HSB- A Next Gen Hemophilia Patient Care System with Smart Card

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FINAL YEAR DESIGN PROJECT REPORT

This Report Presented in Partial Fulfillment of the Requirements for the **Degree of Bachelor of Science in Computer Science and Engineering**

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APPROVAL

This Project titled **"HSB- A Next Gen Hemophilia Patient Care System With Smart Card"**, submitted by Binty Rani Mitra, ID No: **213-15-4570** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **16 September, 2025**.

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We hereby declare that this project has been done by us under the supervision of **Hasnur Jahan**, **Lecturer** Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this projectnor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

People with Hemophilia in Bangladesh have been encountering difficulties for quite a way because there has not been any single digitalized health care system in place for catering to the needs of this group of people. HSB - A Next-Gen Hemophilia Patient Care System with Smart Cards bridges this essential gap, and presents a novel and all-inclusive online platform for the Hemophilia Society of Bangladesh (HSB), which is a WFH-affiliated National Member Organization (NMO). This solution combines access to emergency prescriptions, patient smart cards, injection locator services based on location services; creations that aimed to improve treatment access and data flow as well as patient empowerment. It built with HTML5, Tailwind CSS, Javascript. Firebase Realtime Database, Leaflet.js the solution facilitates real-time patient monitoring, automatic prescription delivery and doctor's signatures and QR-based ID verification. One thing that is new is the “Factor Near You” locator, a map that can help patients find factor available to them nearby. It allows for administrators to track patient sign-ups, view use of factor, capture subscription fees and generate reports, and for patients to use a personalized dashboard and educational resources. The application also has a live news feed, this is maintained by HSB to provide up to date information. This ground-breaking project is the first national digital infrastructure for Hemophilia care in Bangladesh, greatly accelerating emergency response, facilitating administrative operations, and serving as a launching pad for further telemedicine.

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Chapter 1

Introduction

This chapter presents the context of the problem, the motivation to develop the system, its goals, methods employed, the goals to be achieved and the report's structure. The purpose here is to provide a clear sense of what the project sets out to do.

1.1 Introduction

Hemophilia is an uncommon and complicated bleeding disorder which is difficult to be diagnosed and treated effectively, when the body lacks of necessary clotting factors to clot properly [2]. Patients with Hemophilia across Bangladesh have long been deprived of centralized digital platform for patient care, delay in treatment, unavailability of real-time data and lack of proper management of medical resources [4]. The Hemophilia Society of Bangladesh (HSB), a National Member Organization (NMO) of the World Federation of Hemophilia (WFH) [5], currently does not have any system that consolidates patient, medication, emergency prescription or patient education information [4]. Over 4,000 registered patients of hemophilia in Bangladesh are depending on the Hemophilia Society of Bangladesh (HSB) for treatment, assistance, and hope [4]. HSB-A Next-Gen Hemophilia Patient Care System with Smart Cards, the goal of HSB that I'm proposing a full service, web based digital platform which aims to revolutionize and optimize the existing pen paper processes of Hemophilia management by offering a comprehensive web-based digital platform for effective real-time Hemophilia care management in Bangladesh. Not only for Bangladeshi hemophilia patient but also helpful for world-wide hemophilia patient care and management as well.

1.2 Motivation

The main focus for the project is the unmet clinical need that is a life-threatening one on thousands of Hemophilia patients, which is the delayed access to the treatment without having a robust and digital access infrastructure. During emergencies, many patients (or their family members) who have factor and who are able to inject are not treated because they do not have a valid prescription, with potentially life-threatening or life-ending consequences [6]. In addition, there is no

mechanism to find the nearest available factor injections or to be informed about bleeding disorders to patients and public now [4]. From a technical and computational point of view, this is a chance to use real-time data management, interactive maps, identification systems based on QR codes and PDF report generation to build a digital solution with a concrete impact on society. Being able to solve this problem would make a huge difference to the Hemophilia society and prove that modern web technologies have the potential to make healthcare in resource poor settings course-changing. Well organized and factually accurate patient information reports may well help Hemophilia Society of Bangladesh to get grants from the government and from other organizations.

1.3 Objectives

The key objectives of the project are:

1. Design and implement a centralized web-based patient care system for Hemophilia Society of Bangladesh.
2. To utilize a smart card system for patient identification and verification, utilizing QR codes.
3. To issue an emergency prescription and produce a PDF file valid by 24 hours.
4. Add a map-based "Factor Near You" function to find injections nearby.
5. For the integration of patient registration, factor usage tracking, fee collection and generate utilization report instantly from an admin panel.
6. Building a secure patient portal with access to smartcards and medical history.
7. To create an interactive, admin accessible news section that will keep users up to date with upcoming events and services.

1.4 Methodology

The project was built on top of a modern technology stack: HTML5, Tailwind CSS, JavaScript (ES6+), Firebase Realtime Database and various assisting libraries like jsPDF, html2canvas, QRCode.js, Lucide Icons, and Leaflet.js. Programming was carried out with the Visual Studio Code (VS Code) editor, and version control was handled by GitHub. Under the hood, we used the Firebase libraries for accessing data in real-time. Image data was processed through ImgBB API and location-based features were provided by Google Maps and Leaflet. The architecture of this system

consists of patient management, emergency services, map services, education and administration control modules. We focused on responsive design, user security, and accessibility in English as well as Bangla.

1.5 Project Outcome

This project will achieve the following outcomes:

1. Digitally enable operations of the Hemophilia Society of Bangladesh.
2. Provide timely access to authorized treatment with emergency prescriptions for hemophilia patient in Bangladesh.
3. Let patients find factor injections in real time and tap local donors.
4. Deliver a robust, secure, smart card-based identity infrastructure for global use by citizens.
5. Streamline operational processes for registration, monitoring, and reporting.
6. Enhancing patient information and public awareness through interactive education.
7. Act as a best practice at the national level of Hemophilia digitization, and may be replicated in other medical fields or countries.

1.6 Organization of the Report

The report is divided into six chapters, each focusing on an element of the process for creating and deploying the HSB - A Next-Gen Hemophilia Patient Care System. The arrangement is intended to begin at a reasonable level of problem statement and carry through to system realization and eventual analysis, standard adherence, and conclusions.

Chapter 1 Introduction: Present the general context of the project Background, motivation, objectives, methodology, expected results Present the structure of the report

Chapter 2 Background: Background information on Hemophilia and healthcare scenario in Bangladesh. This also has a comprehensive literature review of all systems available worldwide, compares it with similar products, conducts a gap analysis, so as to explain where this project fits in.

Chapter 3 Research Methodology: Describes need analysis and design specifications. It covers system design, including functional, non-functional requirements, data flow diagrams, user interface design, detailed development methodology, project planning and task allocation.

Chapter 4 Implementation and Results: Technical setup and development environment are described. It describes approaches to testing, performance assessment and a results discussion from a deployed system.

Chapter 5 Engineering Standards and Design Challenges: Investigates the extent to which the system conforms to accepted software, hardware, and communication system standards. The study also investigates social, environmental and ethical influences, elaborates the sustainability construction plan, addresses the inherent complex engineering problems and supports the project management; with financial concerns within scope.

