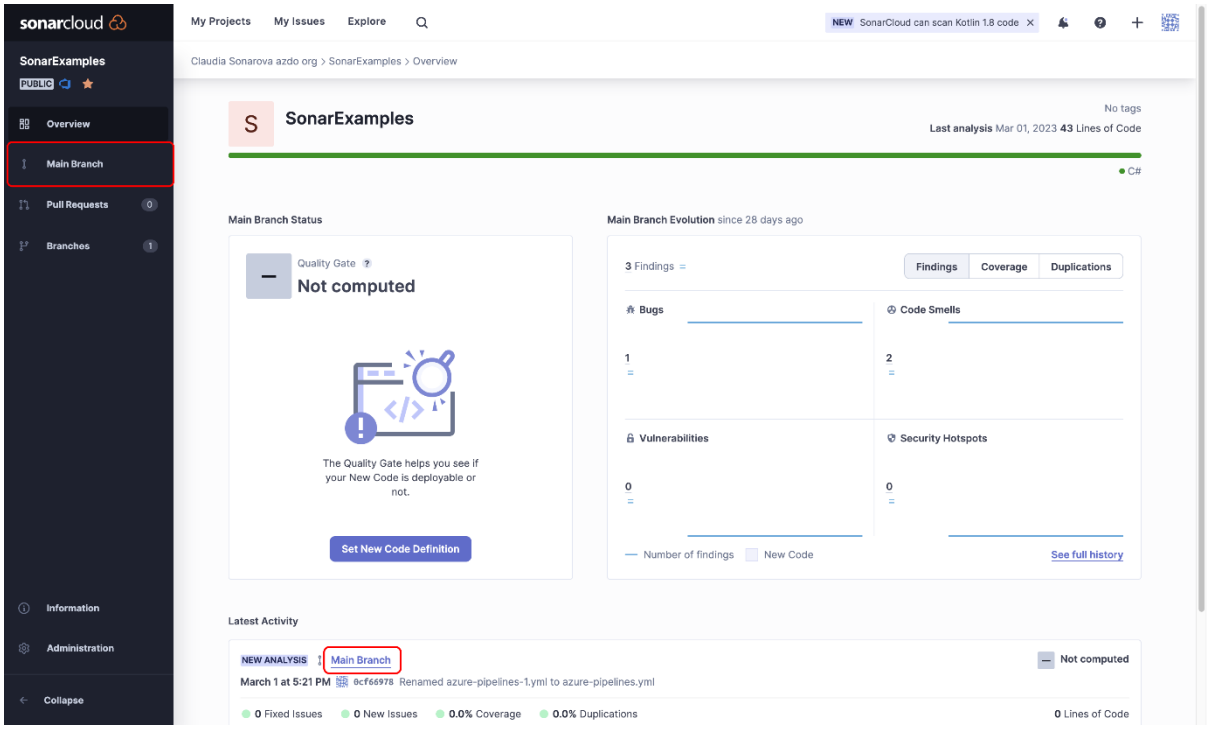


Visual studio

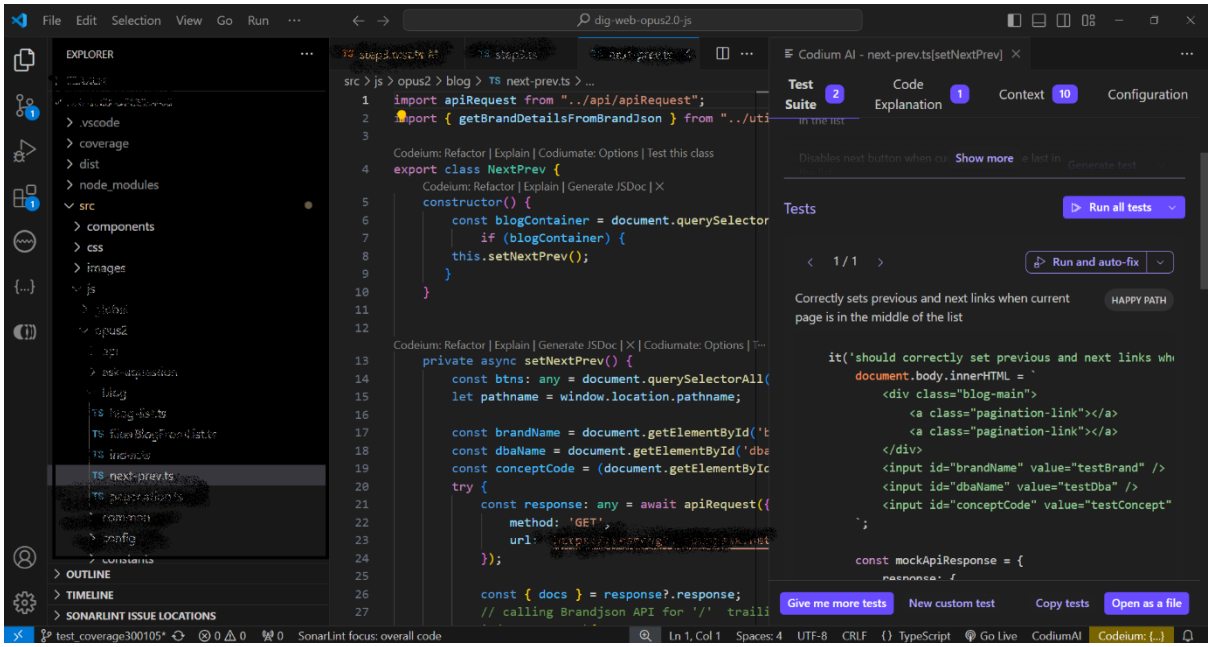


Appendix II

sonar cloud



Codium plugin



Appendix III

Presenting in the organization

Fun activities

Working in the organization