An Undergraduate Internship on "Development of Patient Discharge Module" at Bioforge Health Systems Ltd.

By

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Spring, 2021

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June 17, 2021

Dissertation submitted in partial fulfillment for the degree of Bachelor of Science in Computer Science
Department of Computer Science & Engineering
Independent University, Bangladesh

Attestation

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at IUB or any other educational institution, except where due acknowledgement is made in this report. Any contribution made to the project by others, with whom I have worked at Bioforge or elsewhere, is explicitly acknowledged in the report. I also declare that the intellectual content of this report is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

17/6/21

Nusrat Tahsin Kamaly

Acknowledgements

I would firstly like to thank The Almighty Allah for giving me the endurance and the ability to work hard, for giving me the ability to write this report to and for giving me the chance to be able to do my internship at Bioforge Health Systems Limited. Also, my parents for their unconditional love and support that have sustained, nurtured, and got me ready for this challenge.

I would like to thank my honorable faculty and supervisor Ms. Romasa Qasim, Lecturer, Department of Computer Science & Engineering, Independent University, Bangladesh, for her invaluable guidance, patience, time, constructive criticism and thoughtful advice regarding various aspects of my internship and preparation of this report.

I would like to thank my senior advisors Dr. Dewan AFK Choudhury, Ju-un Nahar Choudhury and all the others who made me feel at home from day one in the company and helped me navigate throughout the projects. I would also like to thank Khandakar Sajid Mahmud, Hasnain Hossain and Muttakin Islam for their contribution to the project. I am thankful for the continuous guidance and support along with the vast pool of knowledge which was key for the completion of the project.

Lastly, I would like to acknowledge my external supervisor and my mentor Ms. Shama Hoque for supporting, guiding and being patient with me as an Intern for Bioforge Health Systems Limited. Without her extreme energetic support and guidance, I could not have finished the project successfully.

Letter of Transmittal

17 June 2021
Romasa Qasim
Lecturer,
Department of Computer Science and Engineering,
Independent University, Bangladesh

Subject: Letter of Submission for Internship Report, Spring 2021

With due honor and respect, I, Nusrat Tahsin Kamaly, from Spring 2021, Section 07, would like to submit my Internship report. This report is written to kindly to inform you that I have completed my internship program and its report. My internship was conducted from 1st January to 1st April 2021 at Bioforge Health Systems Limited.

This report is based on my personal experience and the work I did at Bioforge Health Systems Limited during my internship. The primary goal for my internship was to gain first-hand experience in all the different technology related fields of the company which include documentation, software development, research and development and to get acquainted with software development processes and practices with emphasis and priority on understanding how a software is being built rather than what is being built.

Over the period of my internship at Bioforge Health Systems Limited, I found out that I learned and applied a lot of new skills and technologies. The company comprises a small team of software craftsmen who learn, collaborate, and innovate together.

I hope the following report can achieve your approval and is up to the mark. Sincerely,

Nusrat Tahsin Kamaly

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Evaluation Committee

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Abstract

In this report, I have written about my experience as an employee at Bioforge Health Systems Limited. Bioforge Health Systems Limited is a biomedical hardware and software company, dedicated to support hospitals and doctors deliver effective and precision healthcare using innovative technology. The company was founded back in 2017 with a handful of engineers and a doctor ready to change the medical industry here in Bangladesh for the better. In 2020, Bioforge and the team became MIT Solvers and recipients of the Bill and Melinda Gates Foundation Award for their ongoing low-cost and portable incubator and phototherapy lights project. As an intern, I was assigned to the software team in the company. During the initial phase of the internship, I was faced with many new technologies which I had never encountered before as I did not have any formal experience in the software industry. Bioforge Health Systems Limited gave me the opportunity to develop myself and introduced me to the software development process where I can use the knowledge, I have gained in the future to improve myself.

During my internship I was introduced to the technologies that are used in the Software Development phases. I was exposed to developing User Interfaces with a popular JavaScript framework -Angular. In this timeline I progressively got familiarized with some of the Software Engineering Process and tools which are involved in taking an application from Inception to Development and finally Production.

After completing all basic learning sessions, I was assigned to work on a company project where my task was to work in a team to develop a web application named Genesis-D Discharge Module and the idea of the application is to provide hospitals with a simple and efficient system to Generate Discharge Summaries

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Chapter 1

Introduction

1.1 Background of the work

The project “Genesis-D Discharge Module” is being developed as a working part of a hospital management system to specifically take care of patient discharge procedures. Hospitals are an essential part of the healthcare structure and thus require an efficient working system to handle all of its incoming patients’ data. Information of all the patients entering a hospital needs to be smoothly managed and integrated into the hospital's treatment functionalities for it to run successfully. Inevitably, using a paper-based system, to keep track of this large amount of everyday data would be time-consuming and prone to errors. To mitigate this issue, this project will work on creating a Discharge module to take in, store and classify patients’ information in an automated manner.

The module is built as a Web application hosted on the user’s device to allow for quick access to an admission details form. The patients’ information will be stored as a record and simultaneously become linked to a suitable department. Data storage removes the need for duplicate records for each visit of the same patient and helps build on their medical history. Linking the data to the hospital’s department allows not only for bed allocation to become fixed on arrival but also for medical personnel to have easy access to patient history and other relevant information.

The system aims to replace any paper-based system by offering a more efficient alternative. The module will be primarily operated by consultants, RMO, Interns or any other medical professional in charge of handling Discharge Reports. Data may get lost or misplaced in transfer to other departments when using paper forms. Medical secretaries have particularly shown higher satisfaction to the use of hospital information systems as compared to other medical staff, making the use of an Discharge module as a replacement less challenging [1]. The software also has the potential to be integrated into a developing hospital management system where the patient’s data on admission can be updated through diagnosis, testing and treatment up to the patient’s discharge. This opens the possibility to automate common hospital administrative and monitoring processes for better benefits to healthcare as a whole.

1.2 Objectives

The main objective for the Genesis-D Discharge Module is to fully digitize the patient discharge procedure, make the process more accessible and standardized.

Other objectives include:

1. To create a system with a user-friendly interface that is simple and efficient.
2. To automate the storage of patient records based on initial data input during the admission process to allow for secure access to data and retrieval of data for analysis and decision making.
3. Reduce the waiting time of patients,
4. Ensure that patient data is not lost forever with the discharge certificate, but stored in a manner that can be used for research purposes and business review, and
5. Reducing the operative load on the medical staff including RMOs and others involved in the discharge process.
6. Use the information generated to help in making administrative and executive decisions in regards to a specific department or the institution as a whole
7. Possibility of future integration with other modules of a hospital management system.

1.3 Scopes

The solution being offered focuses on a very specific task within the daily operations of medical staff in the wards and cabins; namely, the creation of multiple discharge certificates for outgoing patients. The Bioforge Health research team has closely studied the process and has identified a number of methods to improve the process. The primary concerns were as follows:
Reduce the waiting time of patients,
Ensure that patient data is not lost forever with the discharge certificate, but stored in a manner that can be used for research purposes and business review, and
Reducing the operative load on the medical staff including RMOs and others involved in the discharge process.
Use the information generated to help in making administrative and executive decisions in regards to a specific department or the institution as a whole
It goes without saying that the proposed system will rely on an IT backbone, using cloud servers and a stable internet connection. The following document considers factors like resources that need to be allocated and the costs that will be borne by both teams.

Chapter 2

Literature Review

2.1 Relationship with Undergraduate Studies

In my last 4 years here at Independent University, Bangladesh almost all my courses have contributed some significant knowledge in the development of the module. Out of which many courses were vitally important and played a huge role. These courses are as per the following in no specific order: -

- **CSE 213, Object Oriented Programming:** It is now a standard practice in the industry to be using object-oriented programming for any type of software application as most of the data represented are in objects. The course teaches on how to write modular based programs which can be recycled and therefore can be used many times for different purposes.
- **CSE 203, Data Structures:** In Data Structures we are taught about Stack, Queue, and Linked List utilizing the C++ programming language. The essential objective of this course is to make students and programmers imagine how unique data structures work. As "Genesis-D Discharge Module" involves many complex data structures, the skills gained from this course made handling them much easier.

- **CSE 309, Web Application and Internet:** This is the course where the development of web applications was taught. It covered very important technologies that are highly in demand in the industry, such as HTML, CSS, JavaScript, jQuery, View Engines (Handlebars and embedded JavaScript), Node.js, Express.js, MongoDB and deployment with Heroku. The tools and technologies learned from this course immensely contributed to the development of "Genesis-D Discharge Module" as it is a web application-built web technology, and it has a backend server which had to be deployed to the cloud server as well.