Chapter 6 Conclusion: Summarize the main outputs and deliverables of the project. It also covers the present limitations of the system and the prospective directions for further development and feature extension.

Chapter 2

Background

This chapter gives the necessary background information in order to comprehend the motivation, the scope, and the impact of the proposed system. It includes Burden of hemophilia care in Bangladesh Discussion of related systems Gaps identified Summary

2.1 Introduction

Hemophilia is a rare bleeding disorder that is usually passed down genetically and where blood does not clot as it should due to loss or lack of one of the blood clotting factors, most commonly Factor VIII (Hemophilia A) or Factor IX (Hemophilia B) [1]. Since it is a chronic disorder, ongoing medical care as well as urgent care for bleeds are needed. According to the World Federation of Hemophilia (WFH) prevalence is more than 465,327 affected persons in the world, however, most of them remain undiagnosed or untreated especially in the developing countries [5]. The Hemophilia Society of Bangladesh (HSB) is the recognized National Member Organization (NMO) under WFH, in Bangladesh. HSB provides an essential service for over 4000 registered patients who count on this organizations care and support [4]. Nevertheless, HSB still does not have any integrated digital system for patient data, medication used with them, emergency procedures or alert campaigns. This void creates some very dangerous situations including delayed treatment, absence of an authorized prescription, the absence of a central database of patients life in danger, files and inadequate access to education – all of which can cost lives. Although digital health solutions are growing worldwide, in the case of Hemophilia, it is minimal especially in low resource countries such as Bangladesh. The proposed project seeks to fill that gap through the enhancement of an integrated web-based system targeting Hemophilia germ line carriers, caregivers, and HSB employees. The sections that follow review existing tools, enumerate their challenges, and describe how this solution addresses immediate, unmet needs.

2.2 Literature Review

This Table 2.2 offers a review of hemophilia related literature, research, and work world-wide. Overall, the literature review presents both global and local on hemophilia, providing the insights into the data sources, treatment consideration, clinical characteristics, and newer therapies. Chaccroboti et al. [1] pledged a publicly accessible dataset known as HemoData to carry out hemophiliac research in Bangladesh. Srivastava et al. [2] gave detailed international standards on standardized management and care of hemophilia. A recent clinical study by Islam et al. [3] showed demographic patterns and treatment issues experienced by moderate and severe hemophilia patients in Bangladesh, whereas the previous study by this group on children [5] showed complications and case outcomes among pediatric patients. Hoyer [4] created in-depth molecular and clinical overview of Hemophilia A that formed initial knowledge of the disease. Lastly, Mannucci [6] has discussed the history of hemophilia therapy, including the changes between plasma based factors and products with extended half-life, non-factor therapies, which include emicizumab , and emerging therapeutic modality, such as gene therapy.On the whole, the literature under consideration shows the desire of countries all over the world to standardize the treatment of hemophilia and to pay increasing attention to regional information and research tailored to the peculiarities of patients in Bangladesh. This type of literature promotes increased effectiveness of the healthcare interventions as they are case-sensitive.

Table 2.2: Summary of Literature Reviewed.

Author (s)	Year	Title	Methodology	Key Findings
D. Chaccroboti et al. [1]	2024	HemoData: A Comprehensive Dataset for Hemophilia	Dataset Publication	Introduced a public dataset to support Hemophilia research in Bangladesh.
A. Srivastava et al. [2]	2013	Guidelines for the Management of Hemophilia	Clinical Guidelines	Established standardized practices for Hemophilia treatment and care.
M. N. Islam et al. [3]	2022	Clinical Profile of Moderate and Severe Hemophilia	Clinical Study	Highlighted clinical challenges and demographics in Bangladeshi patients.

		Patients in BD		
L. W. Hoyer [4]	1994	Hemophilia A	Clinical Review	Defined molecular and clinical characteristics of Hemophilia A.
Islam et al. [5]	2016	Hemophilia in Children	Pediatric study	Focused on complications and case outcomes in Bangladeshi children.
P. M. Mannucci, [6].	2020	Hemophilia therapy: the future has begun	Centenary Review	Outlined advancements in Hemophilia treatment plasma derived factor therapy to extended half-life treatments, nonfactor drugs such as emicizumab, and the future directions such as the gene treatment.

2.2.1 Similar Applications

This Table 2.2.1 below show the similar application system of our HSB project as well. Internationally, there are some web applications are used for healthcare and hemophilia management, few of them however has provided tailored, real time activities and made for Bangladesh like contextuality. Provision of personal records or logistics documents for blood products ordered is already provided by the World Federation of Hemophilia (WFH) for patients with bleeding disorders through logistics and national member organization (NMO) management [6], but the WFH does not offer a universal patient-facing system for emergency logistics. Current website of Hemophilia Society of Bangladesh (HSB) has informal service where no provision for emergency prescription, patient data management etc are included [5]. Tools such as Steps for Living by NHF can provide useful educational resources to patients, although they do not implement treatment tracking or smart card systems [7]. In some hospital systems like CMC Vellore patients can access appointment

digitally and some of the records are digital, but it is not disease specific [8]. Local healthcare providers such as Popular Diagnostic Centre Ltd [9] and BRB Hospital Ltd [10] have online reports and appointment scheduling without any chronic disease management.

Table 2.2.1: Table of Similar Application

Application /System Name	Location	Purpose / Features
World Federation of Hemophilia (WFH) [8]	International	Logistics and NMO management for blood products
Hemophilia Society of Bangladesh (HSB) old v [7]	Bangladesh	Informal services, basic info management
Steps for Living (National Hemophilia Foundation - NHF) [9]	International (USA-based)	Educational resources for patients
CMC Vellore Hospital [10]	India	Digital appointment access, partial digital records
Popular Diagnostic Centre Ltd [11]	Bangladesh	Online reports, appointment scheduling
BRB Hospital Ltd [12]	Bangladesh	Online reports, appointment scheduling

The former mentioned HSB web system to date did not have smart card identification, emergency prescription generation, donor-based availability of factor using map, which are unique features of the proposed HSB web system thus it is country's first of its kind all-in-one care system for hemophilia patients.

2.3 Gap Analysis

This Table 2.3 is showing the empty spaces identified when reviewing current systems and platforms providing support to patients with hemophilia and healthcare service provision. The comparison indicates that there are few and limited features that can be offered on these platforms. As an example, the materials are assisted by the WFH Platform [8] and NHF Steps for Living [9], Moreover, the only system that

provides patient registration and database management is Popular Diagnostic Ltd. [11]. Nevertheless, none of the current platforms offer such necessary features as the emergency prescription generation, the factor injection availability mapping, role-based access, real-time monitoring, or smart card integration. Conversely, the Proposed HSB system addresses these gaps by making all the key features integrated into a single platform to make sure that the healthcare system is more comprehensive, patient-centered, and technologically superior.

