An Undergraduate Internship on Hardware Nexus

By

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Attestation

I hereby attest that I, Mohd. Jamilur Rahman Shaan-1730142 an undergraduate affiliate of Independent University Bangladesh, have completed the report and submitted it in partial fulfillment of the requirement for the Degree of Computer Science and Engineering from Independent University, Bangladesh (IUB). I have been guided by my respected faculty Md. Abu Sayed. I also certify that all my work is authentic and based on my research and experience gained from my internship. I declare that the above mentioned statement is true and accurate to my acknowledgement.

_____   _____
Signature   Date

Mohd. Jamilur Rahman Shaan
_____
Name

Acknowledgement

Letter of Transmittal

11 September 2021
Md. Abu Sayed
Lecturer
Department of Computer Science and Engineering, Independent University, Bangladesh

Subject: Submission of Internship Report.

Dear Sir,

This is to inform that with due honor and respect, I, Mohd. Jamilur Rahman Shaan (ID: 1730142) from CSE 499, Internship Course of Summer 2021 Semester, Section 5, would like to submit my Internship report. I have completed my internship program under the supervision of Ms. Shama Hoque This report is based on my internship program and the project I have worked on at Techdojo Limited.

This report is based on my experience and the work I did on 'Hardware Nexus' at Techdojo Limited during my internship program. The primary goal for my internship was to gain experience from working in the software engineering industry and familiarize myself with all the different technology related fields of the company, documentation, software development and to get acquainted with software development processes and practices. Over the period of my internship at Techdojo Limited, I had to learn and adapt to the evolving technologies being used in different situations and requirements and to be able to apply them in real life projects. I shall be highly obliged if you are kind enough to receive this report and provide your valuable judgment. I hope the following report can achieve your approval and is adequate.

Sincerely,
Mohd. Jamilur Rahman Shaan
1730142

Evaluation Committee

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Supervisor

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Internal Examiner

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External Examiner

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Convener

Abstract

In this report, I have thoroughly explained the structure and configurations of the E-commerce based web application named 'Hardware Nexus'. I have outlined the objective of this project, details on management in building the website up until deployment. I have further explained the methodology used to complete the website starting from planning, to developing, to testing and launching it out for deployment. Before beginning the start of this project analysis of the outcome, draw graphical explanations of the website were created as well as the discussion of the results and finally to obtain make analysis from the results. All of the aspects regarding each factor have been discussed in details below. Apart from the explanation of the project I have shared my internship experience at Techdojo Limited. As an intern of the company, I was assigned with a list of responsibilities that I had to perform remotely due to the ongoing pandemic of COVID-19. Before being assigned to the project, I was tasked to learn the basics of the MERN stack which is a full-stack framework. The stack included ReactJS, ExpressJS, MongoDB and NodeJS. Furthermore I got to learn value tips and tricks in developing a fully functional, efficient, user-friendly responsive web application which I believe is monumental to my career in the future.

Keywords— computer, computer hardware, mern, full-stack, github, image-hosting

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Chapter 1

Introduction

1.1 Overview/Background of the Work

With the advancement into Industrial Revolution 4.0, the demand for computers be it desktops or something portable like laptops, is at an all-time high globally. Hence, machines like computers are very much needed to keep with the ever changing advancements. Be it for work, education, business, or even for some social interaction, computer systems are key for operation. Now, ever since the global pandemic COVID-19 has shrouded the entire world with its deathly cloak, the economic and social disruption that has been caused by it is nothing short of devastation. Countries have been forced to go into lockdown for months on end, and when it comes to a developing nation like Bangladesh, it has been greatly impacted by this. Workplaces, clothing industry, judicial institutes, and as well as educational institutes have all been shut-down. People have been forced to work from home, and the young generation to study on online platforms.

This further increased the demand for PCs and laptops all over the globe. Since the pandemic has affected the workflow of many industries, there has been a shortage of semi-conductors that are required to make the computer chips [1]. Since the manufacturing of these chips are struggling to keep with the demand, the price of computer hardware is quite high.

Since Bangladesh imports majority of the computer hardware, the price inflation is proving to be more demanding for majority of the consumers. Due to this, the second-hand market for such hardware is very active, since most of the population is in need of a computer or laptop. To mitigate this issue, a group of developers from Techdojo [2], including myself, have decided to work on an online system. The objective of the platform is to provide an easy-solution for the second hand market.

Users need to sign-up for the system. After that, they can login with their credentials and browse through the listings that other users have provided. If they like an item they see, and wants to see some more information regarding the item, they can click on the item and see detailed information of the hardware. They can comment if they want to know more about the item. If they want to search for a specific hardware they can type it in the search bar and look

if there is any available listing. Users also have the option to put a hardware of their own up for sale.

1.2 Objectives

- The aim of this system is to provide an easy solution for consumers to acquire affordable computer hardware

- The system aims to keep all user information secure and protected

- Provide detailed information of the hardware the potential buyers

- Provide the option for consumers to consider getting computer hardware without breaking the bank

1.3 Scopes

- A Landing page for users when they visit the website

- Display all the computer hardware available

- Searching option to find a specific hardware

- Update user profile

- Detailed information about the computer hardware

- A rating system to rate user

- Post listings for computer hardware

Chapter 2

Literature Review

2.1 Relationship with Undergraduate Studies

The knowledge I gained from studying the undergraduate courses from Independent University, Bangladesh has helped me developed a set of skills that enabled me to put my contribution in the development of 'Hardware Nexus' system. If not for these mentioned courses, it would have been very difficult for me to keep up with my peers. The courses are:

- **CSE 203-Data Structure**: This course was my first proper introduction to data representation and storage in data structures like arrays, nested arrays, array of objects, nested arrays and nested objects. The aforementioned Abstract Data Types helped me breaking down complex data models and structures in 'Hardware Nexus' into simpler and smaller chunks of code that are easy to manipulate and implement. It also helped me in choosing efficient implementation methods.

- **CSE 213-Object Oriented Programming**: This course helped me into having deeper understanding of classes and the benefits of object oriented design and programming. By learning how to write programs that offer modularity, it helped me to write clean, reusable and less repetitive code. As 'Hardware Nexus' is a large system with many functionalities, this skill of creating modular codes helped me create small modules that can be used with other new or old modules and mix and match them to add new functions to the system.

- **CSE 303-Database Management**: CSE 303 was the first course that provided me a glimpse into project design and planning. It taught me important data modelling tools such as Entity-Relation model, Business Process Modelling Notion (BPMN), Rich Picture, Six-Points Analysis and many more. All these tools and techniques helped me plan and organize my project. This course also helped me storing and manipulating data in a database. Since 'Hardware Nexus' is using a non-relational database, knowing the manipulation of data in a database was key.

- **CSE 307-System Analysis and Design**: It is through this course that I learned about the concept of the System development life cycle (SDLC). The stages that are involved from starting till completion. I learned about the various types of SDLC models and when to use what. For 'Hardware Nexus', the team I am working with is following an Agile method. It will be discussed in detail later in this report. CSE 307 also taught me how crucial it is to have a clean and easy to understand UI, how to clearly define both functional and non-functional requirements for a system. It is also taught me the importance of incorporating tools such as Level-0 Data Flow diagrams, as well as Context Flow diagrams for design and analysis of systems.

- **CSE 309 — Web Applications and Internet**: This course is where I learned the building blocks of web-based client-server architecture concepts. How to use basic web technologies such as HTML, CSS and JavaScript to create a web page from a blank white screen to an attractive web site with the added bonus of implementing responsive design. As 'Hardware Nexus' is platform for all sorts of users it needs to be secure and scalable. This course has taught be the basics of what I need to get started.

- **CSE 451 — Software Engineering**: This course broadened my scope of project analysis and planning. Topics like requirements elicitation, risk analysis and quality assurance techniques, and a large emphasis on SDLC prepared me to tackle with the work flow in the project I am working in. Learn how to evaluate requirements for the system and then applying the process of analysis and design using the object-oriented approach was really helpful for me to adjust in a professional work-environment.

2.2 Related works

The project I am working on, Hardware Nexus, is an e-commerce platform. There are some research articles that share the ideology of 'Hardware Nexus'.

- In 2020, a case study was conducted by Saima Ritonummi on UX on an E-commerce website emphasized on how much it is pivotal. For a good and successful e-commerce website, potential customers look for two main things. The UX should be intuitive and pleasing to the eye. The main objective of any e-commerce system is to attract as my customers it can. To achieve this goal, it needs to gain customer satisfaction by providing flawless functionality and good user experience [3].

  With this topic in mind, 'Hardware Nexus' was developed in the same manner having the same goal, i.e. to attract as many customers possible with good UX.

- Earlier in 2016, Neto, João Quariguasi Frota, Jacqueline Bloemhof, and Charles Corbett conducted a research on the market prices of re-manufactured, used and new items that are listed on eBay. Their main item of focus was types of iPods. From their study, they found that items that were listed as re-manufactured were somewhat more expensive than the ones listed as used. In addition to their finding, they also discovered that used items that had descriptive details were positively received and approached for purchase by customers. This just goes to show that customers usually would opt more for used products that are well described rather than re-manufactured products [4].

  Since the primary focus of 'Hardware Nexus' is to be a hub for used computer hardware, its focus parallels with the findings of Neto, João Quariguasi Frota, Jacqueline Bloemhof, and Charles Corbett's research. The system will encourage users to provide as much as details as possible so that potential buyers can be convinced for their purchase.

Chapter 3

Project Management & Financing

3.1 Work Breakdown Structure

Work Breakdown Structure (WBS) is a tool used in Project Management that helps us breaking down a complex project into smaller manageable and achievable activities/processes. The basic concept of this tool is a divide and conquer approach which results an increase in efficiency and productivity. In our WBS for we followed this top-down approach:
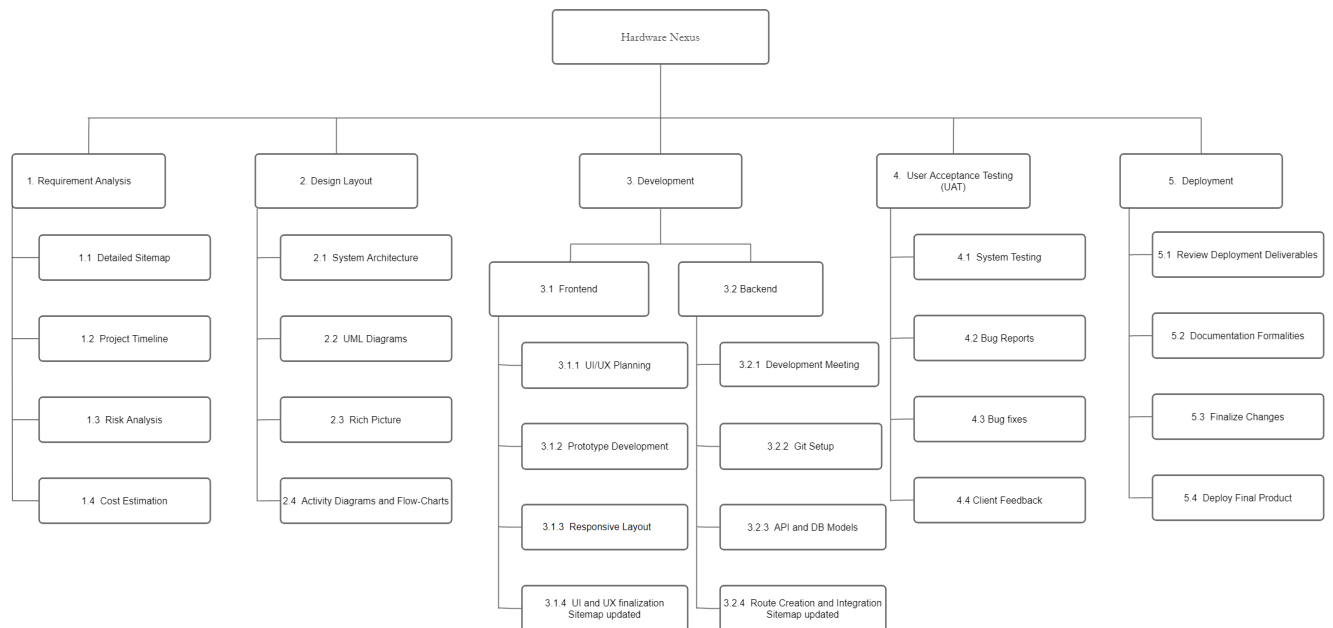
Figure 3.1: Work Breakdown Structure of 'Hardware Nexus'