- **CSE 303, Database Management:** This was the first course which taught on how to design and plan a project. It covered popular planning and strategy practices such as System Development Life Cycle (SDLC), Rich Picture, Requirement Analysis, Entity Relationship Diagram, Business Process Model and Notation Diagram and many more.

- **CSE 307, System Analysis and Design:** This course gives an overview of different SDLCs and how to adopt each one of them to the project.

- **CSE 451, Software Engineering:** This course was particularly important as in this course we were taught how to manage our projects, make timelines, and work with our master's peers to make applications hands on which combined a lot of what we learned

from our previous courses.

2.2 Related works:

1. Smart Software [2] is a healthcare-based software company which develops different kinds of hospital management modules with cloud servers which are all integrated into one hospital management system. The Appointment module here is very similar to Genesis-D Discharge Module as it meets most of the objectives for our project.

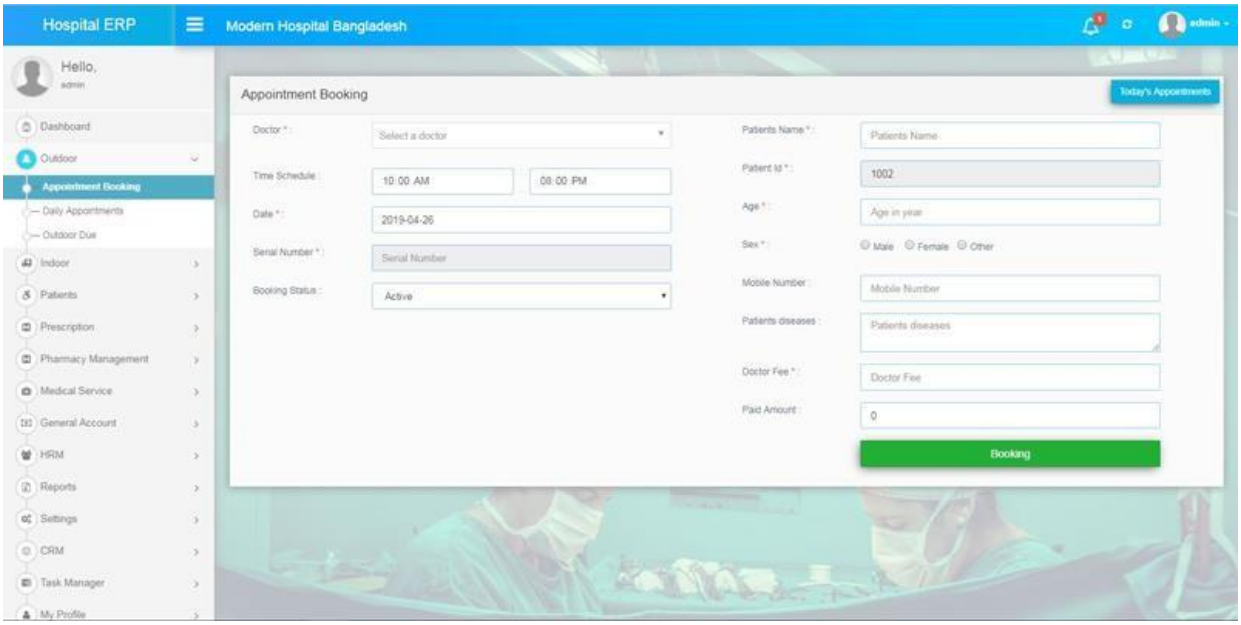


Figure 2.1: *Smart Software Appointment Booking User Interface*

2. Millenium Heart and General Hospital [3] situated in Lalmatia, Dhaka is currently using a desktop-based Discharge application with a local server which is also a part of an entire hospital management system.

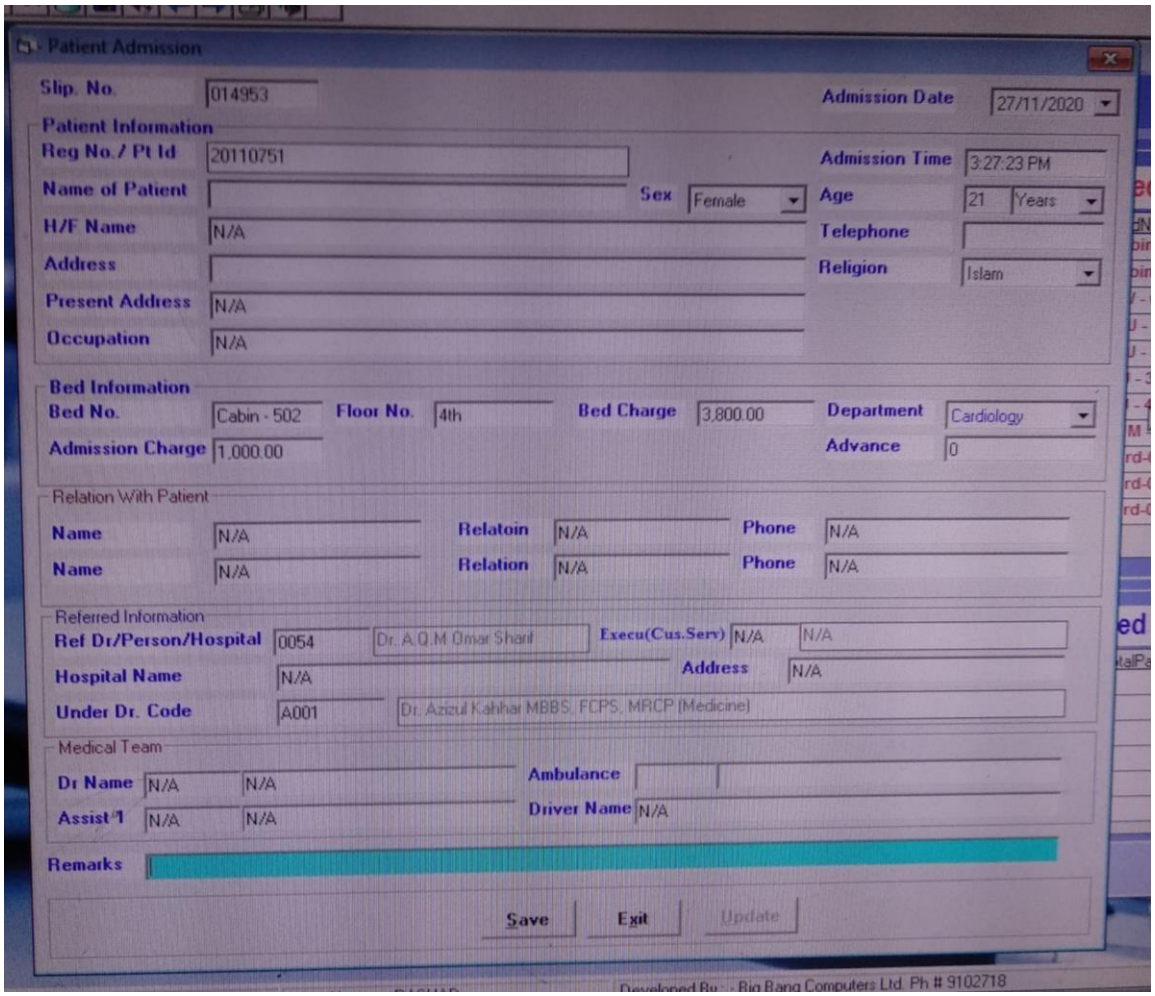


Figure 2.2: *Millenium Heart and General Hospital Discharge System*

Chapter 3

Project Management & Financing

3.1 Work Breakdown Structure

1. Genesis-D Discharge Module

1.1. Project Planning and Brainstorming
- 1.1.1. Planning of the overview for the project
- 1.1.2. Initial market and background research
- 1.1.3. Planning of basic system architecture
- 1.1.4. Design and development of Process Flow Diagrams
- 1.1.5. Development of Security Requirements
- 1.1.6. Development of Quality and Testing Requirements

1.2. Gathering Requirements and making an SRS
- 1.2.1. Making questionnaire for gathering functional requirements
- 1.2.2. Identifying Non-functional requirements
- 1.2.3. Gathering samples for UI UX development (Hospital Visits)
- 1.2.4. Making an SRS

1.3. Development of UI and Prototype
- 1.3.1. Development of UI wireframe and prototype
- 1.3.2. Art works Development
- 1.3.3. Graphic Asset development
- 1.3.4. Finalize UI and UX

1.4. Development and Unit testing of all components
- 1.4.1. Importing of all libraries and setting up environment
- 1.4.2. Front-End development from UI and UX and testing of each component.
- 1.4.3. Development of Back-End and unit testing of all features.
- 1.4.4. Development of Data Models
- 1.4.5. Development of APIs, Admin and Login components and unit testing of components.
- 1.4.6. Development and testing of Security components.
- 1.4.7. Integration and configuration
- 1.4.8. Bug fixing and issue resolution.
- 1.4.9. Finalize the development stages and Unit testing.