Table 2.3: Gap analysis among existing systems

Features	WFH Platform[8]	HSB Website [7]	NHF Steps for Living[9]	CMC Vellore Portal[10]	Popular Diagnostic Ltd[11]	Proposed HSB System
Patient Registration & Database	No	No	No	Yes	No	Yes
Emergency Prescription Generator	No	No	No	No	No	Yes
Factor Injection Availability Map	No	No	No	No	No	Yes
Smart Card with QR Code	No	No	No	No	No	Yes
Patient Portal for Individual Access	No	No	No	No	No	Yes
Role-Based Admin & Officer Access	No	No	No	No	No	Yes
Real-Time Monitoring & Reporting	No	No	No	No	No	Yes

2.4 Summary

This chapter laid out the necessary groundwork to grasp the emergence of the HSB – A Next-Gen Hemophilia Patient Care System. It explored the related literature, compared existing similar systems, and presented the current local and international cases. The

results confirm that there is partial support for education or basic care management for hemophilia patients in Bangladesh from some global as well as regional systems but none of these address a real-time, emergency, and identity-based solution for this disorder. Sensitivity analysis shows there is a particularly strong potential for new system innovation as the gap between the theoretical ideal and what can be achieved is wide and the successful HSB innovation that aims at emergency prescription generation, smart cards, factor availability mapping.

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Chapter 3

Research Methodology

In this chapter, we discussed how the proposed system would be implemented for the Blood Centre of the Hemophilia Society of Bangladesh (HSB), which included Designing, Requirements, DFD and UI Design. This SDLC guided approach helped and paved way to a highly scalable, efficient, and patient focused secure web platform.

3.1 Requirement Analysis & Design Specification

3.1.1 Overview

For the purpose of satisfying patients, administrators, and medical officers, we applied the SDLC (Software Development Life Cycle) model. This model established a framework for continued development, with a focus on the planning, designing, development, testing and maintenance of the system. We adopted an iterative development process which would successively develop modules in cycles, test at an early stage and refine based on feedback from the stakeholders. I have been used Modern technology for developing this project like HTML5, The major phases included:

1. Requirement Analysis
2. System Design
3. Implementation
4. Testing
5. Deployment
6. Maintenance

For making this project I have followed Iterative model (figure:3.1.1) because it enabled development to take place in small cycles with constant improvement. The initial features of the system including patient data entry, smart cards based on the QR codes and emergency prescriptions were included. Functionality, addition of donor management and Bengali font support was enhanced after each cycle via testing and user feedback given by HSB officers and mock patients.

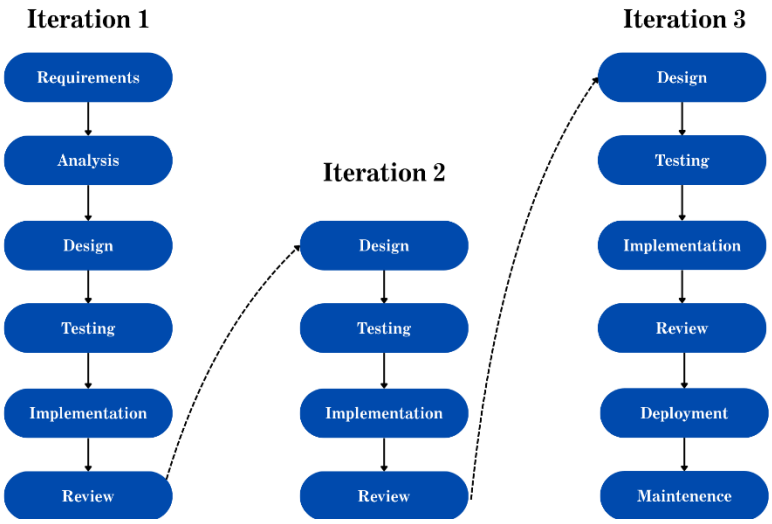


Figure 3.1.1: Iterative model diagram

This project frontend was built with HTML5 for the structure, CSS3 for the design and Javascript (ES6+) for the interaction on the client-side. Tailwind CSS was chosen for productive design and Lucide Icons for scalable UI icons. For advanced functionalities, html2canvas converted DOM elements into images, jsPDF created downloadable PDFs, and QRCode js generated patient smart card QR codes. Project includes Google Fonts – Noto Sans Bengali; and follows modern design practices like responsive designs with Tailwind CSS classes, CSS transition module for animations. On the backend, Firebase offered scalable services with firebase-app (setup) and firebase-database (real-time data storage) modules. Its aim was to create an innovative medical system at a minimal cost which is user-friendly and responsive to all the stakeholders via contemporary technology and the SDLC approach.

3.1.2 System Design

System design & implementation process Diagram: This diagram 3.1.2 showing overall designing and implementation process from first to last. The figure demonstrates a systematic method to create the HSB digital platform of Hemophilia care in Bangladesh. It starts with identification of the problem (lack of digitalization in Hemophilia care) and involves the stakeholders (both HSB officers and patients) to collect the requirements. The design stage is aimed at the creation of the HSB Admin Panel that will combine a variety of modules, including patient database management (Firebase), registration of new patients, monitoring factor utilization, managing subscription fee, granting individual patient access, and creating smart cards. These

modules are connected to the Patient Portal, which provides such functions as emergency prescription, factor availability map, virtual smart cards, map of factor history, and subscription fee history.

The system is then connected with a public site where simple information, news, and online education is available to Hemophilia patients. The last stage is testing and deployment, which entails the system being functional, secure and user friendly. In general, the design focuses on a patient easy to use, modular, and integrated solution, which unites administration, patient management, and dissemination of information to the population in a single, integrated digital ecosystem.