3.2   Process/Activity wise Time Distribution

Task	Days
Requirement Analysis	7
Design Layout	7
Development	30
User Acceptance Testing	10
Deployment	6
Total	60

Figure 3.2: Activity wise Time Distribution 'Hardware Nexus'

3.3   Gantt Chart

With the help of Gantt Chart, we were able to keep track of the progress of the project. It helped us to have a clear vision of what we wanted to achieve and by when we wanted it to be completed.
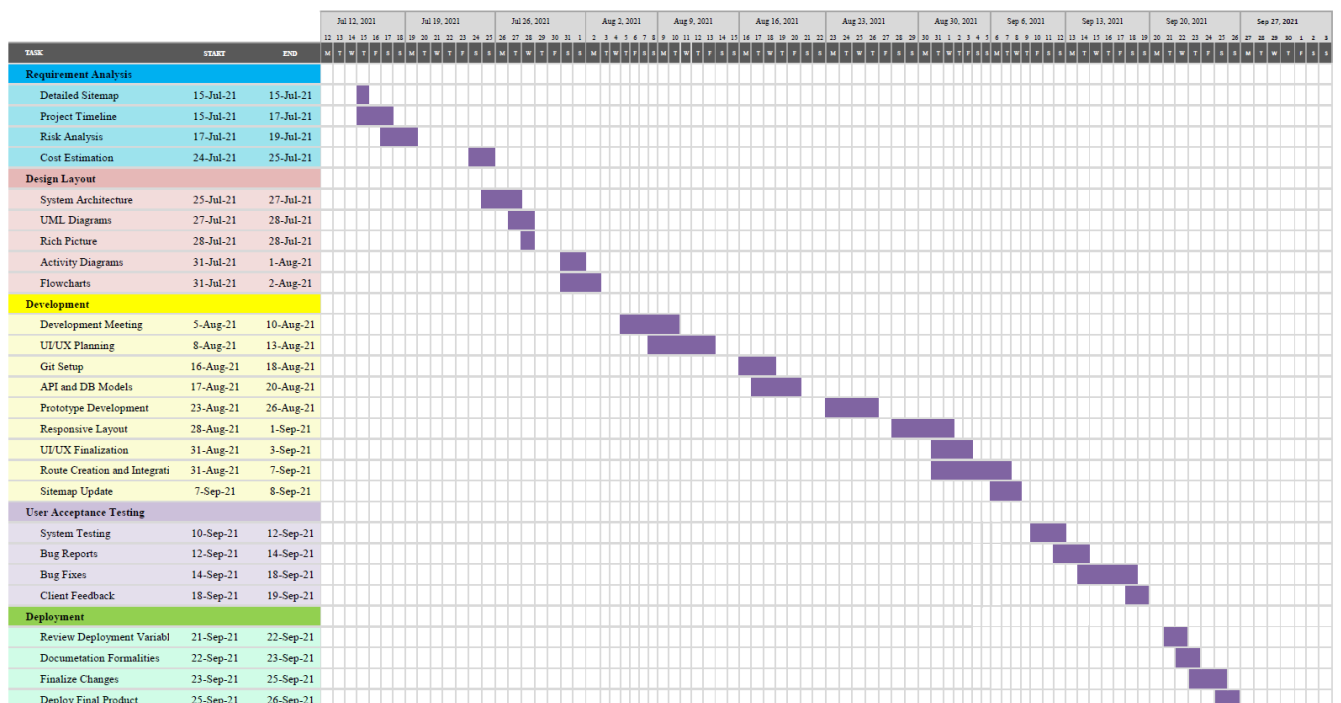

Figure 3.3: Gantt Chart of 'Hardware Nexus'

3.4   Process/Activity wise Resource Allocation

- **Requirement Analysis** : Gathering requirements is a crucial task before the onset of any project. If the requirements are not properly gathered and analyzed, it can lead to project failure. Similarly for 'Hardware Nexus', it was was crucial too. We dedicated 10 % of the entire work to Requirement Analysis

- **Design Layout**: The need for a good Design Layout is key. The main user of 'Hardware Nexus' will be all types of users. So the design of this system must be intuitive so that users can easily understand what each component of the system does what. We allocated 12 % of the entire work load for this.

- **Development**: The most crucial part of any system is the development. If it is not developed properly, it will be received poorly by its users. From designing a good and responsive system to making it fast and reliable is very important. For this phase, we allocated 45 % of the entire workload.

- **User Acceptance Testing**: After everything is developed, some revisions must be done to the system to check for any underlying bugs before it is handed over to the client. Some documentation also needed to be done. About 25 % of the workload was allocated to this phase.

- **Deployment**: At the very end we have Deployment. After checking everything, the system is hosted on the client's domain and handed over to them. Some training is also given to them so that they know how the system works. Out of the entire workload, 8 % was allocated to this phase.

Below is a table of the entire activity wise resource allocation for 'Hardware Nexus':

Task	Work Percentage
Requirement Analysis	10
Design Layout	12
Development	45
User Acceptance Testing	25
Deployment	8
Total	100

Figure 3.4: Activity wise Resource Allocation 'Hardware Nexus'

3.5 Estimated Costing

For 'Hardware Nexus' the cost that comes with the system is associated with a multitude of services. From UX/UI design to Front-end and Back-end development of the system, to test the system before final handover to the client, all these services contribute to the total costing of the system. An approximate cost of the system is being below in the system. Additional charge will be added if the client wants after development services, such as site hosting and domain.

Stage	Time (in Hours)	Cost (BDT)
UI/UX Design	40-60	35,000
Front-end	200-220	40,000
Backend	220-230	50,000
Testing	40-50	20,000
Total	500-560	1,45,000

Figure 3.5: Estimated Cost of 'Hardware Nexus'

Chapter 4

Methodology

4.1 Extreme Programming (XP)

For the development methodology, developers at Techdojo Limited follow an Agile approach. To specify which agile framework, we follow the Extreme Programming (XP) method. It allows teams to produce high-quality software and adapt to evolving and changing requirements at a reasonable pace [5].
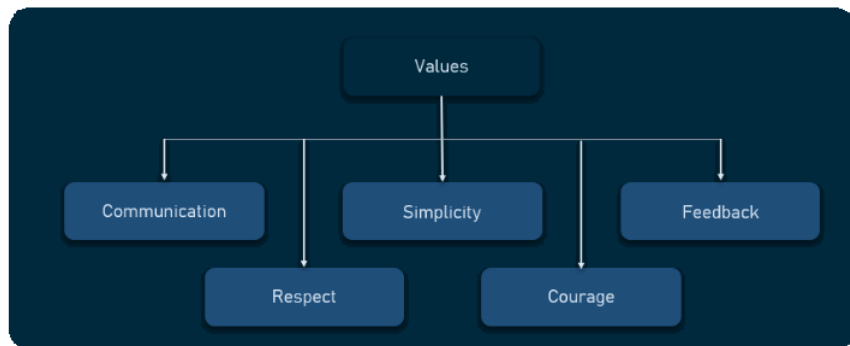
Figure 4.1: Values of XP

Extreme Programming is built on five values, and based on that along with other perks, we decided to adapt to this approach:

- We had to make sure that the communication between the team and management was clear. Nothing was to be interpreted or misread.

- We had to keep things simple. This allowed us to make quick and revisions. It also made our meetings short, precise and to the point.

- Feedback was very much encouraged during development. Client feedback was of the

utmost priority. Through the use of prototyping, we gained valuable feedback which helped us improve on our work.

- There was a mutual respect amongst everyone in the team. Every decision, suggestion was taken with utmost respect and answered with constructive criticism if needed.

- We were constantly encouraged to show courage. To think outside the box, and to try and use new methods of implementation which would help processes become quicker and more efficient.

- With the use of XP, we were to able to do our work at a fast rate whilst be able to keep with the user requirements at each stage.

- We had more control of the project due to the daily meetings that were conducted

4.2   Web Application Development

'Hardware Nexus' is primarily a full-stack web application. This results it being an interactive system built using the state of the art web development technologies that users of the system can access from their browser, be it desktop, laptop or mobile. Web applications usually have two components: the front-end and the back-end. Front-end involves in designing and developing the graphical user interface (GUI) for the client side. Whereas the back-end involves handling of the server-client communication and also executing any scripts that process background information or perform tasks [6].

4.3   Development Tools Used

In my tenure as an intern at Techdojo Limited, I was introduced to a plethora of technology tools that are extensively used in the current software industry. For the development of 'Hardware Nexus', the MERN stack was primarily used, along with some other which are listed below:

- **React**: React (also known as React.js or ReactJS) is a free and open-source front-end JavaScript library [7] for building user interfaces or UI components. It is maintained by Facebook and a community of individual developers and companies. It enabled us to makes a very fast front-end with stable and reusable code.

Figure 4.2: React Logo

- **NextJS**: Next.js is a React framework created by Vercel. It enabled us to build server-side rendering and static web applications using React. It has many great features and advantages, such as, Fast Refresh, Flexible Data Fetching, File System Routing, etc. [8]

- **Node.js**: Node.js is an open-source JavaScript runtime built on Chrome's V8 JavaScript engine [9]. Node.js is intended to run on a dedicated HTTP server and to employ a single thread with one process at a time. We used this because of its ability to scale and faster time to market.

- **Express.js**: Express is a minimal, open source and flexible Node.js web app framework designed to make developing websites, web applications and API's much easier [10]. We used this because it helped making back-end configuration easy and also allows to define routes which we can use to do additional tasks when needed

Figure 4.3: Node.js and Express.js Logo

- **Git**: We used Git, which is a free, open-source distributed version control system [11]. Version control is very much important because it helped us keep records of changes to our project.

Figure 4.4: Git Logo

4.4 Other Non-Development Tools Used

Due to the pandemic, working in an office space in close quarters was not considered safe. Hence, during my time at Techdojo Limited, the policy for the company was to strictly work from home. So in addition with the development tools mentioned above, other non-development tools were by the team working on 'Hardware Nexus' to keep track of workflow, ease of communication, repository hosting, etc.