1.5. Testing
- 1.5.1. Integration of all components
- 1.5.2. CI/CD testing
- 1.5.3. Alpha testing within the company
- 1.5.4. Beta testing with the client

1.5.5. Gathering feedback and making changes accordingly Finalize testing feature

1.6 Deployment
1.6.1 Production Deployment
1.6.2 Release Version

3.2 Gantt Chart

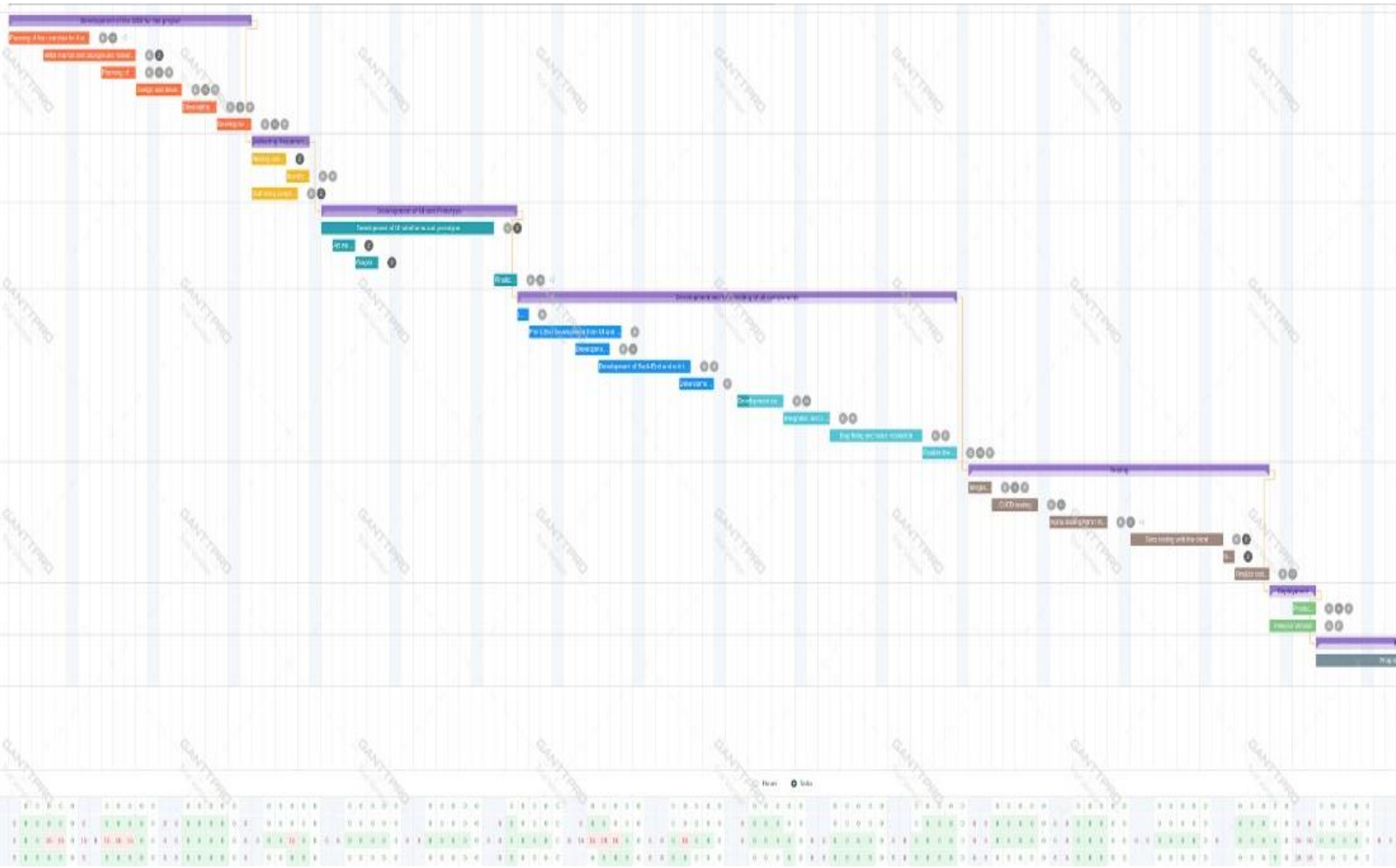


Figure 3.1: *Gantt Chart with Resource Allocation and Activity wise Time Distribution*

Chapter 4

Methodology

Agile Methodology

In software engineering, a software development process is the process of dividing software development work into distinct phases to improve design, product management and project management. It is also known as a system development life cycle (SDLC). We can define SDLC as a framework that describes the activities performed at each stage of a System Development Project. So, it has some basic stages to be followed during the development phase. There are many different SDLC to choose from like

- Waterfall Model
- Prototyping
- Agile
- Spiral Model
- Rapid Application Development
- V-Model
- Incremental
- Evolutionary Model

Agile methodology is a type of project management process, mainly used for software development, where demands and solutions evolve through the collaborative effort of self-organizing and cross-functional teams and their customers.

The Agile methodology is a collection of principles that value adaptability and flexibility. Agile aims to provide better responsiveness to changing business needs and therefore focuses on enabling teams to deliver in workable increments.

Stemming from the values and principles of the Agile Manifesto, it was created as a response to the inadequacies of traditional development methods such as the Waterfall method. The software industry is a highly competitive market due to the fact that software is something that can be continuously updated. This means that developers need to constantly improve and innovate their products to keep on top of the game—and the linear, sequential approach of the Waterfall method just wasn’t cutting it.

Chapter 5

Body of the Project

5.1 Work Description

Genesis-D Discharge Module is a patient registering web application for hospitals to be able to admit their patients in a much more efficient way than the current methods. The goal of the project is for doctors and hospital staff to be able to interact with an application naturally and not feel burdened to be using a system that they are not familiar with and to be able to retain information in a useful manner for the hospital. The team at Bioforge Health Systems Limited envisions using simple yet effective designs and use cases that may help the hospital processes to be faster and thus be able to treat lives sooner.

5.2 System analysis

Six Elements Analysis:

Six Element Analysis – As is

	System Roles					
Processes	Human	Non Computing Hardware	Computing Hardware	Software	Database	Comm. & Network
1. Writing Discharge Certificate for a patient	1.Fill out the details of patient 2. Write the investigation note 3. Write OT note 4.Write medicine name, dosage, instructions 4. Write the advise And follow-up details	1.Discharge Certificate Form 2. Pen	N/A	N/A	N/A	N/A

Six Element Analysis -To be

Processes	System Roles					
	Human	Non Computing Hardware	Computing Hardware	Software	Database	Comm. & Network
1. Writing Discharge Certificate for a patient	1. Fill up patient particular 2. Select the type of Investigation 3.Add details of investigation 4. Select performed Procedure 5. Select dosage, instruction, advice(Bengali) from dropdown list 6.Select date of follow-up	N/A	PC/Mobile/Tablet	JBFH Discharge Module	Cloud Database (MongoDB)	Internet