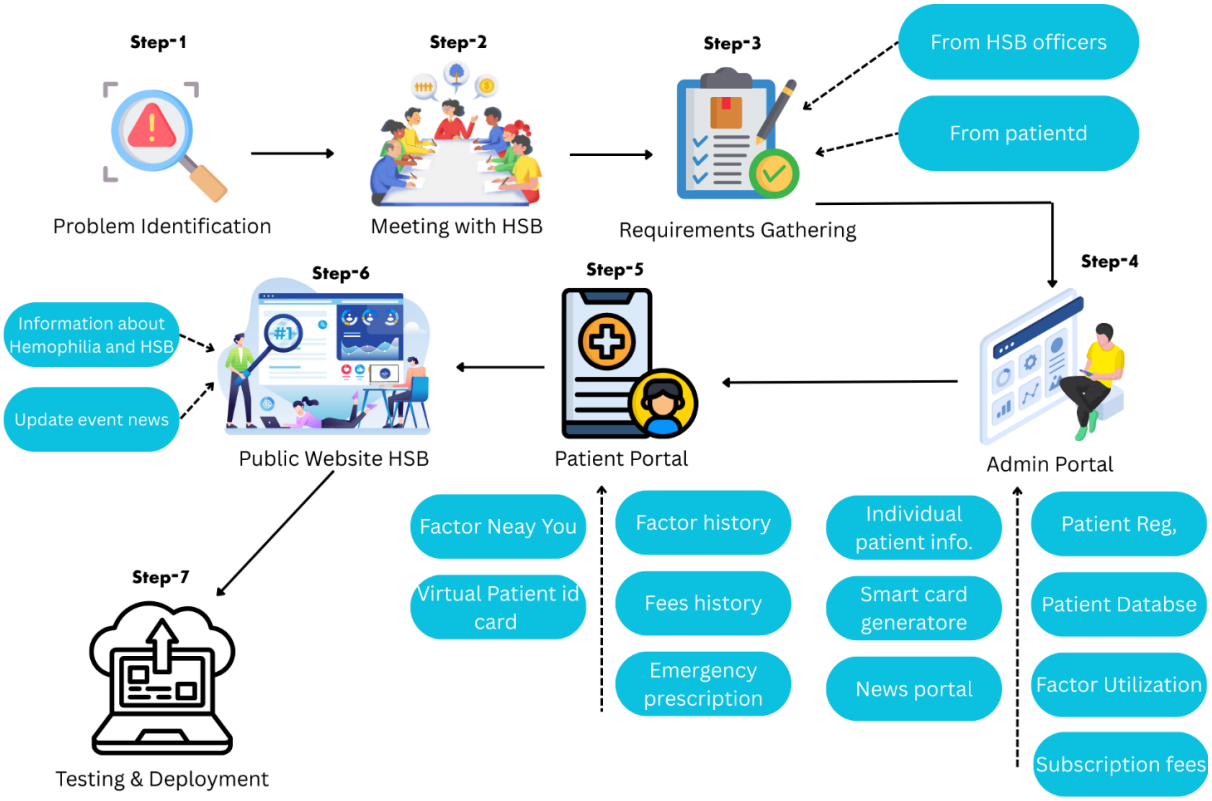


Figure 3.1.2: System design & implementation process Diagram

USE Case Diagram: Use Case diagram represent the interactions of Actors with different types of function in a system as well. In below Figure 3.1.3 showed the full use case diagram. In this use case diagram, you can see there are total 3 primary actor- Patient, HSB admin and RYC (Regional Youth Committee) as well. These three actors are interactions among different types of functionalities of this HSB system.

1.Patient Interaction: Registered patient can able to login at patient portal for accessing –

1. Individual patient information
2. Injection transaction history
3. Emergency prescriptions
4. Factor Near You
5. Smart card

2.HSB Admin: Admin of HSB can directly access HSB admin panel and able to do –

1. Patient Database
2. New patient Registration
3. Smart card Generation
4. Individual Patient info
5. Injection History
6. Subscription Fees

3. RYC: RYC is refer for Regional Youth Committee. There are total 7 official Region in Bangladesh under Hemophilia Society of Bangladesh [1]. Total 7 RYC committee in Bangladesh. These RYC members are actively collect the extra available factor injection information from donor and he can access the Factor Near You admin portal to update this information so that patient can easily get emergency factor information near them as well.

Summarizing, the use case diagram shows that the system allows patients, HSB administrators, and RYC members to interact with each other to maintain patient records, keep track of the treatment history, manage the registrations and subscriptions, and receive the latest news about the factors availability, which would provide everyone living with hemophilia in Bangladesh with the necessary support and better care. Below the use case diagram shown at figure 3.1.3.

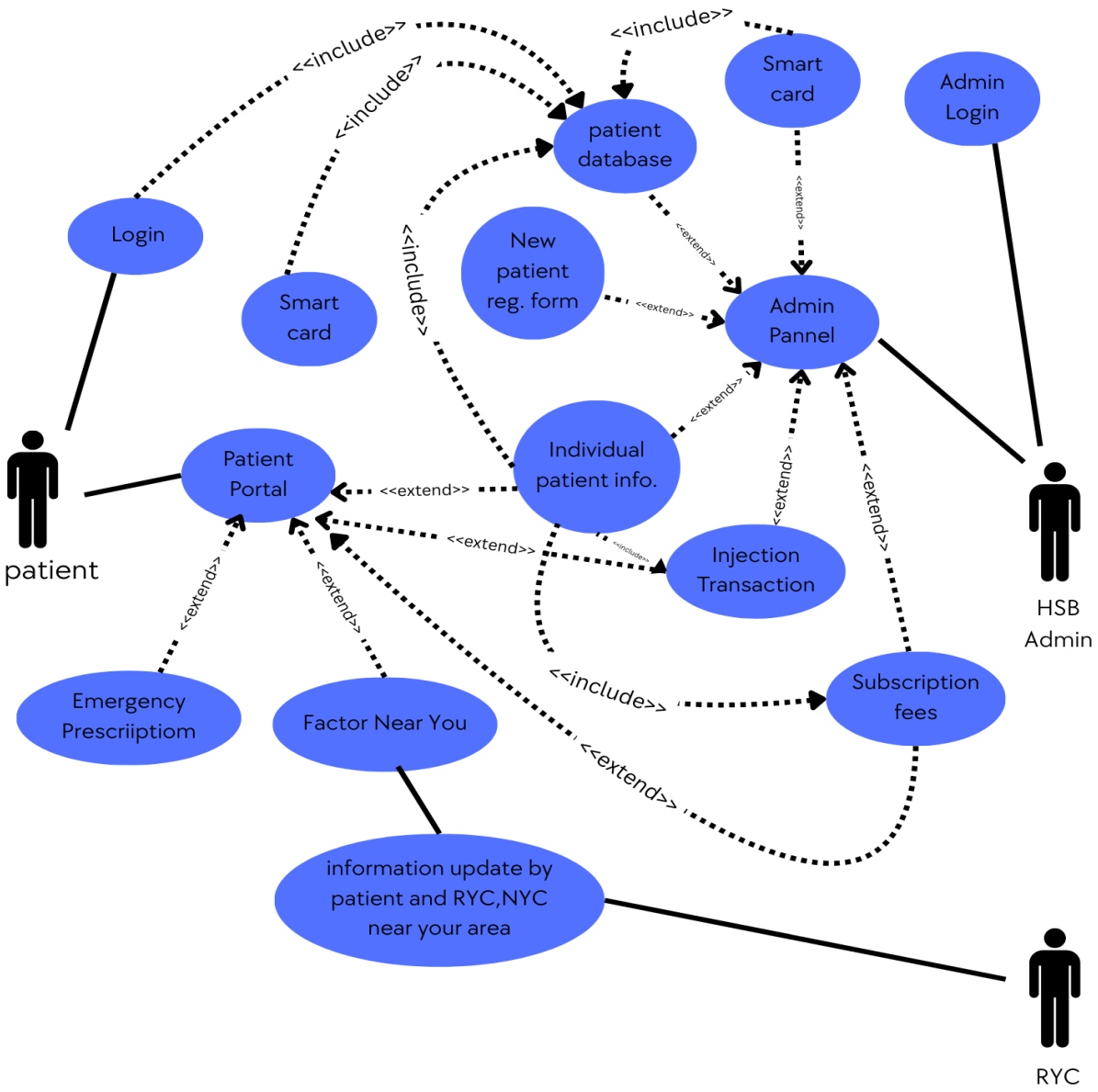


Figure 3.1.3 Use Case Diagram

3.1.3 Functional and Nonfunctional Requirements

Functional Requirements:

1. New patient registration and Patient portal login
2. Role-based access control
3. QR-based smart card generation
4. Smart card scanning for patient info
5. Emergency prescription generation (24-hour valid) for infuse factor
6. Factor availability map with donor information
7. Daily patient activity and factor usage tracking
8. Subscription fee collection

9. Report generation of date to date factor utilization and fees
10. Patient database management
11. Admin dashboard with news/update control
12. Individual patient info viewable via QR
13. Smart card downloadable by patient
14. Role-specific dashboards (admin, officer, patient)

Non-Functional Requirements:

1. Responsive design for all screen sizes
2. Bangla language support (Google Fonts)
3. Fast performance (< 2 sec for core tasks)
4. Mobile responsive allow
5. Data privacy and security (Firebase rules)
6. Offline PDF generation (jsPDF)
7. Modern UI/UX (Tailwind, Lucide icons)
8. Scalable modular architecture
9. Concurrent user support (1000+ users)
10. Real-time data synchronization (Firebase Realtime DB)

3.1.4 Data Flow Diagram

DFD refers to Data Flow Diagram, which is a visual tool used to show how data moves through a system. It helps to know where the data comes from (input), where it goes (Output), how it is processed, and where it is stored in the database.