- **GitHub**: GitHub, Inc. is a provider of Internet hosting for software development and version control using Git. It offers the distributed version control and source code management (SCM) functionality of Git, plus its own features. It provided us to host our code repository and simultaneously work on different features [12].
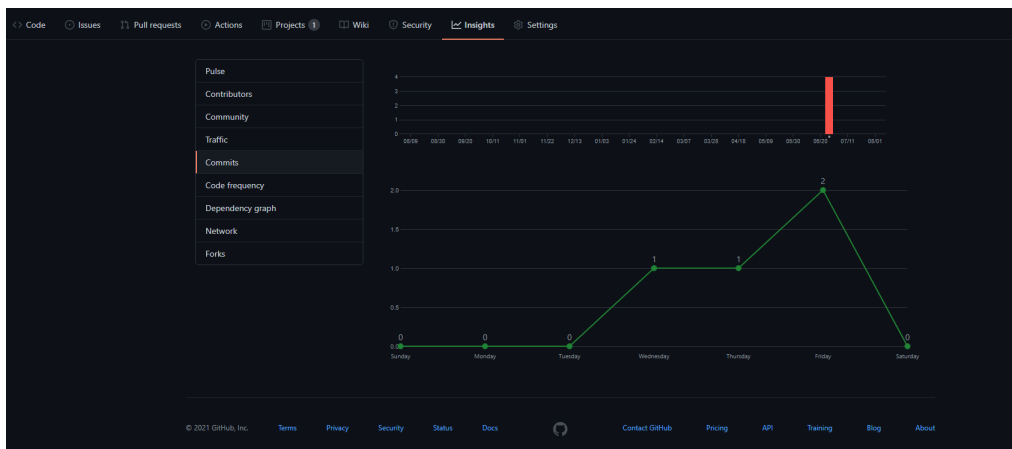

Figure 4.5: Commits in GitHub

- **GitHub Projects**: A tool provided by GitHub that helps us to organize and prioritize our work and thus maintain our workflow. It helped us to keep in track tasks like were left to do, in progress, needed to be revised, needed to be researched and were completed.
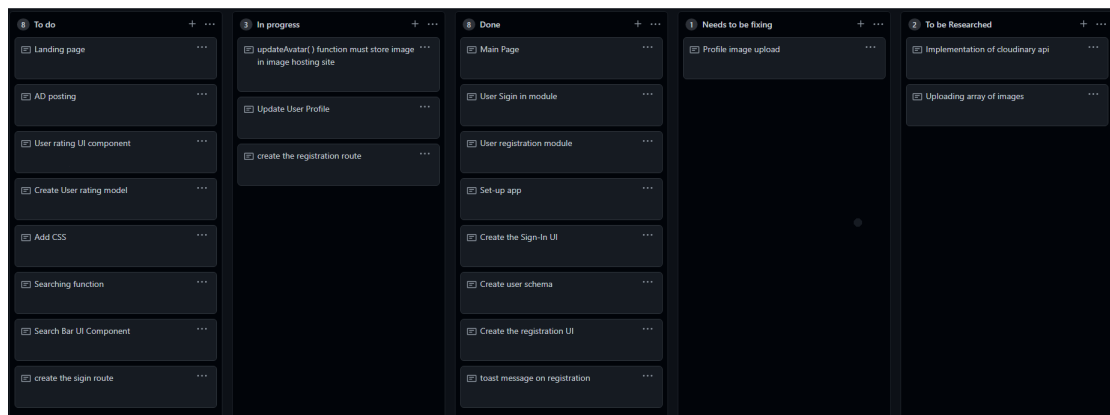
Figure 4.6: GitHub Projects

- **Discord**: Discord is a VoIP, instant messaging and digital distribution platform designed for creating communities. Users communicate with voice calls, video calls, text messaging, media and files in private chats or as part of communities known as servers [13]. Discord helped us maintain communicate with each other, participate in weekly meetings to discuss and plan for our project.
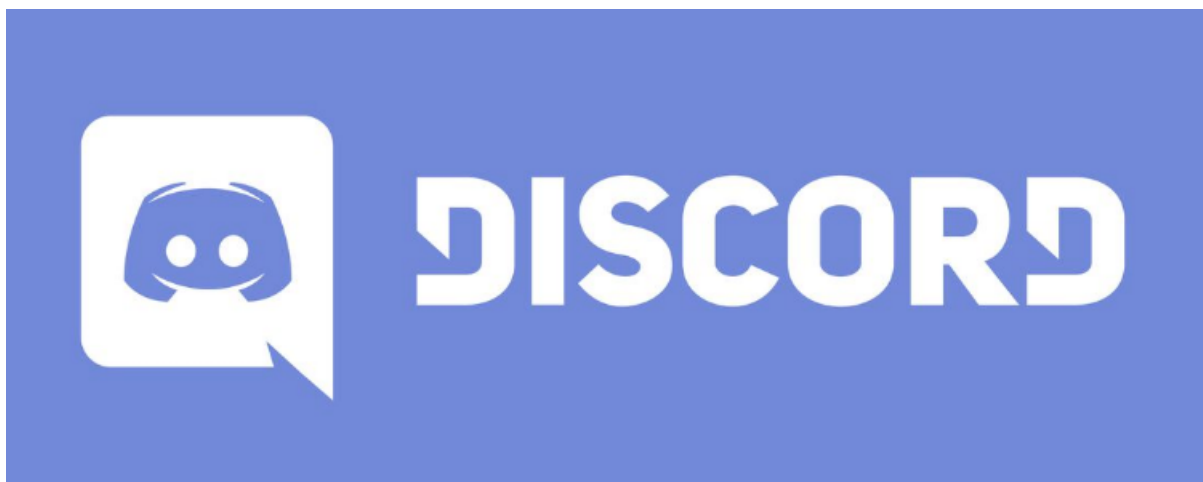

Figure 4.7: Discord Logo

Chapter 5

Body of the Project

5.1 Work Description

'Hardware Nexus' is a web-based application that serves as an e-commerce platform for people to sell and purchase used computer hardware.

First of all, there is the registration page. People have to sign-up to the system before they can use it. In the registration page, user has to input the usual information required to register,i.e. email address, a unique password, a username. The password needs to be at least 6 characters long and can be alphanumeric with symbols. The password will be hashed and stored in the database. This secures the user's account more as the actual password will never be compromised by the system.

After registration, users will be redirected to the login page, where they have to sign-in using their credentials.If the user inputs any wrong information, they will be shown an error in an info-box. Once the user logins with the all correct credentials, they will be prompted with a success message and redirected to the homepage.

Admins can mediate the system. They will have a similar login page but have a different user interface than that of a normal user. Admins has access to the same homepage as that of the user but they also have an extra page which is the admin panel. From the admin panel, the admin can select the ad that needs to be marked as sold which are sent by the item owner. The admin can also delete any fake or bogus posts that are reported by the other users.

In the homepage, users can see a list of all the available hardware that are up for sale. They will be a displayed in a single column in the middle of the page with each row containing an item-card. Each item-card will display a picture from an array of pictures that are assigned to

the post. It will also show if the item is available for purchase or not along with the pick-up location of the item. At the bottom-center of the item-card lies the 'View Listing' button where the user can press to go and see a detailed version of the product. Users also have access to a search bar where they can type any key search term of the hardware they are looking for. Users can also sort the list according to their prices, latest ad listing, etc.

Once a user selects a hardware, they will be redirected to another page where it would show all the information about the hardware, like the price the seller is asking for, the pick-up location where the buyer has to pick-it up from, some technical specifications and key information about the hardware, the contact number with which the buyer can contact the seller. There is also the comments section where the user can ask about extra information if they want, to which the buyer can reply to. Buyers and sellers can also rate the user regarding how their transaction went.

Users also have the option to update their profile information. They can update their avatar, username, change their password. They can request for account deletion if they no longer wish to be affiliated with the system.

For this system, I worked on both the front-end and back-end of multiple modules. It consisted of fetching, storing, updating and deleting data to and from the database, along with uploading media files such as images to server, and also updating the front-end in regards to state and data change. I was also assigned to make the system responsive with a mobile-first approach. Regarding the modules that I worked specifically is the search feature, the ad-posting feature, the registration and login module, the detailed advertisement page of items, profile update feature and lastly, handling the user logout.

5.2 System Analysis

5.2.1 Six Element Analysis

Processes	Six Element Analysis					
	Human	Non-Computer Hardware	Computing Hardware	Software	Database	Communication and Network
Registration	Users: Users signup for the system Admins are preregistered to the system	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Fetch User Data	WAN/LAN and Email: For work and communication
Login	Users, Admin: Users and admin need to login the system before they can use it	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Fetch User Data	WAN/LAN and Email: For work and communication
Post advertisement with image files	Users: Users fill the input form required for hardware details and upload images	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB, cloudinary: Post data and store images	WAN/LAN and Email: For work and communication
Edit Profile, Delete Profile	Users, Admin: Users and admin may updates their profile information and also when they want to delete their account	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Patch and delete user data	WAN/LAN and Email: For work and communication
Search Items	Users: Users search for items they want to purchase	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Fetch items	WAN/LAN and Email: For work and communication
Commenting	Users: User input their comments in the comment box	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Post comment data	WAN/LAN and Email: For work and communication
Delete User, Delete Post	Admin: Admin remove unwanted post and toxic users	Pen and paper, pdf: To keep a track of the requirements and note down bugs	Desktops, Laptops, Smartphones	Web Browsers, VSCode, Postman, Git, Notepad, Discord: To test the system, note-taking, documentation, and collaboration with team	MongoDB: Delete user document and post document	WAN/LAN and Email: For work and communication

Table 1.1: Six Element Analysis.

5.2.2 Feasibility Analysis

Before the onset of development of 'Hardware Nexus', a very important preliminary study was done to find out a key outcome, that is, is this project feasible? By conducting a feasibility analysis, it allowed us to create a comprehensive report on what are the strengths, weakness, opportunities, and threats for this project.

- **Technical feasibility:** Technically, this project is safe and sound. It does not require any fancy hardware or anything. The system is developed with state of the art web technologies, and because of that, it checks all the system requirements.

- **Legal feasibility:** This system complies with all the laws of cyber-security.

- **Operational feasibility:** With the demand for computers in this pandemic, and also the added shortage of silicon supply, the only feasible option for most of the public is

getting second-hand hardware. This system will be able to help people connect with the sellers and vice versa.

- **Economic feasibility:** This system does not excessive moderation. Also, as this project was developed using open-source technology no additional funding was needed for development.

5.2.3 Problem Solution Analysis

While in the development stage, we had encountered some problems that were halting our progress. How to implement the requirements given by the client properly so that they are satisfied. But we brainstormed and overcame these issues with simple solutions. Some of the problems were:

The client wanted to the searching feature to be unique and powerful. They wanted to the results to be returned no matter what the user typed granted the search term was relevant to the hardware. This was a difficult task which meant the search function must not only go through the title or name of the item field but also other fields. What we come with was data aggregation. Aggregation helped us get the data from multiple fields of the data model. From that we could return the result regarding what the user searched.

The client insisted that the details page must have enough information of the hardware. They wanted the user not be misinformed when selecting a hardware to purchase. The wanted the user to be satisfied with the information they get in the website. We overcame this issue by designing the advertisement posting in such a way where the user is emphasized to provide all the basic yet key details of their advertisement. Until or unless they filled in the key details, they were not allowed to post their advertisement.

As part of the initial stage, the client wanted some sort of method of communication between users when dealing the transaction of the hardware other than instant messaging as that implementing that feature would exceed the client's budget. We came up with two solutions for this. Firstly, we added a field where the buyer would provide a contact number so that the buyer and seller could communicate. Another thing we implemented was the commenting feature. This was in accordance to the client's requirement.

Detection for foul language was an important requirement of the client. They wanted to keep the system clean and free of foul language and obscenities. This was an issue that we had to overcome. If any mischievous individual wanted to post some obscene or foul language in the platform, we had to immediately take action. We could not wait for users to report it to the admin. As a result, we decided to come with an algorithm that would detect foul and obscene language as soon as the user posted it. The post or comment would not be posted but rather

instruct the user to retype the entire thing and then post it again. As a fail-safe, we also added the reporting a post or user functionality that would notify the admin to take actions.