Table 5.2: *Six Element Analysis for Genesis-D Discharge Module*

5.3 System Design

5.3.1 Rich Picture

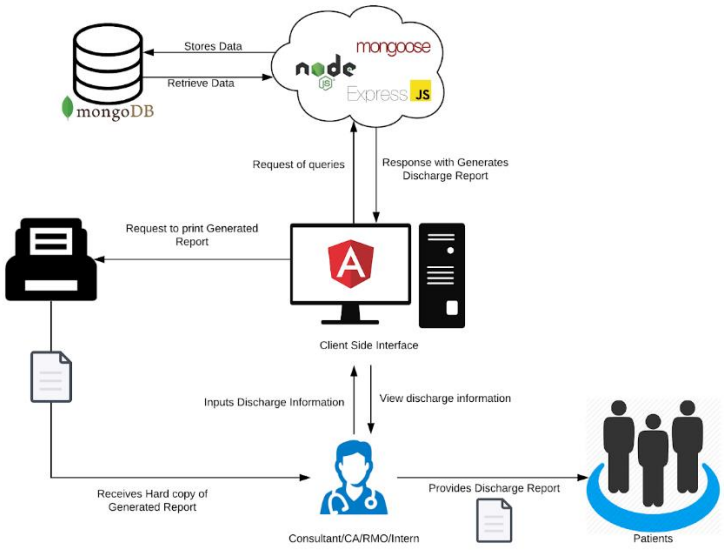
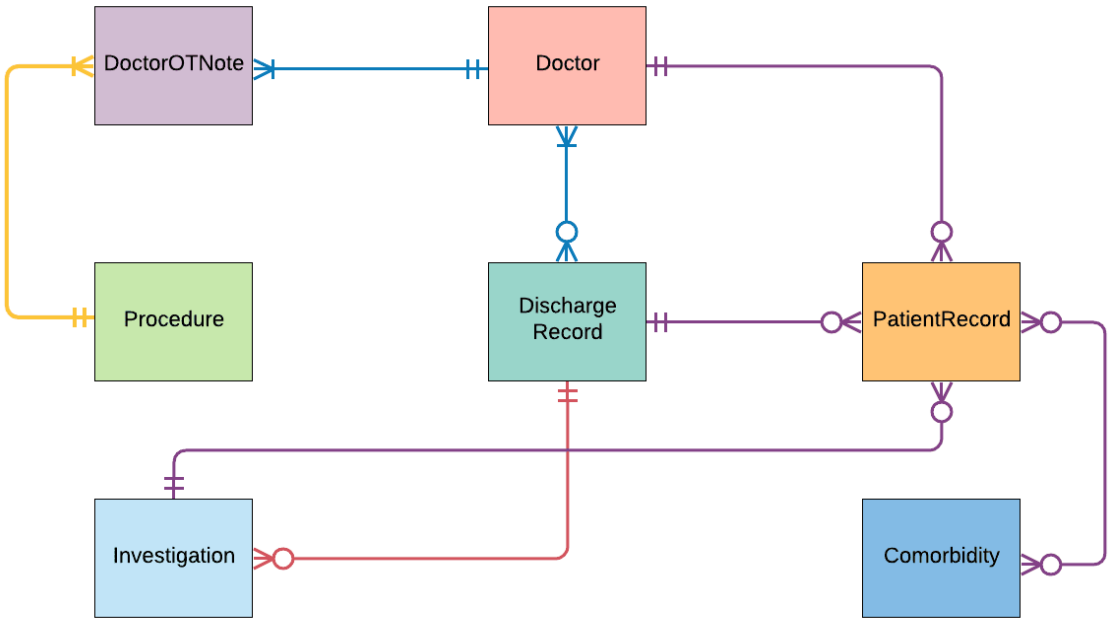


Figure 5.3: *Rich picture for Genesis-D Discharge Module*

5.3.2 Entity Relationship Diagram (ERD)



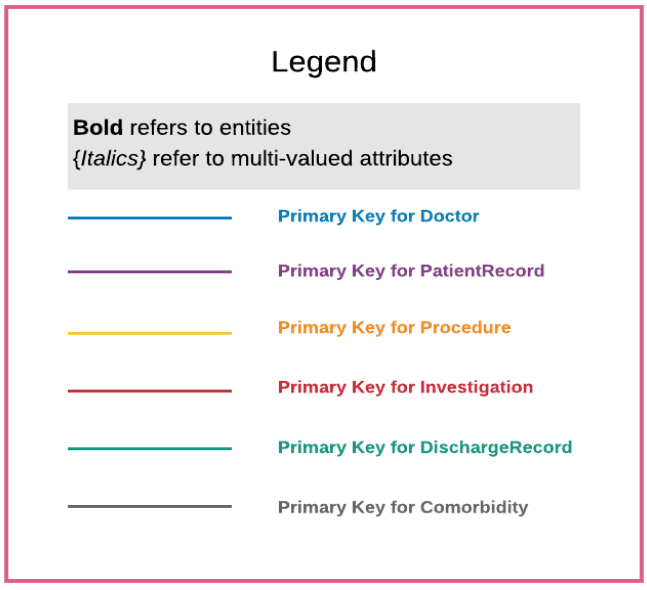


Figure 5.5: *Entity Relationship Diagram for Genesis-D Discharge Module*

PatientRecord		
patient_id	Primary Key/Medical Record Number	String
patient_name	Patient Name	String
dob	Date of Birth	Date
sex	Gender	String
phone_number	Contact	String
address	Address	String

Doctor		
doctor_id	Primary Key	String
patient_id	Foreign Key	String
username	User's Name	String
password	Password	String
email	E-mail	String
created_at	Date of creation	Date
updated_at	Date Last Modified	Date
dept	Department	String

Investigation		
inv_name	Primary Key	String
patient_id	Foreign Key	String
{test_fields}	*Field Names (Multi-valued)*	*Object (Map)*
{field_units}	*Field Units (Multi-valued)*	*Object (Map)*
{result}	*Result Values (Multi-valued)*	*Object (Map)*
inv_date	Investigation Date	Date

Comorbidity		
com_id	Primary Key	String
patient_id	Foreign Key	String
com_name	Comorbidity Name	String

DischargeRecord		
dischage_id	Primary Key	String
patient_id	Foreign Key	String
investigation_id	Foreign Key	String
doctor_id	Foreign Key	String
dept	Department Name	String
admit_id	Admission ID	String
discharge_type	Discharge Type (Radio)	Object (Map)
doa	Date of Admission	Date
dod	Date of Discharge	Date
bed_num	Date of Creation	String
ward	Ward (Radio)	Object
final_diagnosis	Diagnosis Name	String
{surgery_history}	History	Object (Map)
symptoms	Indication	Object
surgeon_name	Surgeon Name	String
anaesthesia	Anaesthesia (Drop-Down)	Object (Map)
anaesthetist	Anaesthetist	String
complications	Complications	String
medicine_dose	Medicine Name + Dosage Amount	String
dose_frequency	Times during day to take meds	Object (Bangla)
duration	Suggested length of taking meds	Object (Bangla)
med_instructions	Medicine Instructions (Drop-Down)	String (Bilingual)
additional_instructions	Additional Instructions	String
advice	General Advice	String (Bangla)
followup_date	Follow Up Date	Date
followup	Followup Advice (Drop-Down)	Object (Bilingual)

DoctorOTNote		
doctor_id	Foreign Key	String
procedure_id	Foreign Key	String
{OT_note}	*OT Note*	*String*

Procedure		
procedure_id	Primary Key	String
procedure_name	Procedure Name	String
procedure_date	Procedure Date	Date

5.3.3 Functional and Non-Functional Requirements

The functional goals of the proposed system aims to tackle the following:

1. Providing basic functionality of the web application from v1.1.0. This includes the ability to Create, Read, Edit and Delete(CRUD functionality) for the user, namely the ability to:
    a. Create or generate reports.
    b. Read reports.
    c. Edit or update reports and/or drafts.
    d. Delete incomplete reports or drafts.
2. Data sharing.
3. Data Analytics.

Details regarding the input fields used are provided in Appendix A: Functional Requirement Details

1. Generate Discharge Report

Priority: High
Section Name: Generate Discharge Report
Pre-conditions:
User must be logged in
Input:
To generate a discharge report, user has to input data of the following forms:

1. Patient details
2. Investigation and procedure
3. Investigation Details (All selected investigation)
4. OT note
5. Treatment

6. Advice and Follow Ups

Activities:
Generate a discharge report
Output:
Generated discharge report
Alternate action:
View discharge history, resume report, view stats, update procedure, update account settings or sign out
Post condition:
Print, Cancel or save the progress of the discharge report

2. Report Drafts

Priority: High
Section Name: Report Drafts
Pre-conditions:
User must be logged in
Input:
Select report from the list of draft reports
Output:
Resume generating the selected report or Delete draft
Alternate Actions:
View history, create new report, view stats, update procedure, update account settings or sign out
Post Conditions:
Print, Cancel or save the progress of the report

3. View Discharge History

Priority: High
Section Name: View Discharge History
Pre-Conditions:
User must be logged in and have the permission to view discharge history
Input:
1. Select discharge history
2. Click on the name of any column to sort the list in ascending/descending order

Output:
View a list of discharge reports sorted according to the selected order
Alternate Actions:
Resume report, create new report, view stats, update procedure update settings or sign out
Post Conditions:
Print list of report or go back to Dashboard

4. Update Procedure Details

Priority: High
Section Name: Update Procedure Details
Pre-Conditions:

User must be logged in and have the permission to edit procedure details

Input:

1. Select an existing procedure or create a new one
2. Select any of the fields to update:

a. Name of the procedure
b. OT Note
c. Treatment(With Bangla language support)
d. Advice(With Bangla language support)

Output:

Updated procedure details

Alternate Actions:

Resume report, create new discharge report, view stats, view history, update settings or sign out

Post Conditions:

Update an existing procedure or create a new procedure

5. View Stats

Priority: Low

Section Name: View Stats

Pre-Conditions:

User must be logged in and must have permission to view statistics

Input:

Select parameters and type to generate a graph

Output:

View graphs and stats based on the selected type and parameters

Alternate Actions:

Resume report, create new discharge report, view discharge history, update account settings or sign out

Post Conditions:

Print stats or go back to dashboard

Remark:

This section is given a low priority as a result of its implementation plan being scheduled for v1.3.0. For details regarding the 'View Stats' section, which will be mainly aimed at enabling an exploratory view of medical and hospital data through analytics(from heat maps to statistical tools for better hospital resource management), please refer to the Project Proposal documentation.