There are many levels in DFD but here we will show 2 levels of Data Flow Diagram. They are-

1. Level-0 [figure-3.1.4]
2. Level-1 [figure 3.1.5]

Level-0

The Level-0 Data Flow Diagram shows below figure 3.1.4 that how the Hemophilia Society of Bangladesh (HSB) system communicates with its three primary external entities registered patients, HSB admins, and visitors. Patient portal gives registered patients access to their personal medical data and services by logging in. The HSB admins enter the system using the admin portal and can maintain the patient records,

update the system information, and monitor the operation of the platform. Non-account users can read the open information provided by HSB. This diagram shows clearly the major data flows and access points that can link these users with the central HSB system.

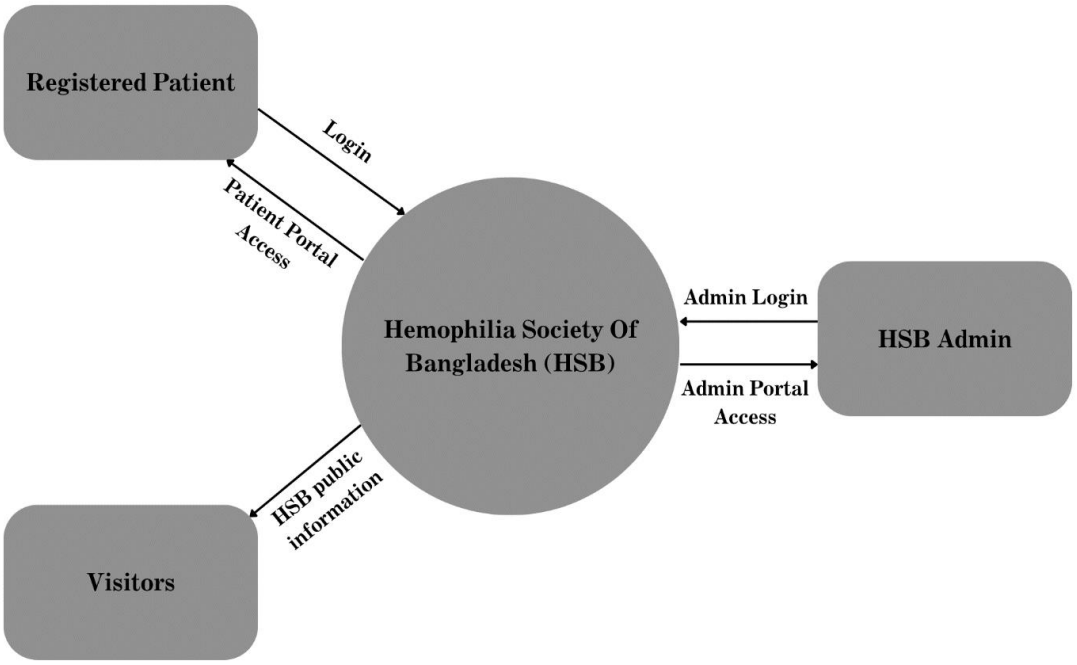


Figure 3.1.4: DFD Level-0

Level-1

Level-1 DFD gives a more detailed perspective of the way the system of Hemophilia Society of Bangladesh (HSB) manages its internal processes and engagements with various users. Patients with accounts can access their personal account using patient dashboard where they can review their personal records, check their injection history, subscription charges and availability of factor in the vicinity. People who lack accounts can use the public web portal to view general information, awareness resources, and contact details on the emergency. The HSB admins operate on the basis of the admin portal to enroll new patients, update on individual records, handle the details of injections and factors, process subscription payments, and print smart cards to the verified members. These interactions are backed by a few important processes, including new patient registration, patient and injection database, factor use, fees management, and smart card generation that store, retrieve and update information where necessary. This illustration depicts how information passes through users, processes and databases in a well-coordinated manner that guarantees proper, secure and efficient management of services to the hemophilia community in Bangladesh. Below DFD level-1 shown at

figure 3.1.5.

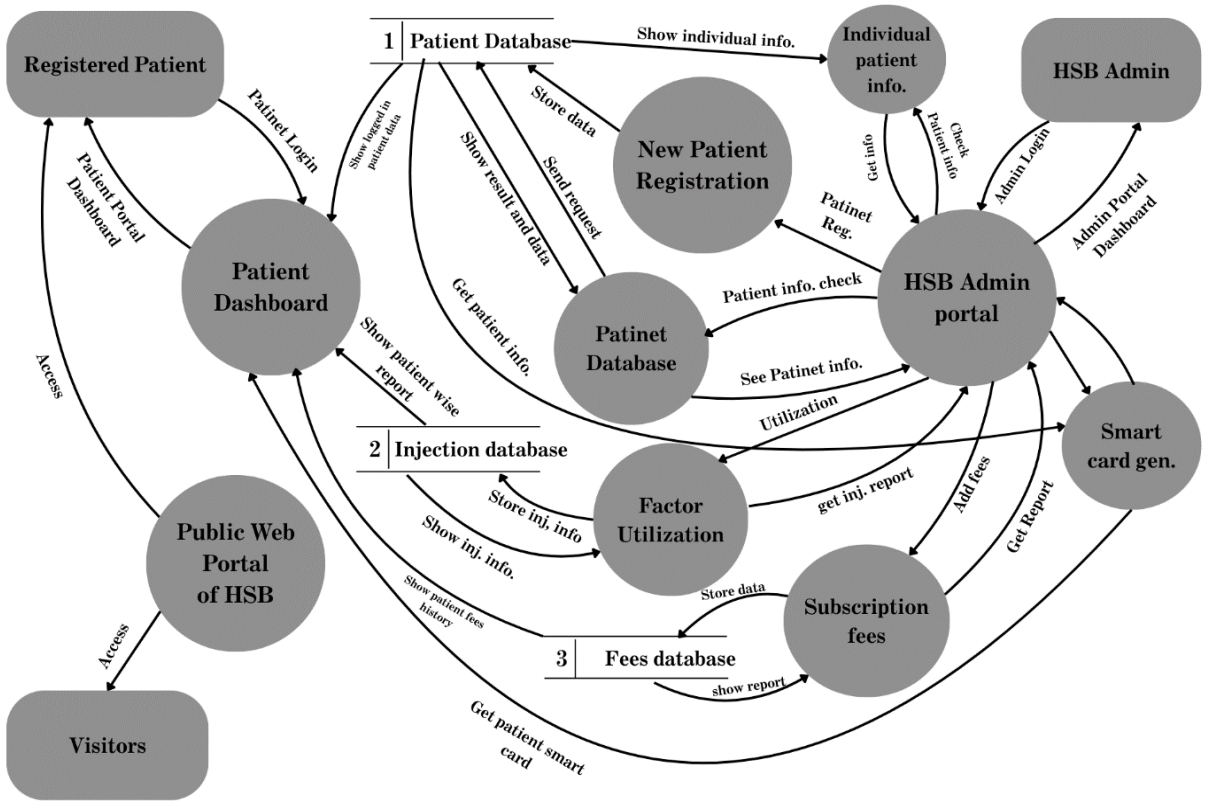


Figure 3.1.5: DFD Level-1

3.1.5 UI Design

Landing page (Public HSB website)