5.2.4   Effect and Constraints Analysis

The system lets users post their used hardware, and other users can buy it off them. But the system lacks the Instant Messaging feature currently as mentioned earlier due to budgetary restrictions. We are still working on adding this and many more features. We also hope to add a payment system so that transactions can be done online which will make it more convenient for the users. Since the current system is a web application, we are also on the early stages of creating mobile application of this system to make it easier for everyone.

5.3 System Design

5.3.1 Rich Picture
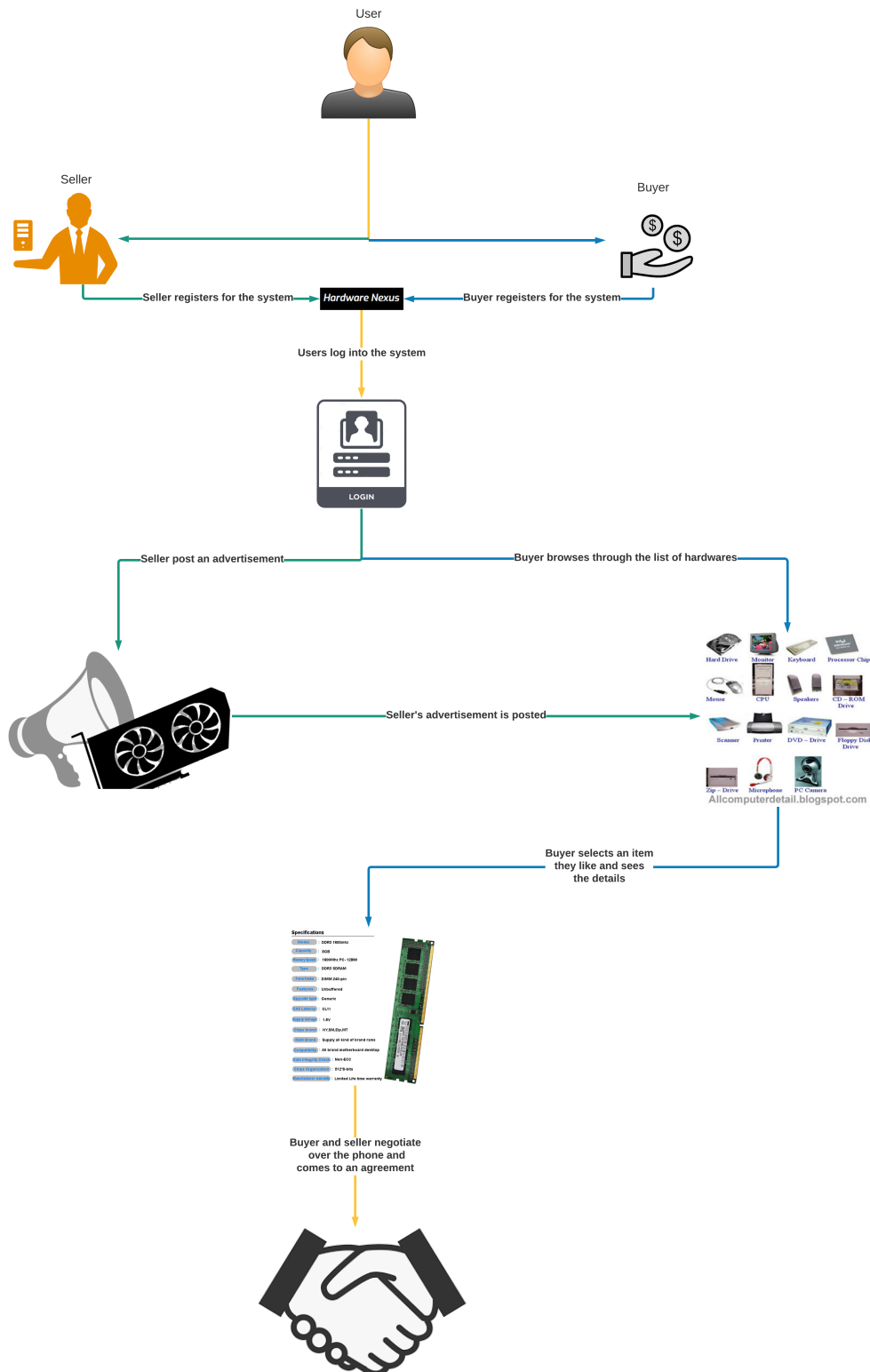
Figure 5.1: Rich Picture of Hardware Nexus

5.3.2   UML Diagrams
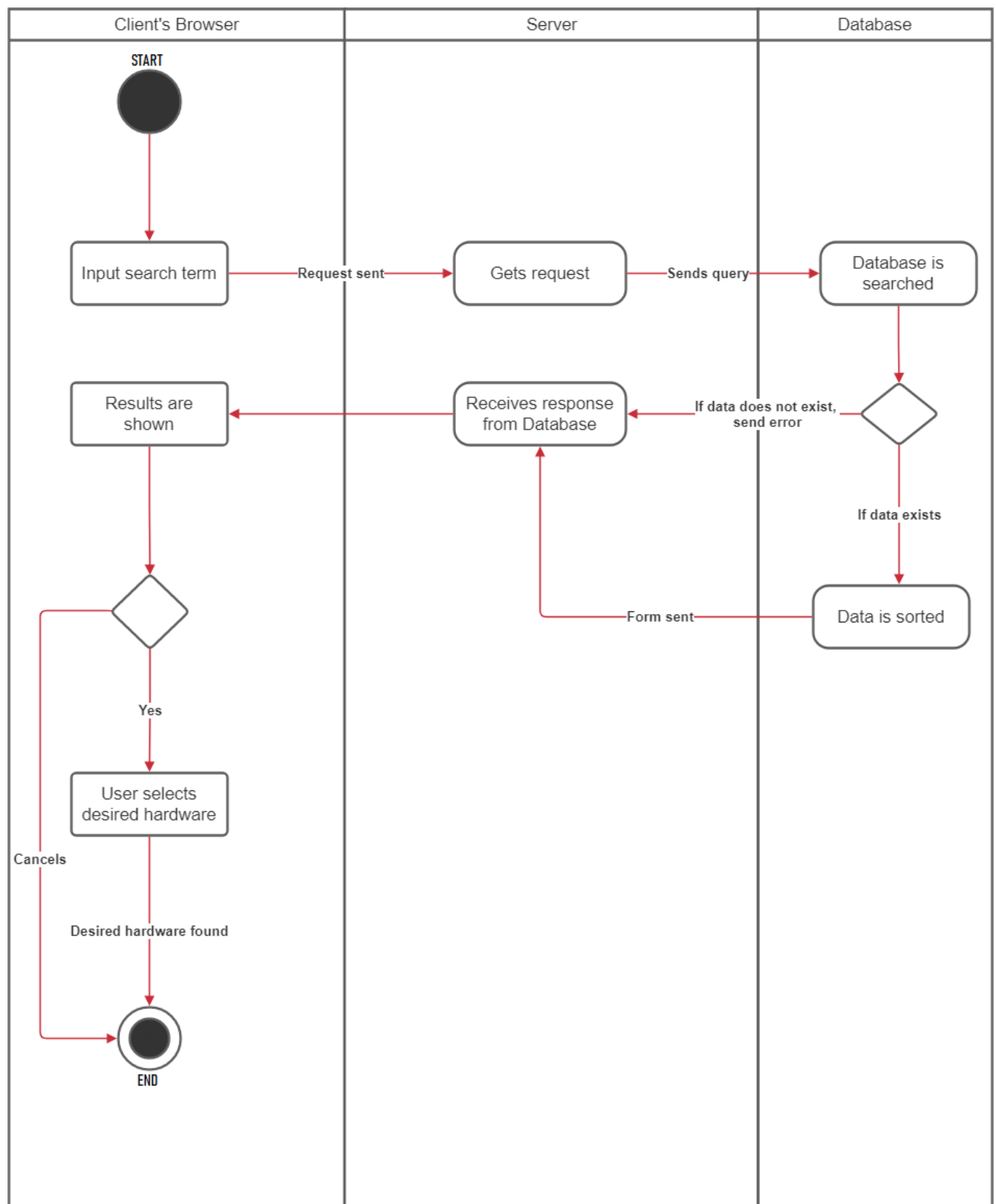
Figure 5.2: Search Hardware Activity Diagram

In figure 5.2, the diagram depicts an activity where the user searches for a specific hardware. The user inputs the word or group of words and that data is sent to the server application where a query is made to the database. If the data exists, the database sends back a response back to the server, and the server then sends the response back to the client. The client gets a list of available hardware in accordance to the search term.
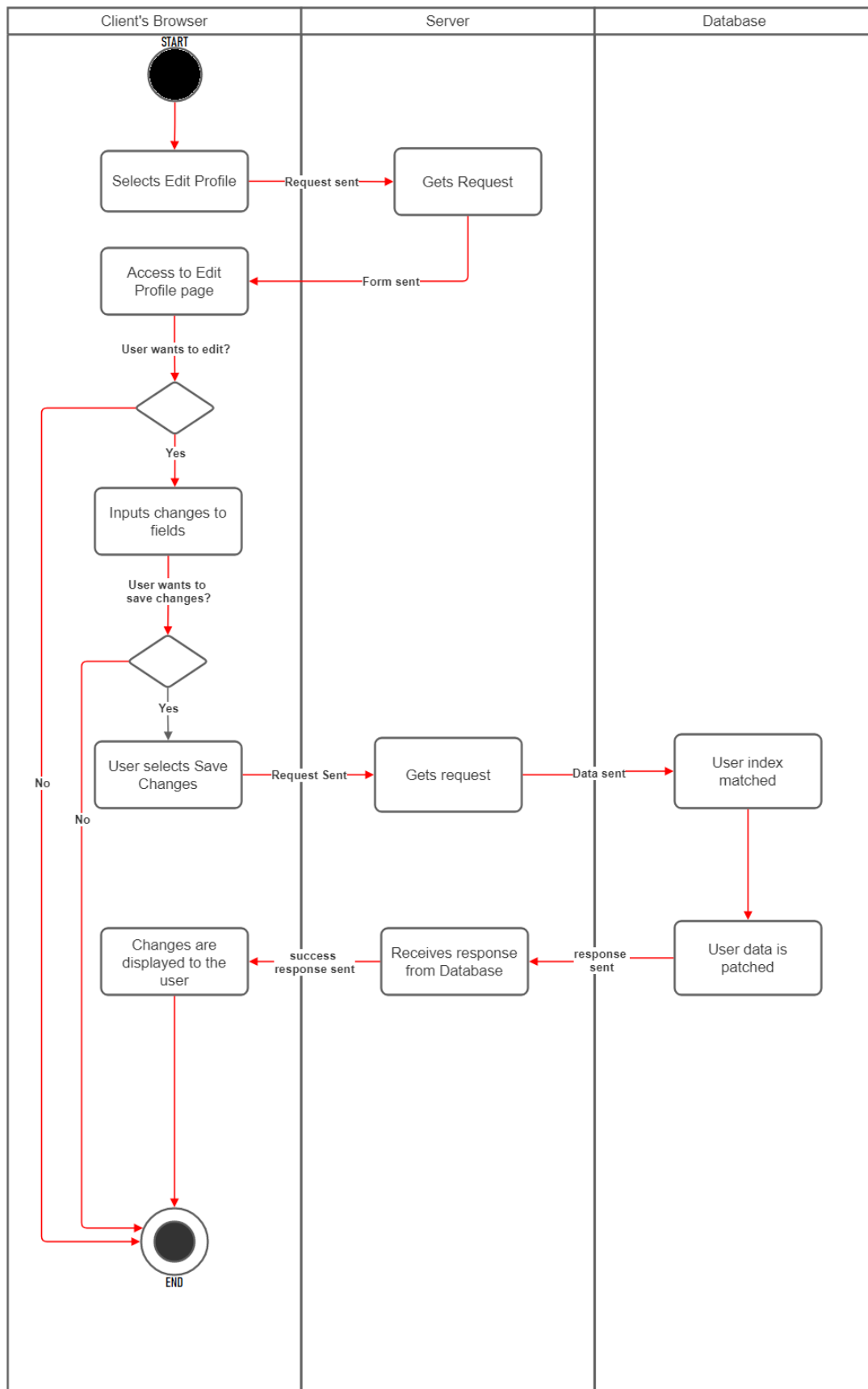
Figure 5.3: User Profile Update Activity Diagram