6. Login

Priority: High

Section Name: Login

Pre-condition:

Must have an existing account

Input:

ID, Password, User type

Output:

Dashboard (Landing page)

Post Conditions:

Select any of the section from the dashboard or log out

7. Sign Up

Priority: High

Section Name: Registration

Pre-condition:

Must receive a registration link

Input:

1. E-mail*
2. Password*
3. Name*
4. Phone number*
5. Role*
6. Address
7. Department
8. Consultant
9. Subspecialty

Output:

New user account

Post Condition:

Login using the same email and password

Non-functional requirements are briefly described of the project are listed and described below:

- **Performance:** It represents the performance of the system which is required to exhibit and to meet the needs of users. Performance describes the acceptable throughput rate and acceptable response time. This application should provide a smooth experience for the user and should have no input lag if the device has a certain minimum hardware specification.

- **Information:** represents the information that is pertinent to the users in terms of content, timeliness, accuracy, and format. Information is about the necessary inputs and outputs and how it will be managed, types of the required data to be stored, how currently the information will be saved into the system, how the interfaces of external systems will work, etc.

- **Security & Control:** Security and administrations are always a concern for any system. All information on the server side and client side is secured. Only the application administrators and developers have access to core code of the application to be able to directly manipulate any sort of information. In this project, node.js and express.js have been used for backend technology, which have various layers of security, where security requirements for this system have been taken care of. Control requirements represent the environment in which the system must operate, as well as the type and degree of security that must be provided. Access to the system or information must be controlled with the privacy requirements.

- **Efficiency:** This represents the system's ability to produce outputs with minimal waste. We have tried to eliminate duplicate steps in the processes and to use the resources in an efficient way. Keeping our code non repetitive by using reusable code and components is how we achieved efficiency.

- **Service:** represent needs to make the system reliable, flexible, and expandable. It is deals with:

    - Who will use the system and where they are located?
    - How many types of users will be in this system?
    - The appropriate human factors.
    - What training materials will be included in the system?
    - Reliability/availability requirements
    - How the system will be distributed
    - What types documentation is required?

- **Extensibility and Maintainability Requirements:** There is one standard user interface designed for the look and feel of the application. The application can be expanded to

Accommodate many further modules without making any changes to any existing modules. The application is created in such a way that the developers can easily maintain both the server and client sides.

5.4 Product Features

5.4.1 Input

*The input of the system has been defined on Chapter 5: Body of the Project; **Functional Requirements** and we can see the view of the input on Chapter 6: Result Analysis.*

5.4.2 Output

*The output of the system has been defined on Chapter 5: Body of the Project; **Functional Requirements** and we can see the view of the input on Chapter 6: Result Analysis.*

5.4.3 Architecture of the System:

Software architecture is what characterizes and structures a solution that meets specialized and operational necessities. Software architecture upgrades credits including a progression of choices, for example, security, execution, and sensibility. It depicts the association and cooperation of software segments. There are many types of architecture that are used among them. The **client server architecture** is one of them which was used for the "Genesis-D Discharge Module" Web application. To make the UI code easier to maintain and test **MVC (Model View Controller)** pattern was used.

5.4.3.1 Client Server Architecture

Client–server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server host runs one or more server programs, which share their resources with clients. A client does not share any of its resources, but it requests content or service from a server. Clients, therefore, initiate communication sessions with servers, which await incoming requests. Examples of computer applications that use the client-server model are email, network printing, and the World Wide Web. [12]

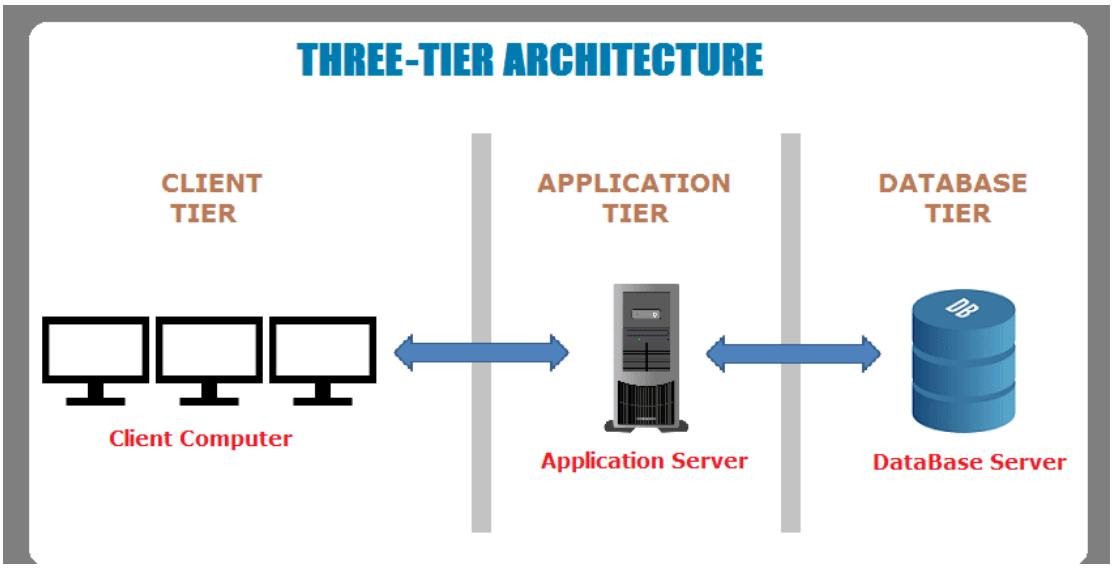


Figure 5.4.1: *3-tier Client Server Architecture*

In "Genesis-D Discharge Module", each client computer accessing their browsers (Google Chrome, Mozilla Firefox, Safari, etc.) is a client that will have access to the application via an application server. Upon interacting with the application to perform CRUD activities, the server accesses the Database server (Atlas MongoDB) and updates the data accordingly.

5.4.3.2 MVC (Model View Controller) pattern

MVC is a design pattern for structuring user interface code. It is a pattern followed in the application code of the project. When the MVC pattern is used a larger portion of the UI code can be unit tested. MVC architecture is triangular: the view sends updates to the controller, the controller updates the model, and the view gets updated directly from the model.

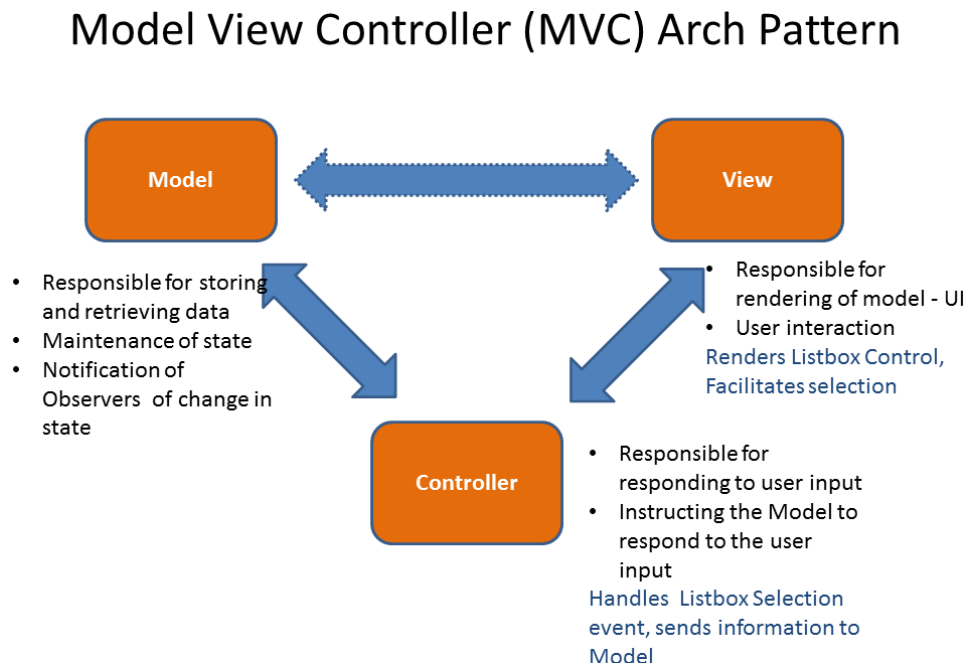


Figure 5.4.2: *Model - View - Controller (MVC) Pattern*

In "Genesis-D Discharge Module", the MVC architectural pattern was implemented. Angular was used in the View (Client side), the server contains routes and controllers, and the mongoose models contain the business logic in the model part.