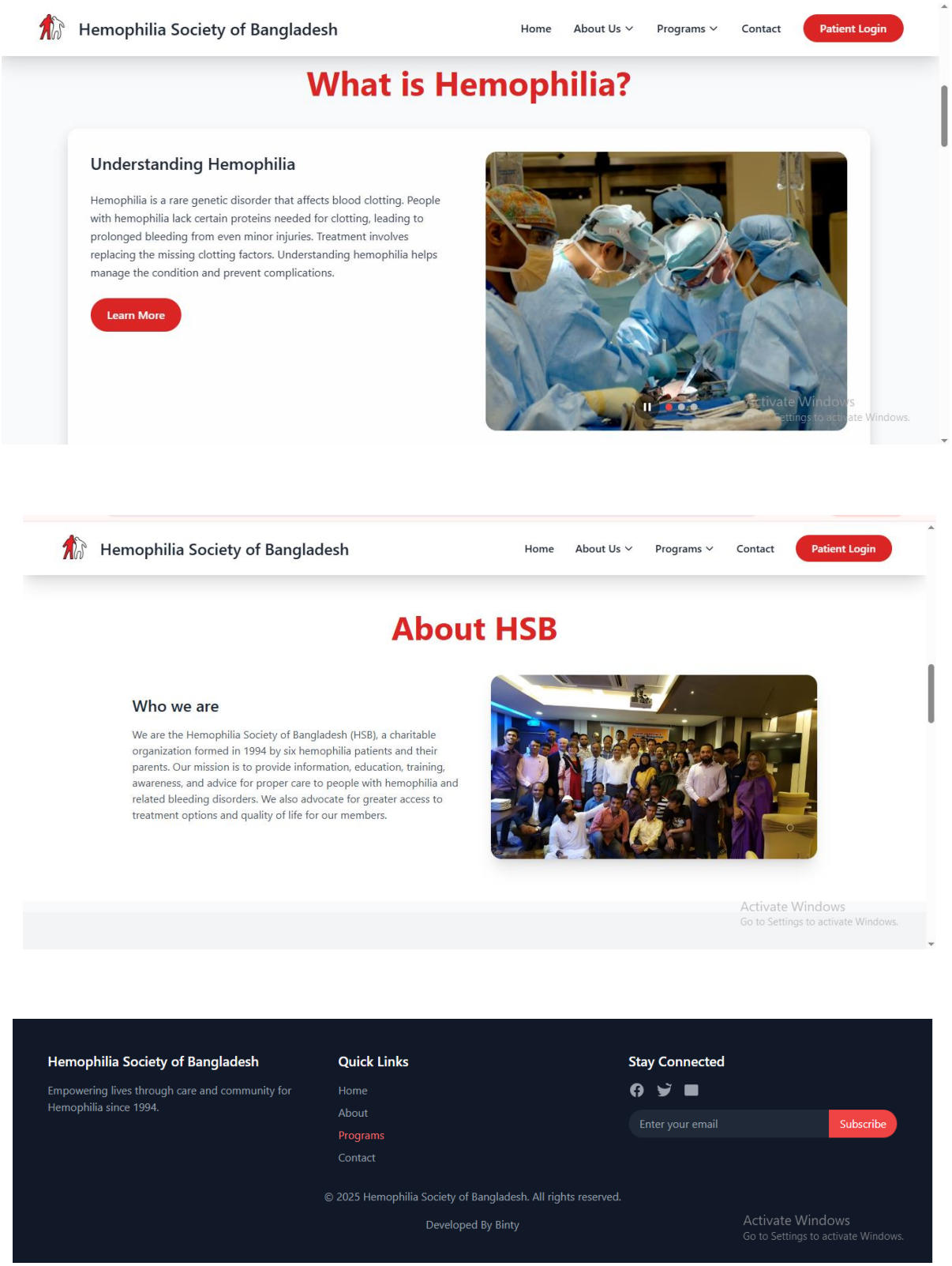


Fig: 3.1.6 (Landing Pages)

Here in this figure 3.1.6 showing the landing pages of HSB where it is showing the details information about hemophilia disorder and the work activities of hemophilia society of Bangladesh.

History Page (Public HSB website)

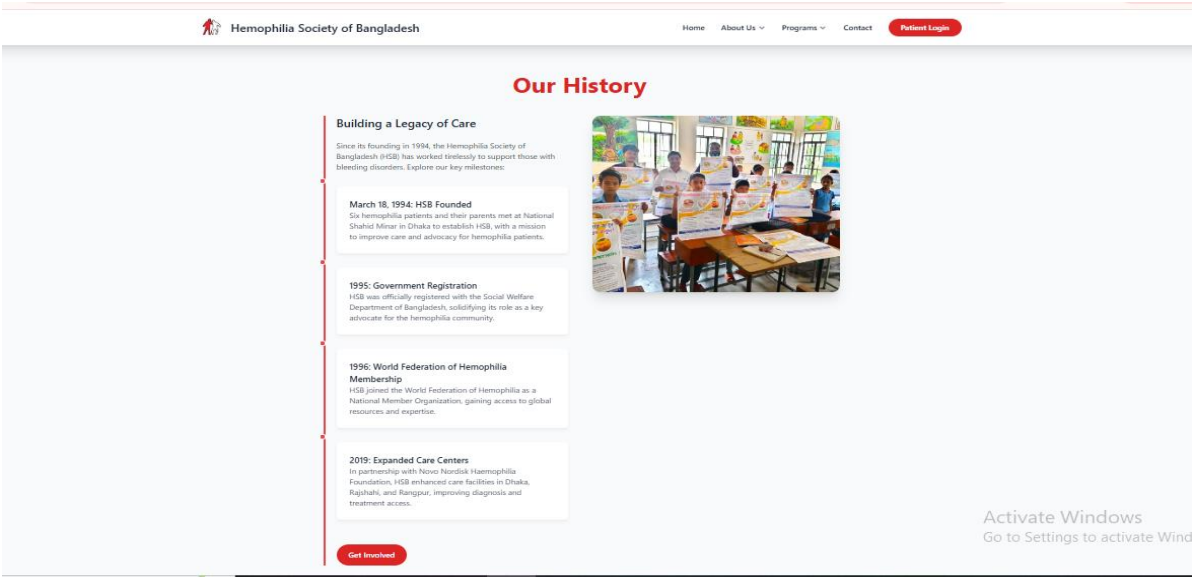


Fig: 3.1.7 (History Page)

In this figure 3.1.7 showing the History page of this system, where showing the start journey, achievements and others information about this organization. This page make a great informative page ever because everyone who come to know about this organization that must be know about the historical journey of it.