In Figure 5.3, it depicts an activity where a user updates their profile information. The user navigates to their edit profile page, from where they can choose which information they want to update, whether be it their avatar or their basic information. After user finishes editing, they press the save changes button and the data is sent to the server. The server receives the request, and sends a query to the database to patch the user model. After successful patching, the database and server respond the client with a success message, and then the client can see his profile with the updated information.
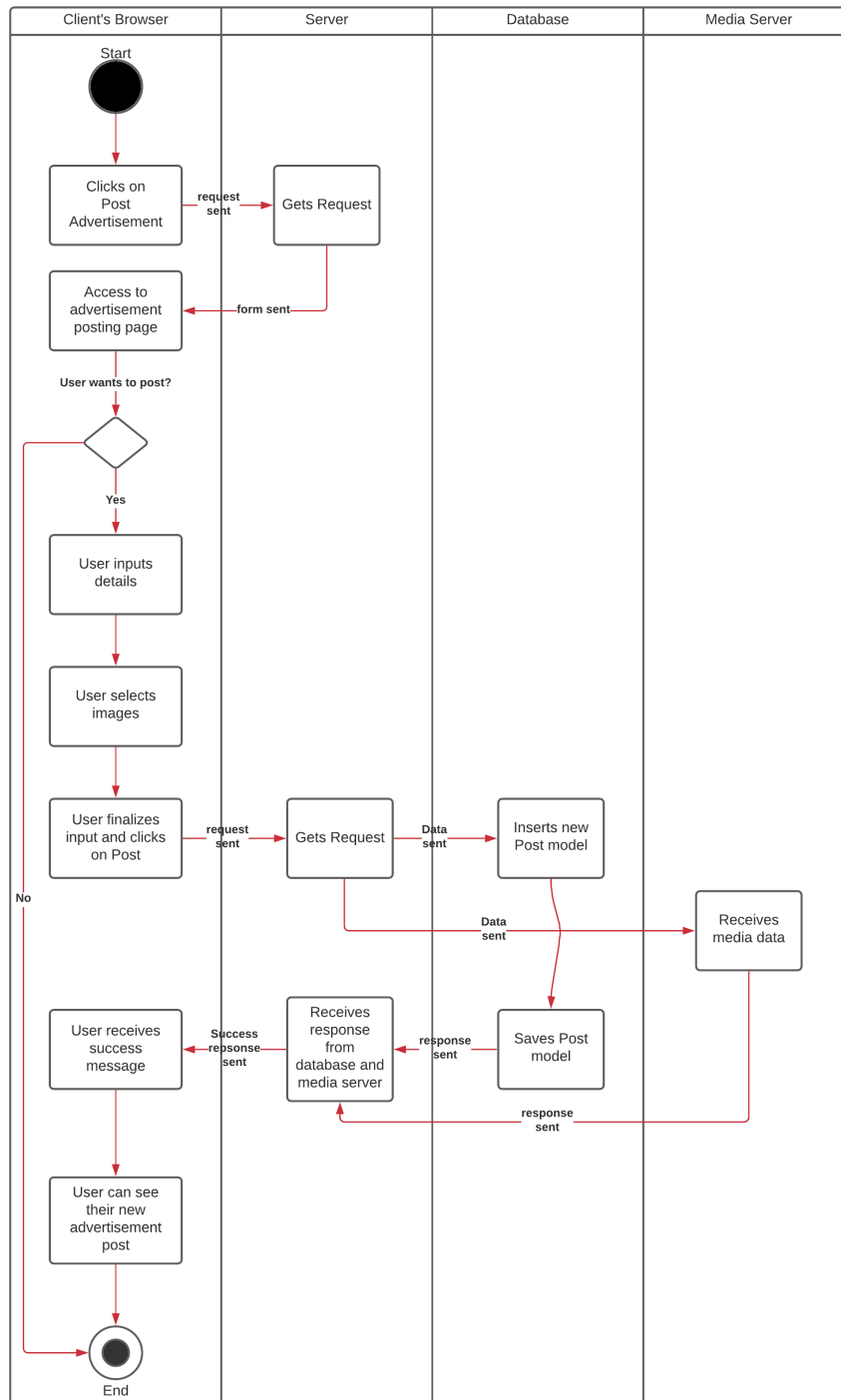
Figure 5.4: Advertisement post Activity Diagram

Figure 5.4 shows the activity of posting an advertisement. The user clicks on the post advertisement button and is then directed to a page where the user has to input the fields that are available. User fills up the input form and selects the images along with it and then presses submit. After clicking submit the server stores the data in the database and the media server. A success messages is show to the user to indicate successful advertisement posting
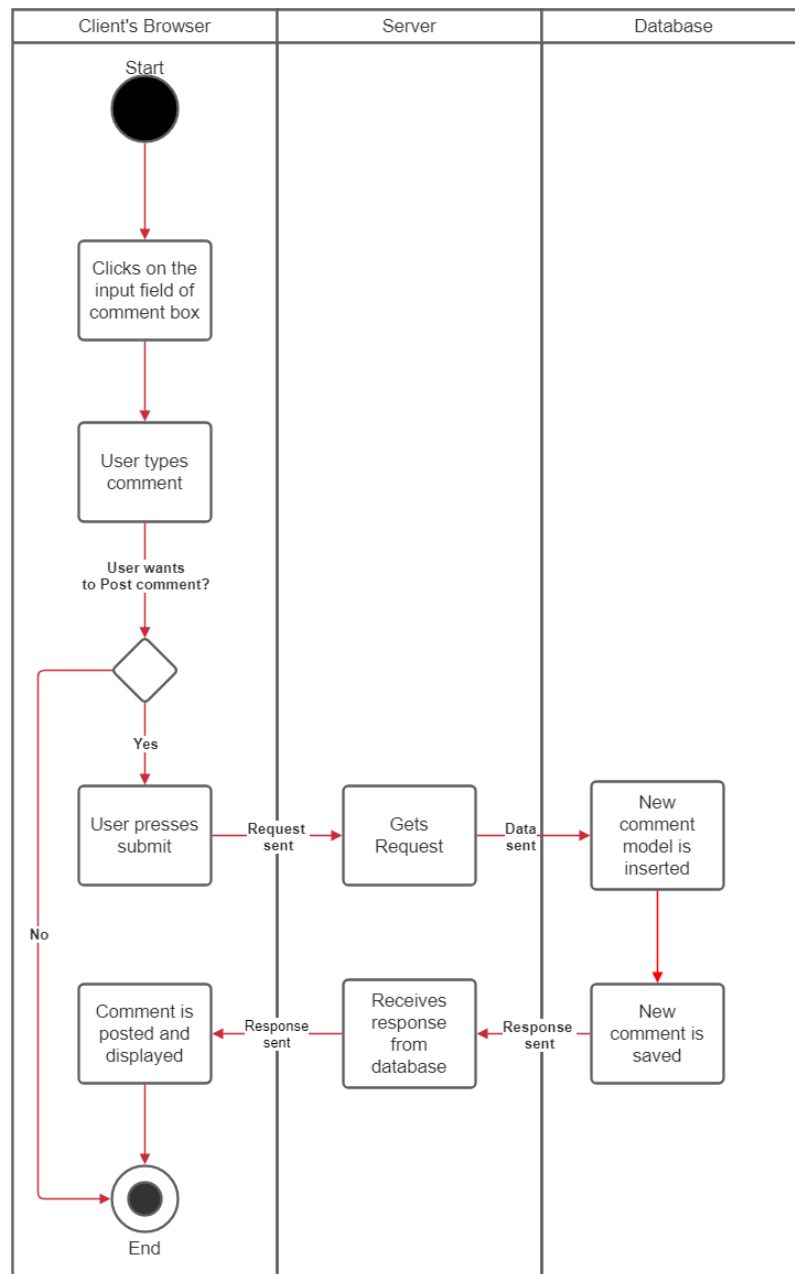
Figure 5.5: Commenting Activity Diagram

From this Figure 5.5, we can see that how an advertisement post activity goes. The user clicks on the comment box and types the a string of characters for the comment. After he/she is done typing, they press on the submit button. The server saves the comment in the database and it is then displayed on the client browser.
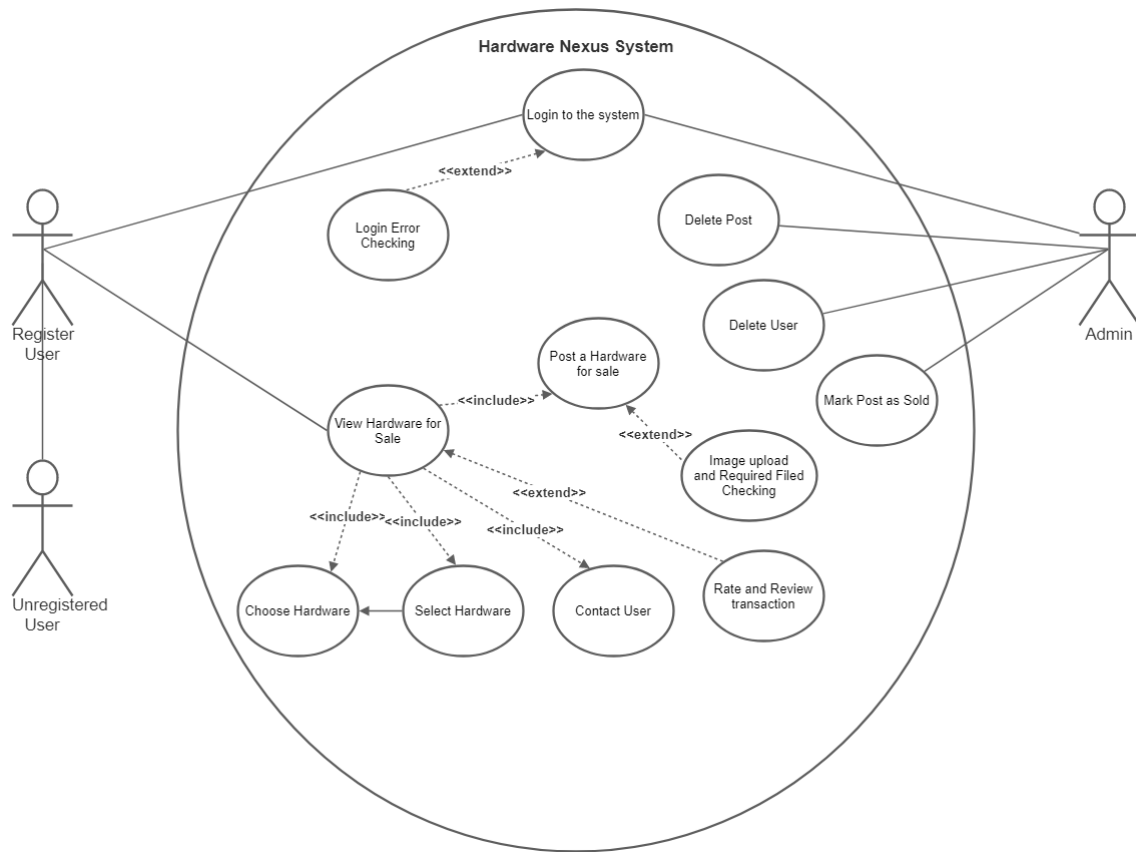
Figure 5.6: Use Case diagram of Hardware Nexus

In this diagram, the Actor, (registered user) can log into the system. They can view the list of available hardware in the front page. They can also search for hardware they want and then select the specific hardware. They can also post an advertisement of the hardware they would like to sell.