Chapter 6

Result and Analysis

As previously mentioned in Chapter 3, the application Genesis-D Discharge Module, is a full stack application developed using a full JavaScript stack called the MEAN stack, consisting of: MongoDB, Express, Angular and Node.js. The stack is designed to make the development process smoother and easier. The four technologies provide an end-to-end framework for developers to be able to develop web applications.

This chapter contains screenshots of the application after development.

- Login Page: This is the landing page for users to log in from

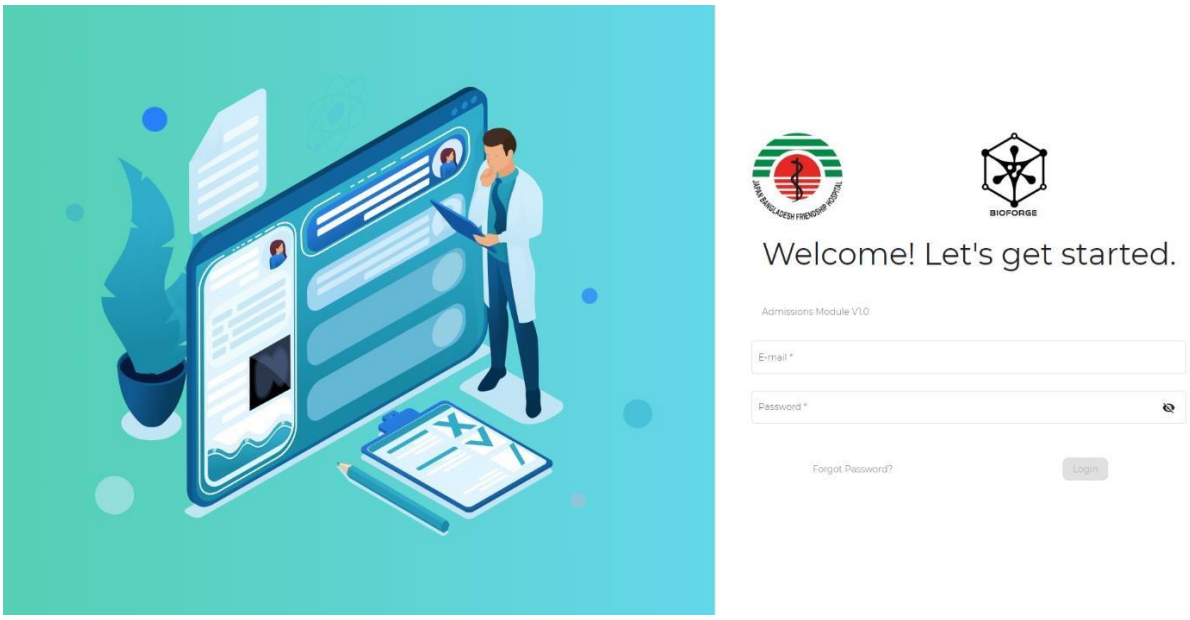


Figure 6.1: *Screen View of Login Page*

- Dashboard: This is where users will be able to choose with which modules, they are going to be using

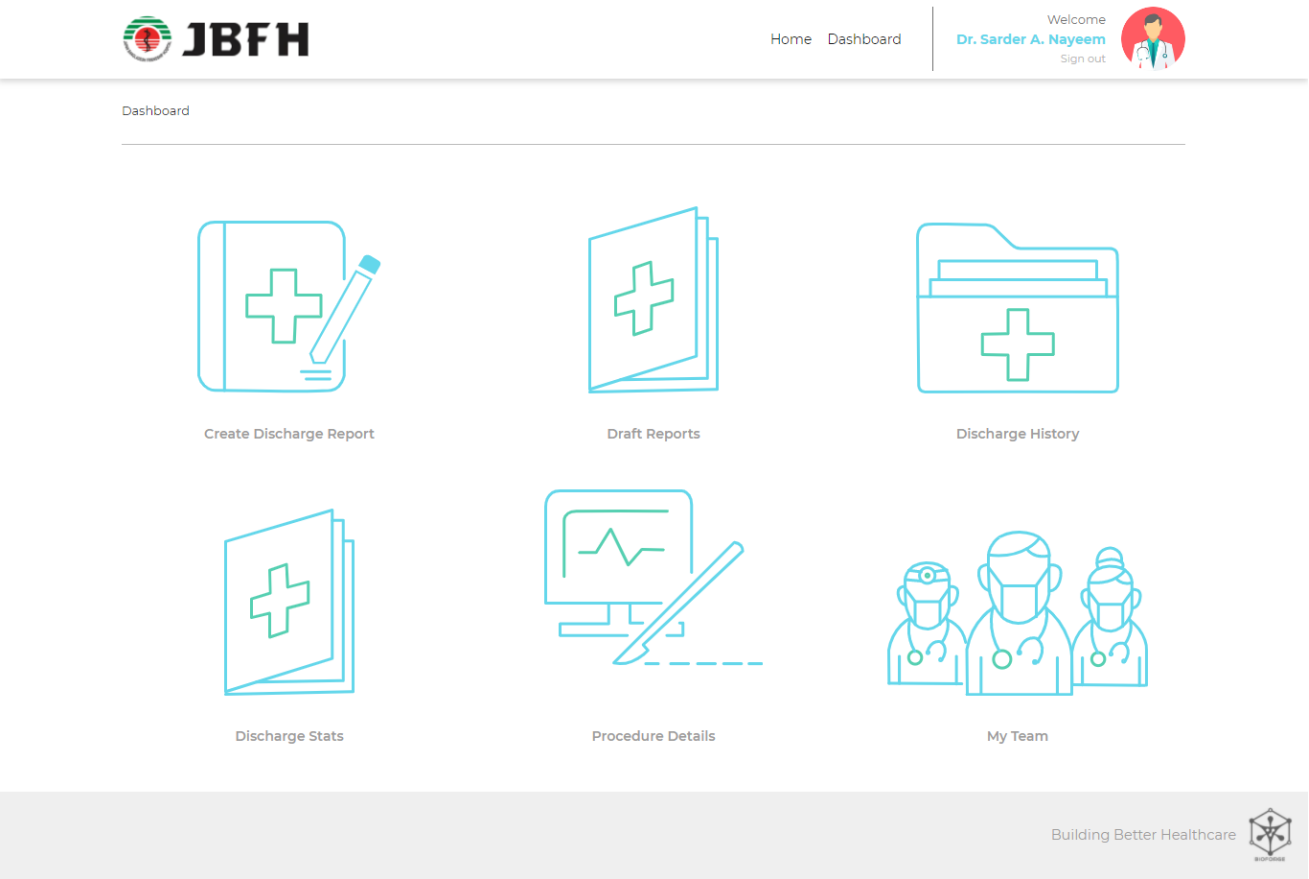


Figure 6.2: *Screen view of Dashboard*

- Create Discharge Report: There are a total of 7 steps to create a discharge report.