Medical page (Public HSB website)

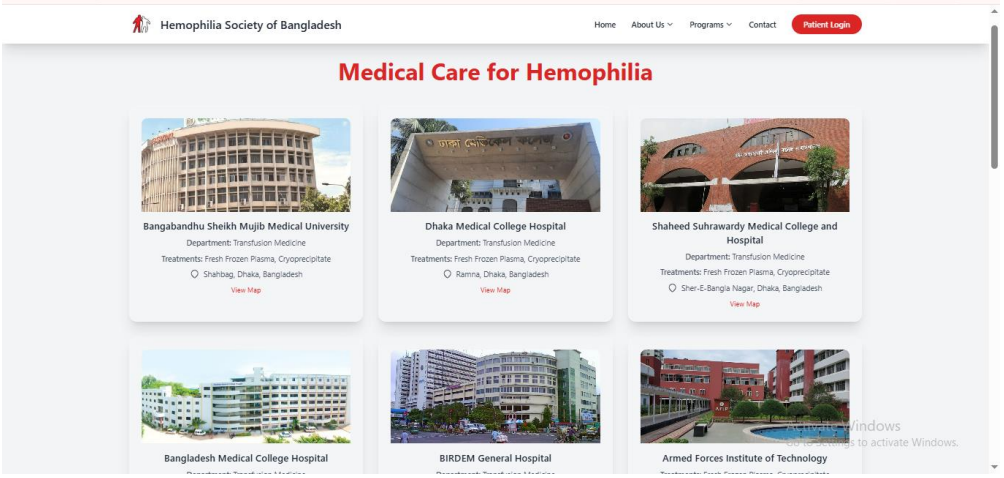


Fig: 3.1.8 (Medical page)

Figure 3.1.8 showing the all available medical list and map-based access with all contact information where hemophilia patient can get others emergency treatment as well. This will help all hemophilic patient to know about the medical services under this disorder.

Contact Page (Public HSB website)

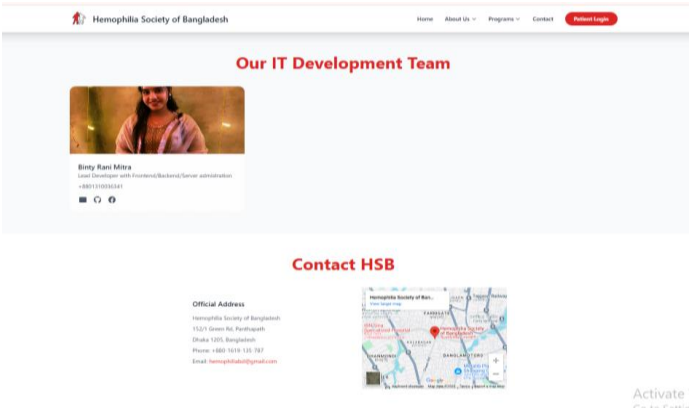


Fig: 3.1.9 (Contact Page)

Figure 3.1.9 showing the contact page, where all information about the system developer and office contact no and addresses are visible for any query for patient and user. If any user need to know about the actual location of HSB main office, can be done by implemented the google map here as well.

Admin Login (Admin panel of HSB)

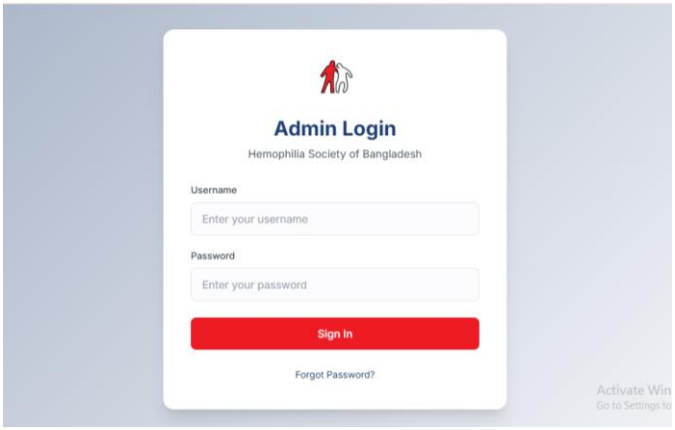


Fig: 3.1.10 (Admin Login)

Figure 3.1.10 showing the admin login page, where only authorized admin from hemophilia society of Bangladesh can access of this admin portal by username and password as well. Unauthorized access is not possible due to the inbuild username and password of admin as well.

Admin Dashboard (Admin panel of HSB)

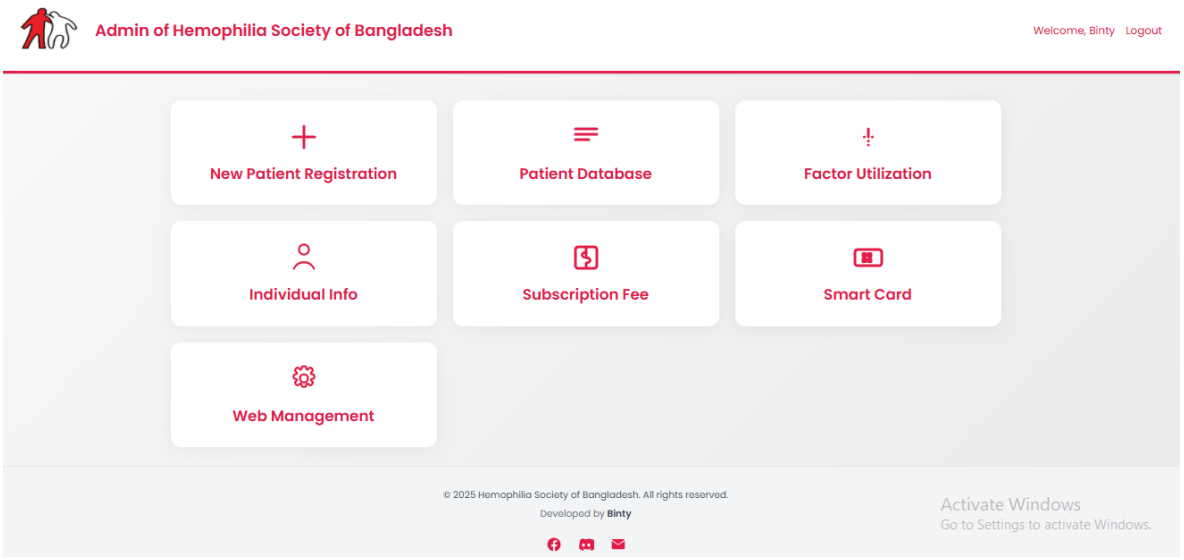


Fig: 3.1.11 (Admin Dashboard)

Here this figure showing the admin portal where admin can handle all kinds of official activities as well.