5.3.3 Functional and Non-Functional Requirements

Functional Requirements: 'Hardware Nexus' has the following functional requirements:

- **Registration**: This is a feature that can be used by all sorts of users. Anyone can sign-up for the system and start using it almost immediately. By registering, they have access to all the features that the system has to offer and it is free too.

- **Authentication**: Authentication is implemented in this system. Users and admins are the main stakeholders of this feature. If they have already registered for the system they have to authenticate themselves with proper credentials before logging into the system.

- **Update Profile**: Users have the feature of updating their profile. They can update their avatar, change their password, or choose different username whenever they want to.

- **Search Item**: Users are given the functionality to search for items they want. They can search by a multitude of search terms they are relevant to the hardware they are looking for. This makes it easier for them finding the right hardware for their needs.

- **View Item**: Upon choosing an item they want to purchase, users can see detailed information of the item they may wish to purchase. They can get access to all the relevant information that will help them get clear understanding of what item up for sale and it's condition. Admins can view items as well.

- **Advertisement Posting**: This is a user-specific feature. Users can post their own advertisement of the item they want to sell. Upon filling up all the required fields, they can successfully put an item up for sale.

- **Commenting**: This feature allows users and admins to post comments to a post made by the users. Users can ask for more information regarding the hardware, and whereas the admin, can warn users if they are doing something inappropriate that goes against the system's standards.
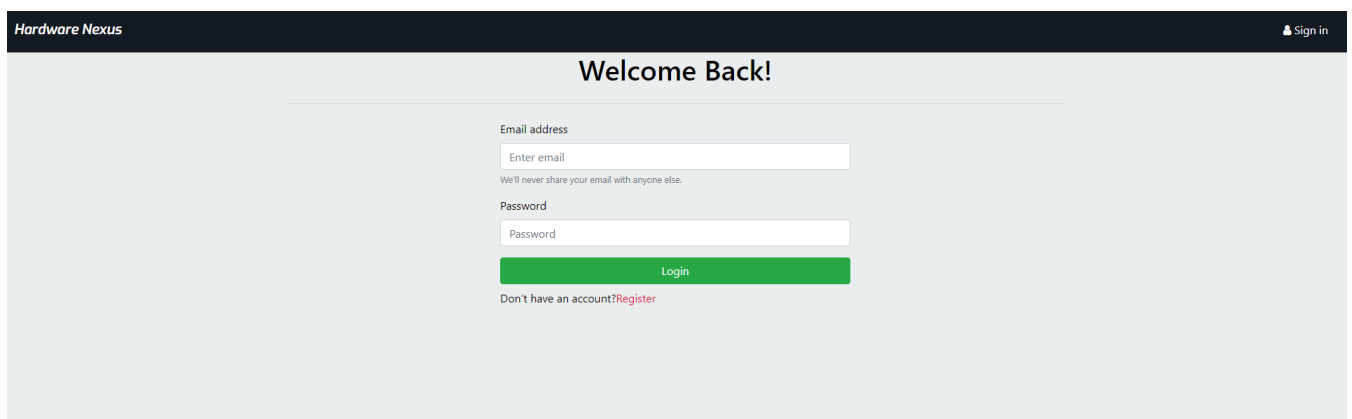
The following features are Admin specific:

- **Delete post**: This is a feature that can be used by the admin. If the admin sees any foul language or any inappropriate content, they can delete the post from the system entirely.

- **Delete User**: This is also a feature that can be used by the admin only. If a user is consistently behaving inappropriately with other users or posting spam or fake advertisements continuously, they can remove that user's account from the system.

Non-Functional Requirements: The system will have the following non-functional system requirements:

- The system will be very secure as only authorized users is allowed access to the system

- The system will be fast providing users with utmost performance

- The system will be intuitive so that users can easily navigate through the system

- The system will be responsive and follow the mobile-first approach

- The system will be very reliable with almost zero downtime unless maintenance takes place
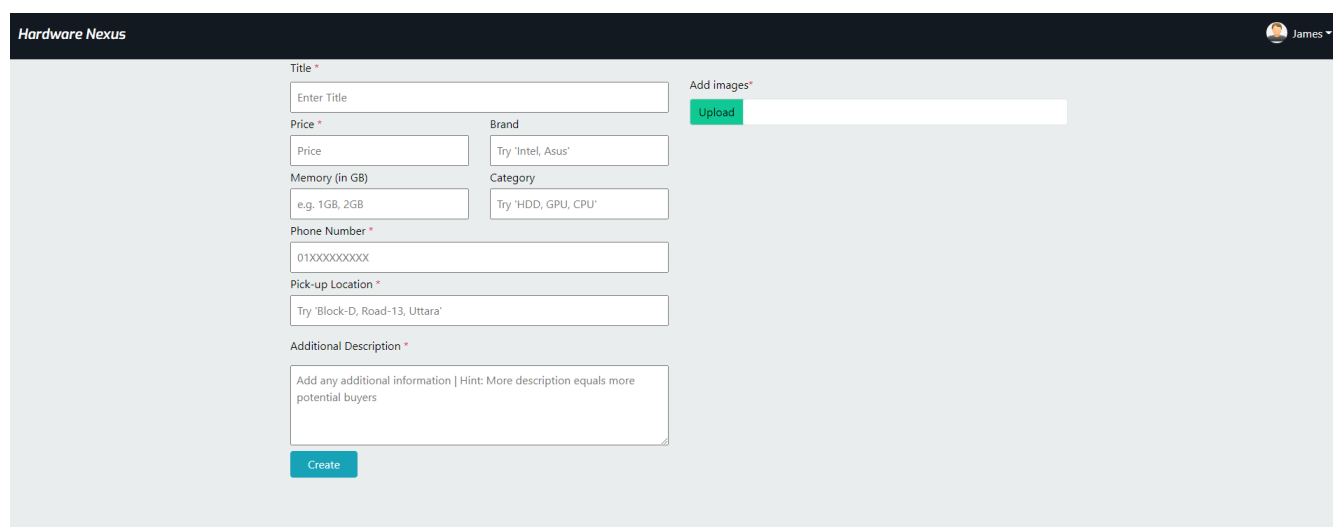
5.4 Product Features

5.4.1 Input

Figure 5.7: User Sign-In

Figure 5.8: Advertisement Posting

Figure 5.1 shows where users can input their credentials and sign-in to the system and whereas Figure 5.2 shows where a user can input the details of the hardware they want to sell and post an advertisement.
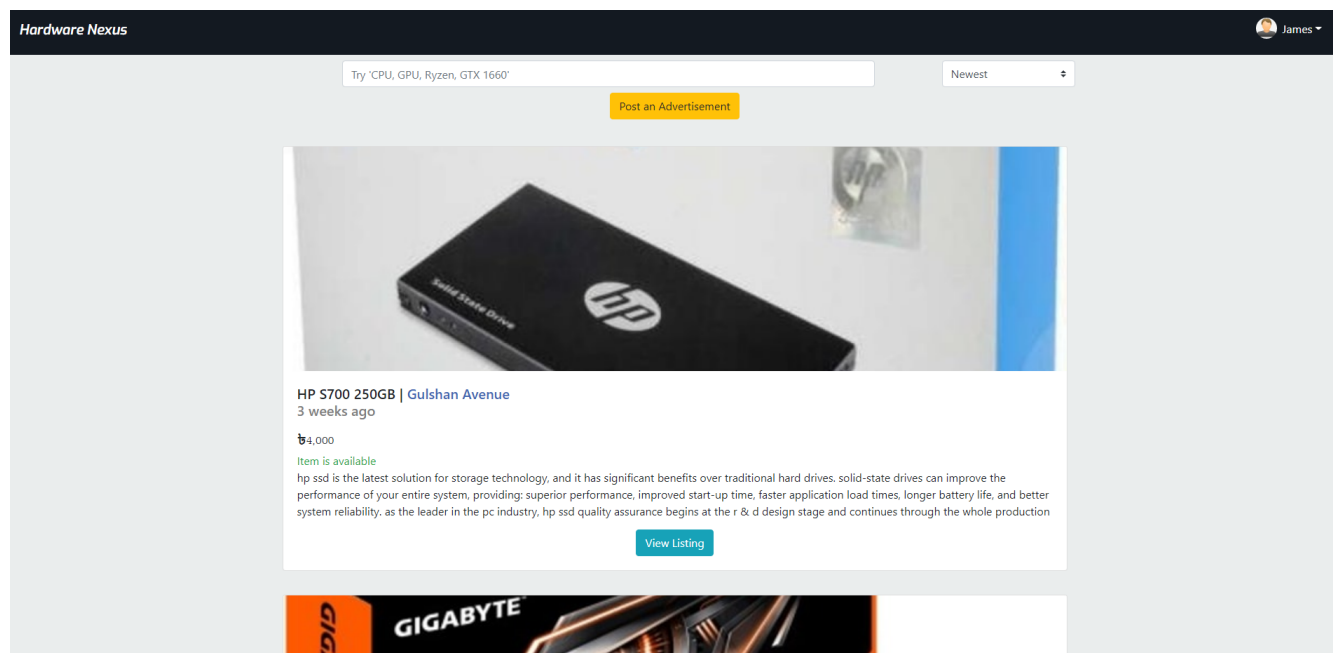
5.4.2   Output

Figure 5.9: HomePage of 'Hardware Nexus'

This is the front page where users can view and search for the hardware that is available for purchase.