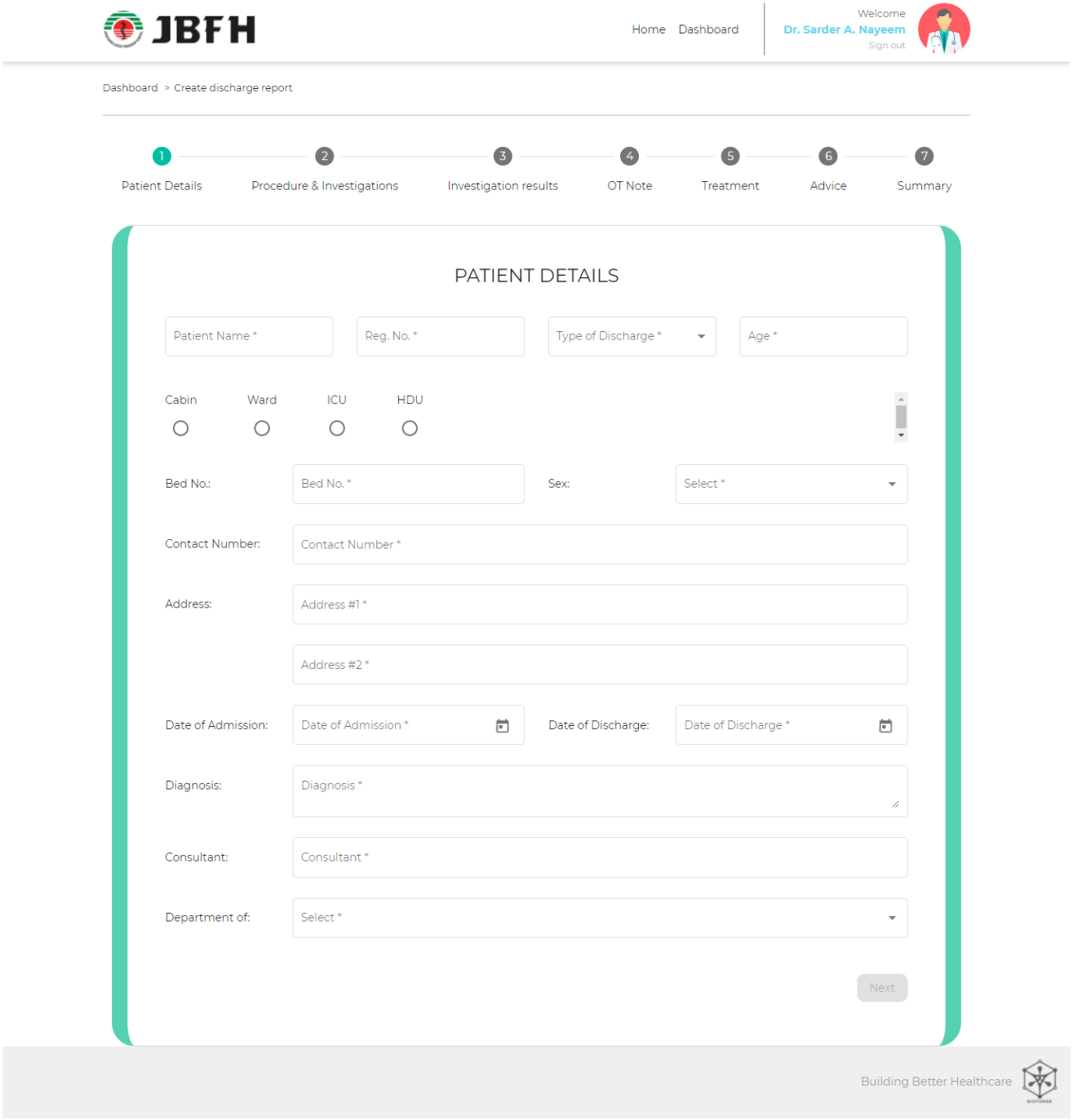


Figure 6.3: *Screen view of Step 01*

- Discharge Summary: This is where all the inputted values will be shown as an output and the user will be able to download it as a PDF.

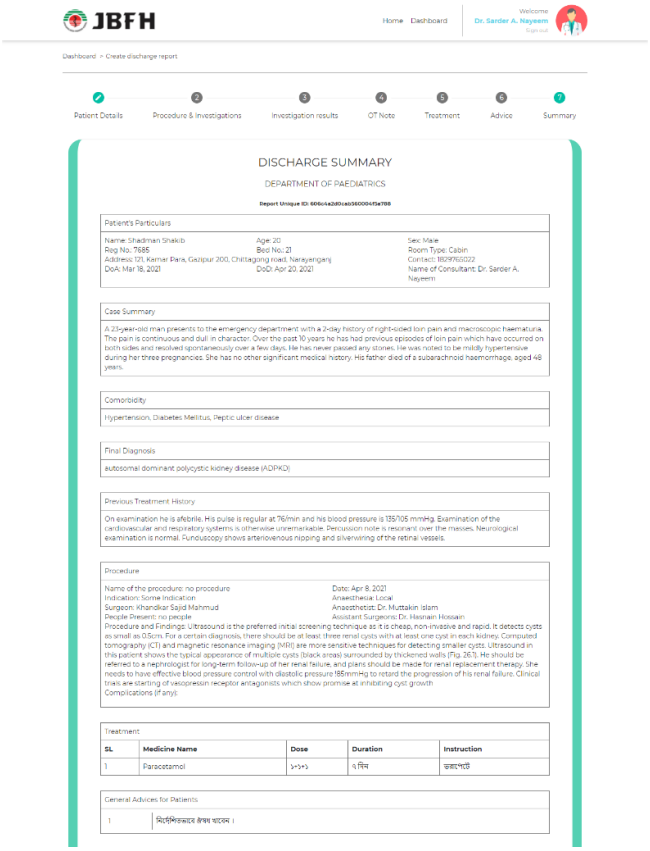


Figure 6.5: *Screen View of Discharge Summary*

Draft Reports:

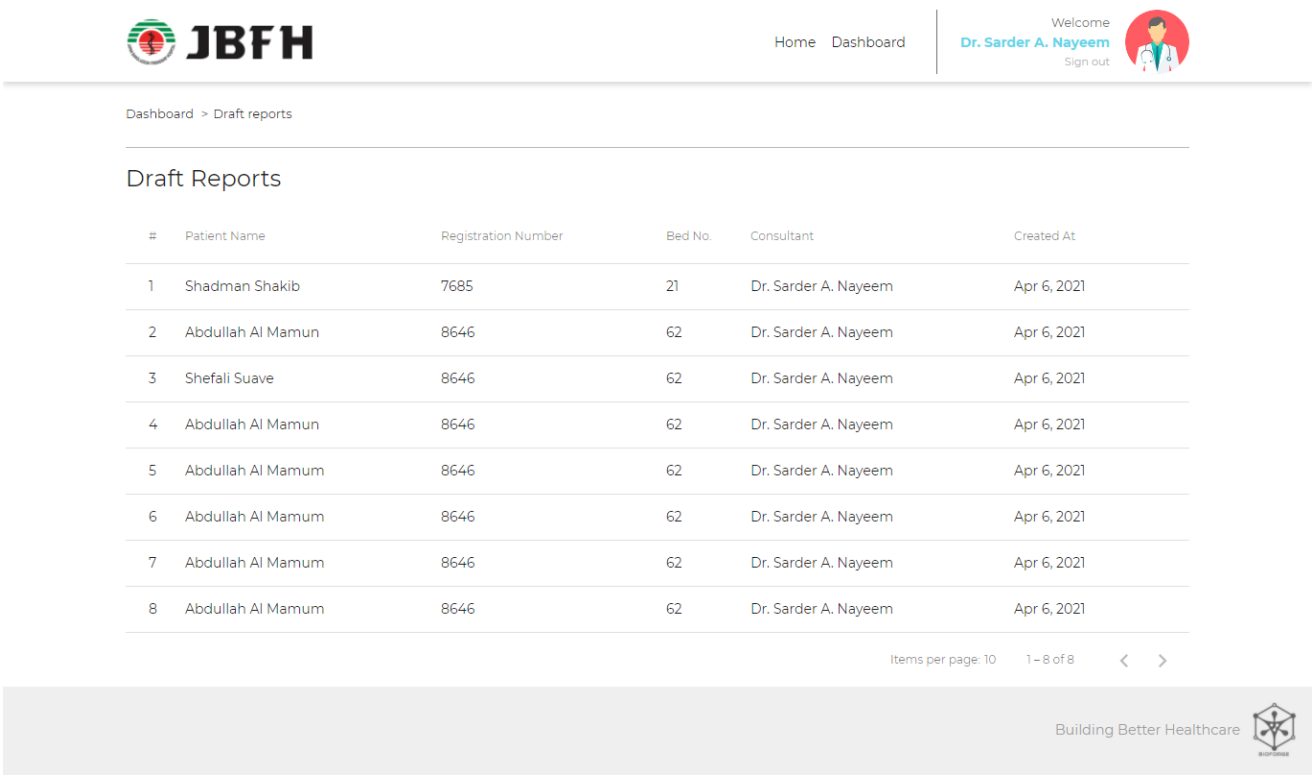


Figure 6.6: *Screen View of Draft Reports*

Discharge History:

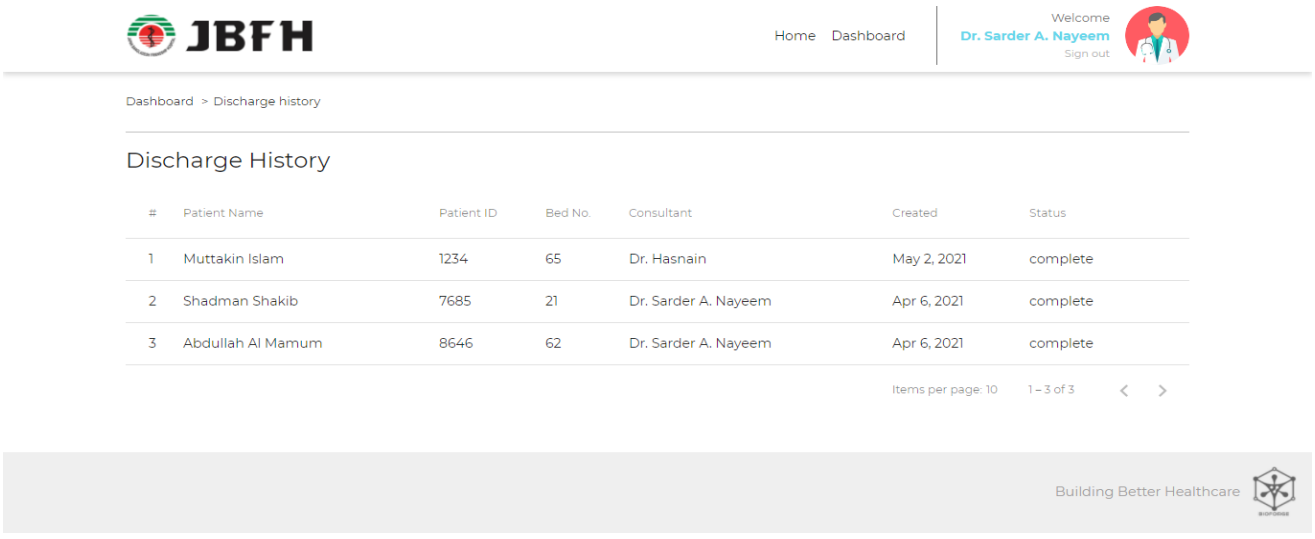


Figure 6.5: *Screen View of Discharge History*

Chapter 7

Project as engineering problem analysis

7.1 Sustainability of the product/work

Sustainability of the product refers to its ability to be maintained and updated. In the modern world, every application being released needs to be maintained and continuously updated for its user base.

A product can be sustainable in three main categories:

- **Community Sustainability:** This type of support comes in many forms such as downloading and installing the application, using the application, subscribing to paid services, feedback and referring to other people etc. After the deployment and official release of the application Genesis-D Discharge Module, it is believed that it will have a strong user base since the target audience for the application is specifically narrow and concise. We can expect the users to refer to other hospitals regarding the application and thus growing the user base. With a growing user base, it will also grow a community and hence it can be said that it is Sustainable in terms of Community.

- **Financial Sustainability:** This refers to how the application's running cost will be maintained after it has been released and whether it will generate enough revenue as acceptable profit. An application's running cost includes - server cost, database storage cost, third party API cost, etc. The initial release of Genesis-D Discharge Module will have a small development fee to use but as the user base grows there are plans to introduce new premium services which will eventually be used to generate revenue.

- **Organizational Sustainability:** It relates to how the organization will continue to operate after the release of the application. After the release of an application, usually the organization maintains the application via its current team, an extended team or by a fresh new team. Also, organizations update their project by adding newer features to it and organization may pivot to other projects, expand the teams, create new teams, etc. Genesis-D Discharge Module has many more features planned for the future to be worked on and released. Since the application has further plans, the project will be maintained and updated after its release as well and release premium services to it. In conclusion, it can be said that the project is Organizationally Sustainable.

7.2 Social and Environmental effects and analysis

Social Effect:

Genesis-D Discharge Module aims to get more hospitals interested in an efficient and data-oriented Discharge process which develops an ease to use virtual applications where they can speed up the paperwork process and focus more on the treatment side of things.

Environmental effect:

The hospitals here in Bangladesh still have a long way to go in regard to getting with the time and using technology for their advantage. As future iterations of the module start rolling out the company hopes to build an eco-system where all applications merge to create a one system which the hospital staff and doctors will be using without any hesitation thus furthering the growth inside the medical industry here in Bangladesh.

7.3 Addressing Ethics and ethical issues:

Ethics and Ethical issues

In the world of smartphones with so much data collection, hacking, cybercrime, etc. there are some unspoken rules and ethics guidelines that need to be followed when working on creating and releasing an application. The developers of Genesis-D Discharge Module believe that the application does not breach any code of conduct of application release and development since they all have been taken into serious concern. Some of them are:

- Collecting only relevant User data: The app does collect user data, but those are strictly and only relevant for the app. The only data that is being collected are the number of patients being admitted and hospital relevant queries.
- Not Sharing or Selling any User data: Even though the data collected may not be of any privacy concern for most users, the app does not let any service, any application or any third party have access to the data collected.
- Data Storage Security: Only the lead developer and the owner of Genesis-D Discharge Module has access to the server and the database. Since they are hosted in the cloud and can only be accessed via lead developer's and the owner's login credentials; the data stored can be deemed as safe and secure.
- Proper use of third-party services and API: Genesis-D Discharge Module does not violate any rules of the third-party services or the APIs that have been used in its development.
- No Discrimination or Favoritism: Genesis-D Discharge Module does not discriminate

of any kind based on race, sexuality, gender, religious beliefs, color, language, political or other opinion, national or social origin, property, birth, or other status.

- Clear Promotion: Genesis-D Discharge Module only intends to promote the company that created it, itself, and people's health. Other than what has been mentioned, Genesis-D Discharge Module has no intention of promoting anything or anybody else.

Chapter 8

Lesson Learned

8.1 Problems Faced During this Period

In the midst of my internship here with Bioforge Health Systems Limited there were a few obstacles which I had to face and overcome:

- **The Global Pandemic:** Even though almost a whole year had gone by for the pandemic, the norms were still very disruptive during daily procedures. Due to the lockdown almost, every member had been working from home and therefore many aspects lacked communication in the beginning however with routine changes and different protocols being set like regular meetings, pair programming and issue reporting, we got into a new normal to work in with which we picked up our productivity gradually.

- **Working on code written by others:** As a programmer who has always been solving problems from scratch, having other applications being handed over and expected to solve existing issues was new to me. It was a learning experience which may have taken me quite some time however my mentors and peers have helped and guided me through being able to learn quickly and surely.

8.2 Solution of those Problems

As a solution to the lack of interaction within team members, we have been working on Discord servers during this period. We would be on voice channels during the entire work hours (10pm-6pm). We learned to do pair programming while sharing the screen and collaborated through GitHub.

While working on other developer's codes, I understood the importance of documentation and meaningful commit messages. We as a team make sure everyone is aware of even the smallest changes made to the code. We have project boards linked to the repositories on GitHub where we keep updating a list of bugs/features we are working on. This makes understanding the state of the codebase easier for the current and future members of the team.

Chapter 9

Future Work and Conclusion

9.1 Future Work

The project Genesis-D Discharge Module will have a few more iterations in the future which may include features like:

- Integration with other Modules
- Custom Roles and Permission

9.2 Conclusion

It was a wonderful experience working with the Bioforge family as an intern. During the internship period I have learnt and applied a great deal of knowledge from my university courses and experience here. I was introduced to new cutting-edge technologies like Angular, Node.js and Express.js. I have learned a lot about developing different kinds of applications also about various development styles. I was pushed to adapt to changes rapidly and come up with logical solutions. During my project, I cooperated with my mentors and seniors to solve the challenges faced. Despite their workload, my supervisors were always there to answer any queries and help me settle nicely. This internship opportunity has paved the way to investigate the development environment and marketplace. I would like to appreciate once again everyone who has made my life as an intern such a great experience.

Bibliography

1. Lærum, Hallvard, et al. “Use of and Attitudes to a Hospital Information System by Medical Secretaries, Nurses and Physicians Deprived of the Paper-Based Medical Record: A Case Report.” BMC Medical Informatics and Decision Making, vol. 4, no. 1, Oct. 2004, p. 18. Springer Link, doi:10.1186/1472-6947-4-18.
2. “Best Hospital Management System in Bangladesh - Smart Software Ltd.” Best Hospital Management System in Bangladesh - Smart Software Ltd., https://www.smartsoftware.com.bd/hospital-management. Accessed 20 Jan. 2021.
3. 3. Millennium Heart & General Hospital Ltd. http://millenniumhospitalbd.com/. Accessed 20 Jan. 2021.
4. “Client–Server Model.” Wikipedia, 19 Jan. 2021. Wikipedia, https://en.wikipedia.org/w/index.php?title=Client%E2%80%93server_model&oldid=1001393187