5.4.3 Architecture

'Hardware Nexus' somewhat follows a three tier architecture much like the MVC(Model View Controller) model. It differs by the part where all the heavy lifting is done on the server side. This makes it quite fast, and easier for client devices to load the web pages faster. The controller and view both is handled at server side, and the model is handled by the database which makes client side bear minimal load on rendering.
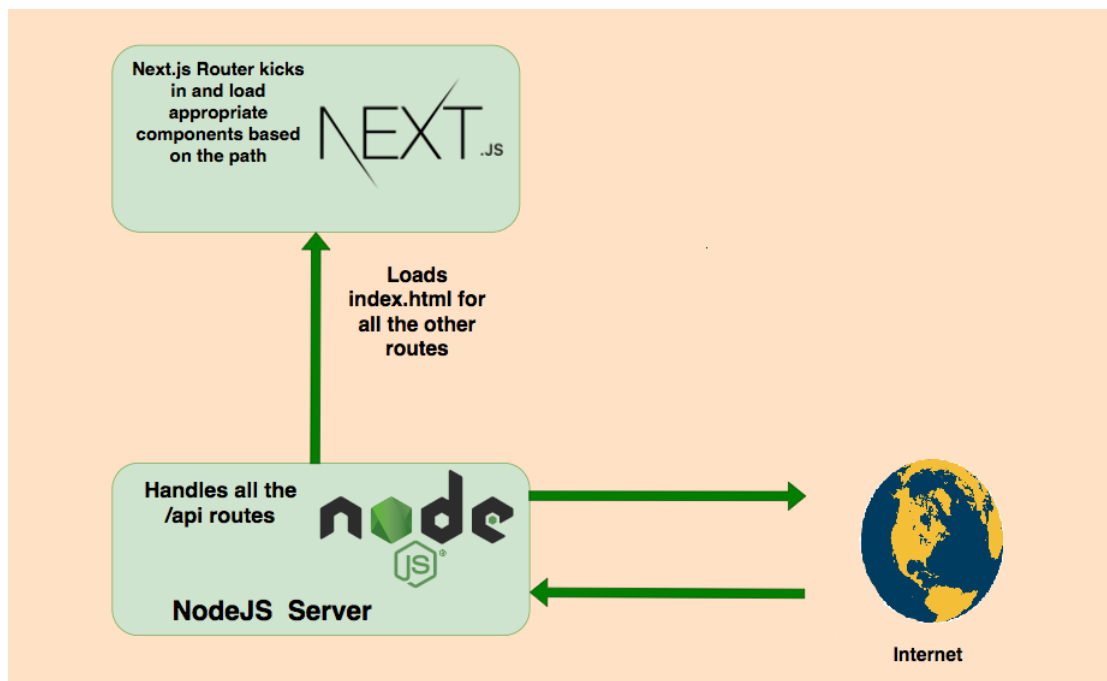

Figure 5.10: Architecture of the system

Chapter 6

Results & Analysis

We had set out with a goal when taking on this project. Provide cheap hardware for people who are in need. The tasks and processes were tested on local hosting machine. Some of them needed changes during development due to some bugs. But later on, we took a different approach to meet the goals. The task mentioned below are the ones I worked on (with Screenshots):

Back-end API calls:

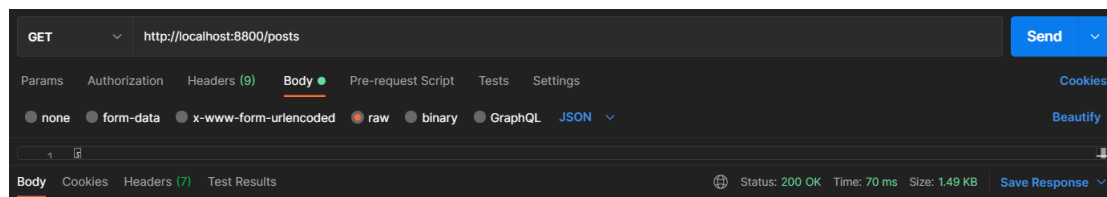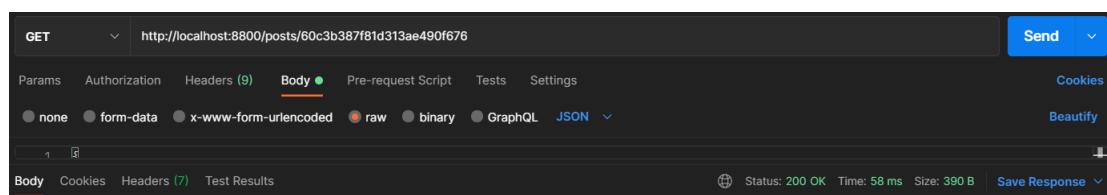

Figure 6.1: API call to Server(Posts)

Figure 6.2: API call to Server(Retrieving a single Post)

From the figures 6.1 and 6.2, it shows some API calls that are done to fetch data, like retrieving all posts or fetching a single post returned a status code of 200. The HTTP 200 OK success status response code means that the request has been made was successful. These were tested using Postman.

Test scripts:
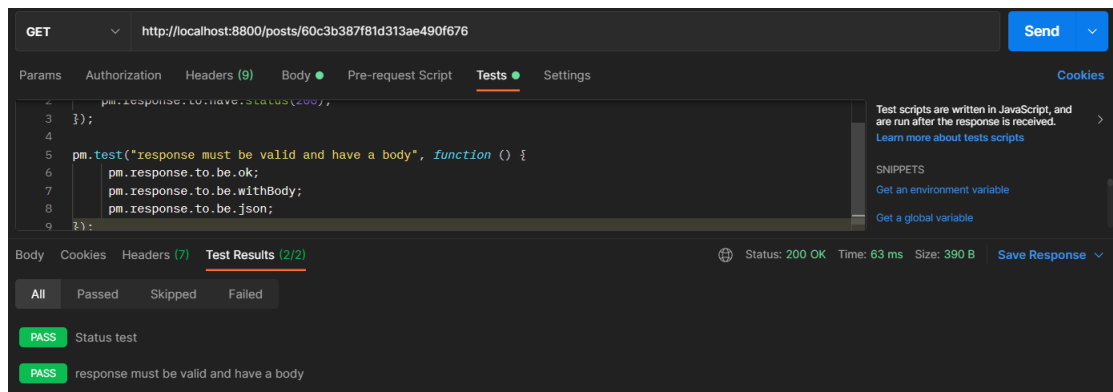
Figure 6.3: Test script for API call-1

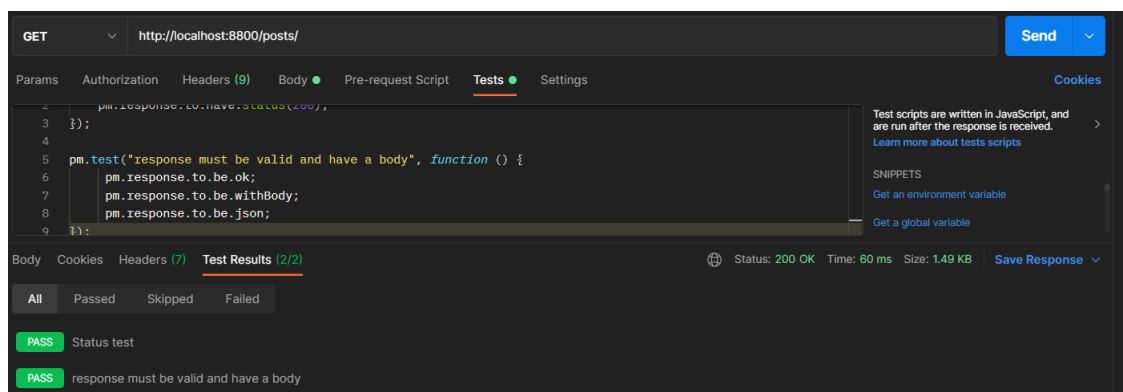Figure 6.4: Test script for API call-2

In figures 6.3 and 6.4, we ran some test scripts to check if it meets the standards of JavaScript API calls. Both of our API calls returned with a status 200 code and also Passed the required parameters for making a standard API call as show in the Test Results section. Additionally the server responded with 60ms response time, which can be concluded as very fast response.

Front-end:

```
[Fast Refresh] rebuilding                                                    hot-dev-client.js:158
[Fast Refresh] done in 192ms                                                 hot-dev-client.js:140
```

Figure 6.5: Page refresh Time

From Figure 6.5, it can be seen that with each page reload and/or redirecting to another page, it takes a mere 192ms for all the data fetching as well as rendering the UI elements for the client side

System Performance:
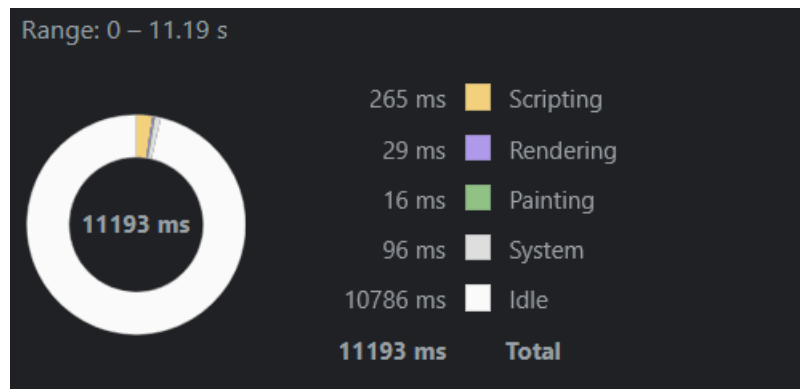
Figure 6.6: System Performance

Using the Chrome dev-tools, we tested the system performance by running a diagnostic analysis for 12 seconds. As shown by this donut chart here, almost 96% of the run-time, was spent idle. This occured to human reaction speed from moving the mouse from the dev-tools to the system. But the real heavy-lifting work takes less than 4% of the entire run time, i.e. about 265ms for page load and JavaScript unbundling. This is the result of using NextJS as it uses server-side rendering cause the client side render to be extremely fast.

Charts based on user data:
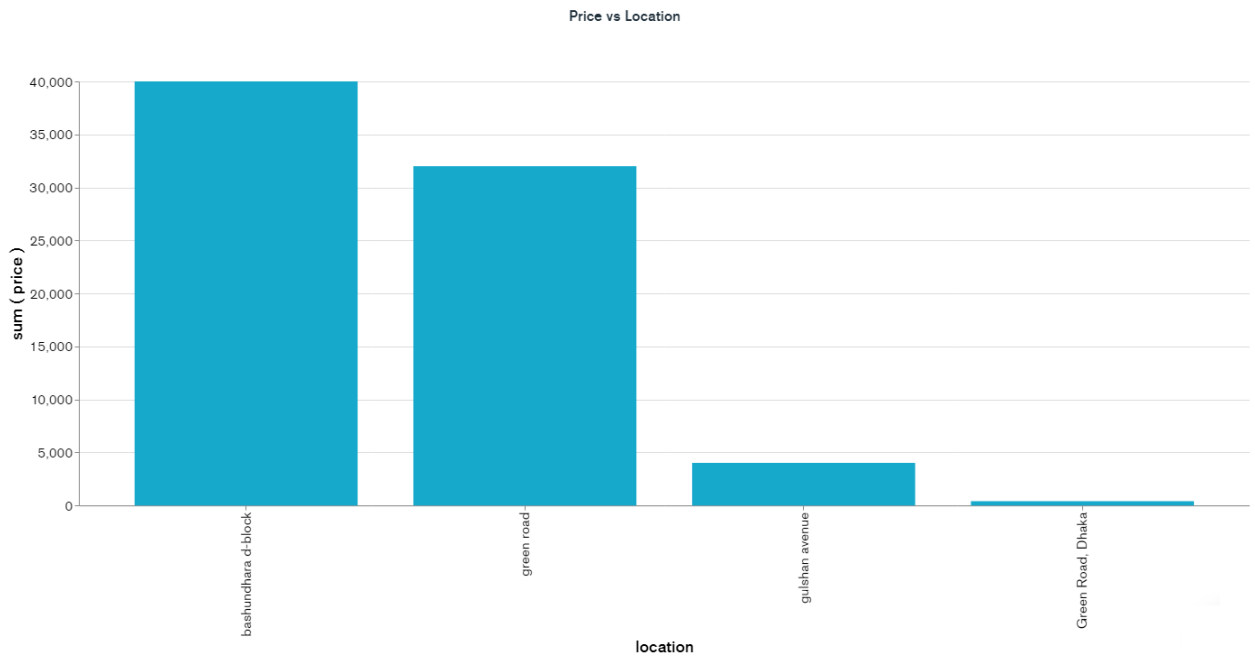
Figure 6.7: Price vs Location
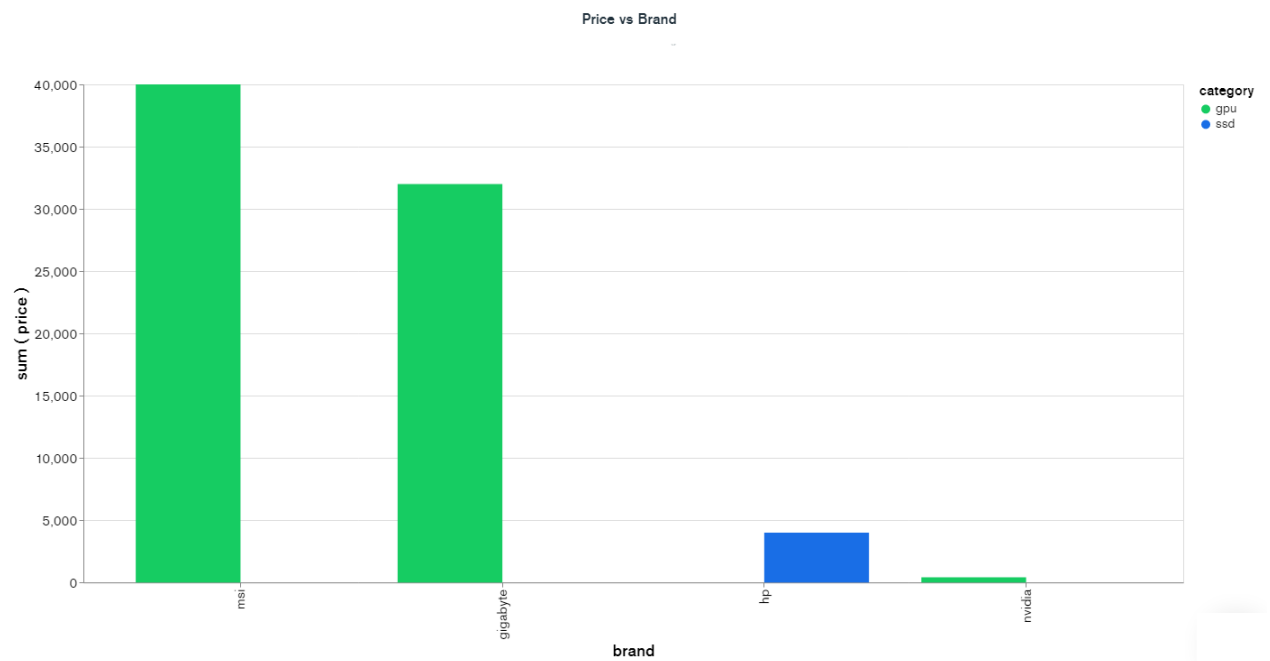
Figure 6.8: Price vs Brand

memory vs hardware type
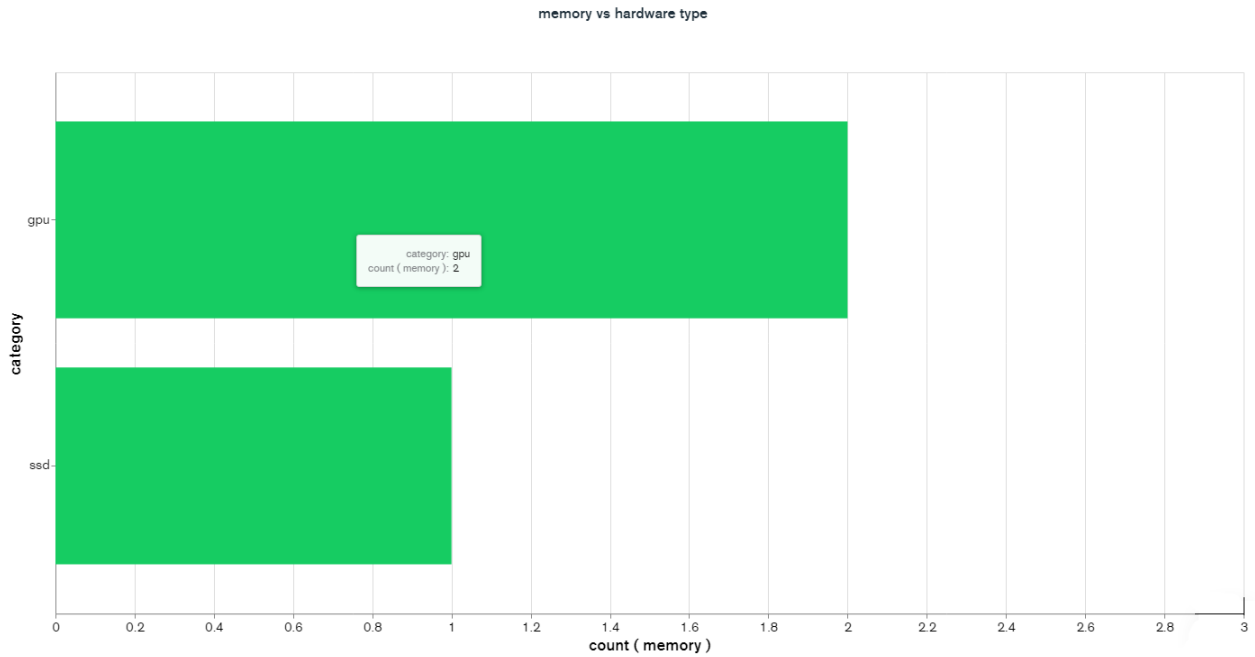
Figure 6.9: Category vs Memory

From Figures 6.7, 6.8 and 6.9 some charts were generated based upon the data that is stored in the database. Figure 6.7 shows a bar chart where what range of prices can be available according to location. Figure 6.8 shows another bar chart where it shows what brands cost what according to sale posts. Lastly, in Figure 6.9, we have a chart where it shows what type of hardware usually has how much memory. All these types of data can be used to analyze and predict hardware and user trends when needed.

Chapter 7

Project as Engineering Problem Analysis

7.1 Sustainability of the Project/Work

One of the core goals for 'Hardware Nexus' was it would be sustainable for years to come. It aims to be the new standard and go-to place for purchasing and sell used hardware E-Markets in the country.

Community: After 'Hardware Nexus' gets deployed on the web, it is predicted that it will create a strong user base and from that will emerge a community of users with mutual likeness.

Financial: The system aims to be free to use at the early stages. It will generate revenue from targeted ads. As the majority cost of maintenance of 'Hardware Nexus' will be consisting of domain hosting and database storage cost, running ads on the system will be able to cover the costs at the beginning. As newer features are added to the system, they system may adapt to a freemium model, where certain features will be charged for a fee. The system also aims to get sponsorship from leading Computer Hardware Manufacturers.

Organizational: 'Hardware Nexus' has lots of features in it's roadmap. These need to be worked on and added into the system at periodic releases. The core features of 'Hardware Nexus' will be kept in mind when moving forward with the newer features.

7.2   Social and Environmental Effects and Analysis

Technology is increasing at a very fast pace. To keep with technology, people are in need of computers. Be it schools [14], work, home or any other aspect in life. The aim of 'Hardware Nexus' is to provide computer hardware at cheap for everyone. With that being in mind, the social and environmental effects are described below:

Social Effect: The system promotes to use used computer silicon instead of selling and purchasing new ones. This will greatly reduce the silicon waste in general. This also results in reducing toxic waste as when these equipment and hardware are taken into waste management, they release toxic chemicals, thus improving overall heath of living things surrounding the landfill where these toxic waste end up in.

7.3   Addressing Ethics and Ethical Issues:

Nowadays people's privacy are not safe. People are concerned of their safety as their personal information are hacked or leaked into the web. We, as the developers of 'Hardware Nexus' adhered to all codes of conduct and privacy as we respect user's privacy.

- **No Sharing or Selling of User Data**: The system will not compromise any user data to any one nor will it allow purchasing of any data.

- **Data Security**: Only the owner, admin(s) and lead developer of 'Hardware Nexus' will have access to the database of the system to limit the chances of data compromise.

- **Clean Ads:** the advertisement that will be run on 'Hardware Nexus' will be the ones that are clear and clean. No sort of spam, scam or fishy ads will be allowed on the system.

- **No discrimination Policy:** Apart from certain age restrictions, no one shall be discriminated in 'Hardware Nexus'. It does not discriminate any kind of users based on race, sexuality, gender, religion, color, beliefs, political, be it national or international, birth or status.

Chapter 8

Lesson Learned

8.1 Problems Faced During this Period

My time as an intern at Techdojo has been a great eye-opener. I faced multiple challenges which I overcame by brainstorming for a workaround or a solution to those problems. At first, I had to write and submit weekly submissions of my internship report to my course advisor. I had to meet strict deadlines along with studying for midterm examinations of other courses and also work on the project from the company I was working in. For the submissions I had to generate reports and charts such as Gantt Charts and WBS and export them to overleaf. It was a difficult thing to do as creating tables in latex was something new and it proved quite difficult for me. Finding the right tool for creating intricate diagrams such as activity diagrams, rich-picture and use-case diagrams proved to be a challenge as well.

Apart from all these, I faced some difficulties at work too. I had to be punctual and attend daily meetings. There were rules and regulations that were to be strictly maintained and I had to make sure that I followed them properly. I had to get myself familiar with their work culture in a very short period of time. Adapt to their work methodology and learn the fundamentals of full-stack web applications from new. The concept of a fullstack web application was new to me, and on top of that, I had to learn a completely new library of JavaScript, i.e. ReactJS. I had to learn how to use different testing tools to measure the performance of the system I was assigned to work on. I was heavily involved in the searching algorithm for 'Hardware Nexus' and there was a particular issue which I assigned to solve. As a Junior Software Developer, all these were very daunting to me, but I was ready for the challenge.

8.2 Solution of those Problems

The last 4 years as an undergraduate student has taught me valuable lessons. From these lessons, I learned the crucial ability of time management. Because of this, I was able to adjust appropriate time for myself so that I can meet the strict deadlines and also study for my other courses as well as work on 'Hardware Nexus' during the semester. As a solution to importing diagrams and creating into latex, I used third-party online tools to create the table and and make the diagrams. I maintained the utmost respect and discipline during work hours. I made sure that I did not overwork myself so that I do not lose focus. I went through several tutorials and online resources and tried to implement them on my own to get familiar with the work I was assigned to do. I practiced at steady intervals and got the hang of it very quickly. Once I grasped the concepts clearly, I could manage a solution for a working searching algorithm for the project I was working on. All I had to do was create a separate API call that would traverse the query with the help of a regex which would bring the desired results. I sought expert counsel from my mentors as well on improving my work.

Chapter 9

Future Work & Conclusion

9.1 Future Works

The system 'Hardware Nexus' is still under development. Some features still need to be polished before it can be deployed. As future work, a mobile application for this system is in early stages of development. It will be made in React-Native, since the current system is built in ReactJS. Developing it on react-native will provide beneficial for development as one code-base can be compiled for both Android and iOS.

Payment gateway like SSLCOMMERZ will also be added after their trade license is verified. Instant Messaging feature shall also be added in a future version of the system.

9.2 Conclusion

The past few months I spent working in my internship was very eye-opening. I got a first-hand experience of what it is like to work in a professional environment. I learned state of the art technology in web development like the MERN stack. I always had an interest in becoming a full-stack engineer. Working on such an exciting project like 'Hardware Nexus' boosted my self confidence. I now feel confident to take on bigger and more complex full-stack projects. My supervisors there taught industry-standard coding style. I also learned how to collaborate with other software engineers, and consequently improved my inter-personal skills such as communication, teamwork, flexibility, working calmly under pressure and how to maintain a rapport with my co-workers. I am very grateful for an experience like this. I feel like working and applying my skills in actual development is really rewarding and self-satisfying.

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