New Patient registration form (Admin panel of HSB)

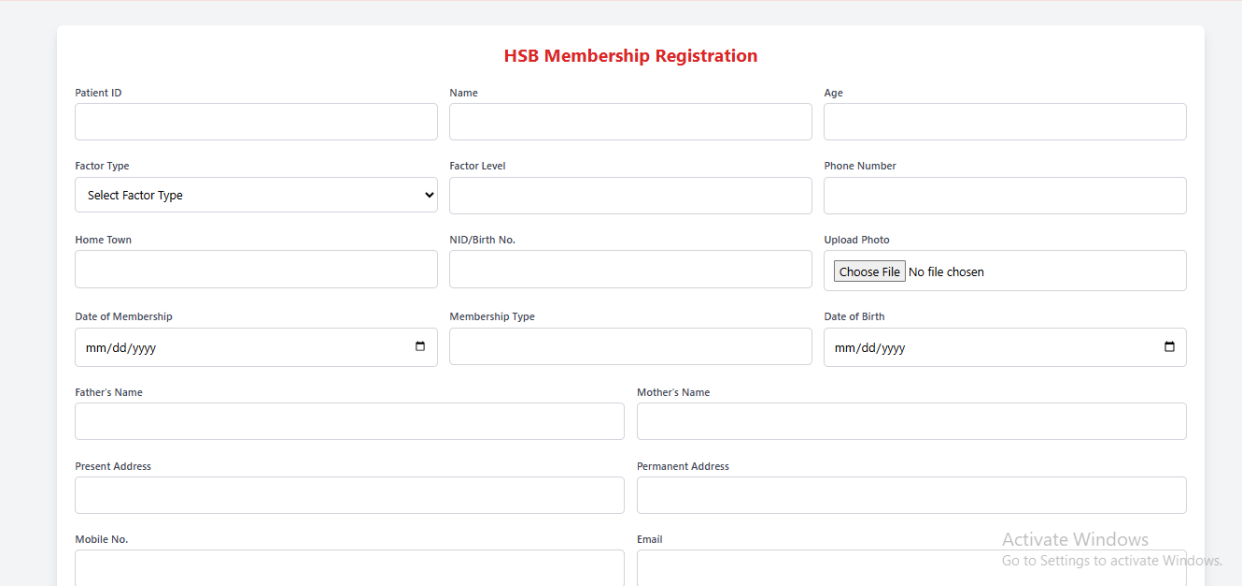


Fig: 3.1.12 (New Patient registration form)

In this figure, when a new hemophilia patient our office to get register him self , this registration process done by this online form as well.

Registered Patients Database (Admin panel of HSB)

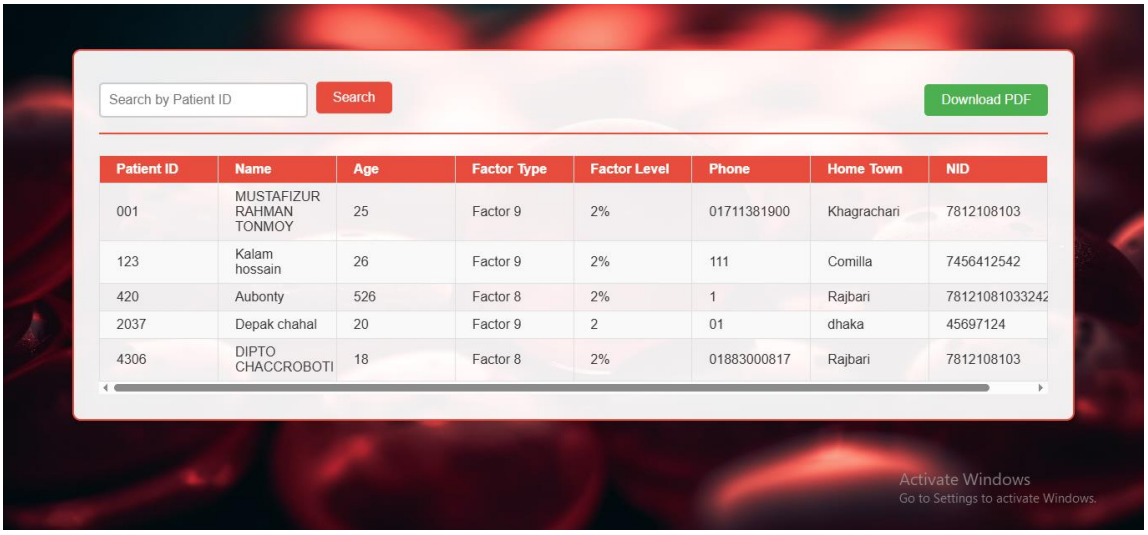


Fig: 3.1.13 (Registered Patients Database)

Admin can see all registerted patient important data from this database as well.Also able to download the patient information report as well. Below figure 3.1.14 show the downloaded pdf format.

Patient Information Downloaded PDF

Patient Information Report HEMOPHILIA SOCIETY OF BANGLADESH

Patient ID	Name	Age	Factor Type	Factor Level	Phone	Home Town	NID
001	MUSTAFIZUR RAHMAN TONMOY	25	Factor 9	2%	01711381900	Khagrachari	7812108103
123	Kalam hossain	26	Factor 9	2%	111	Comilla	7456412542
420	Aubonty	526	Factor 8	2%	1	Rajbari	781210810332423243
2037	Depak chahal	20	Factor 9	2	01	dhaka	45697124
4306	DIPTO CHACCROBOTI	18	Factor 8	2%	01883000817	Rajbari	7812108103

Fig: 3.1.14 (Patient Information Downloaded PDF)

Factor Injection Utilization (Admin panel of HSB)

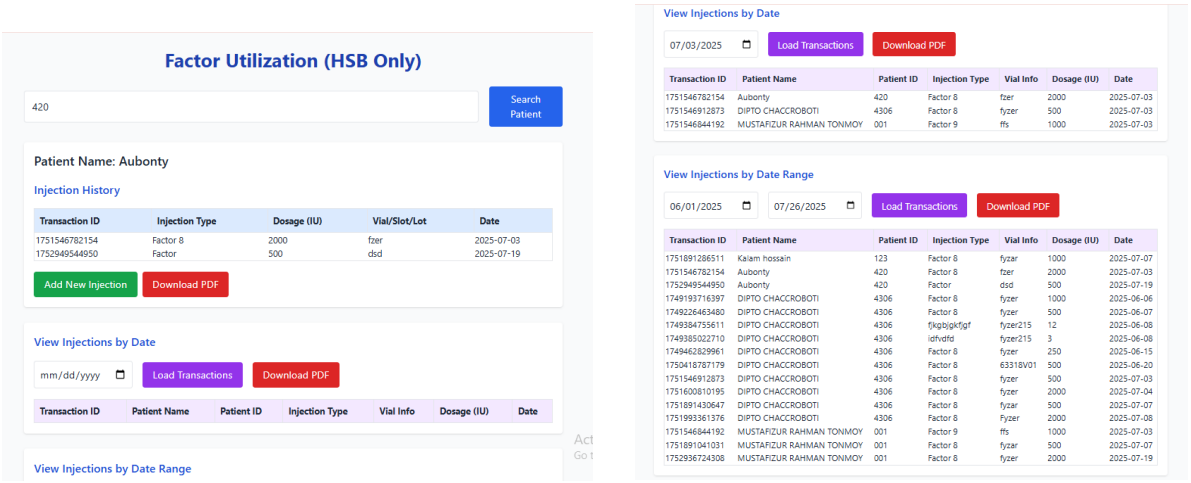
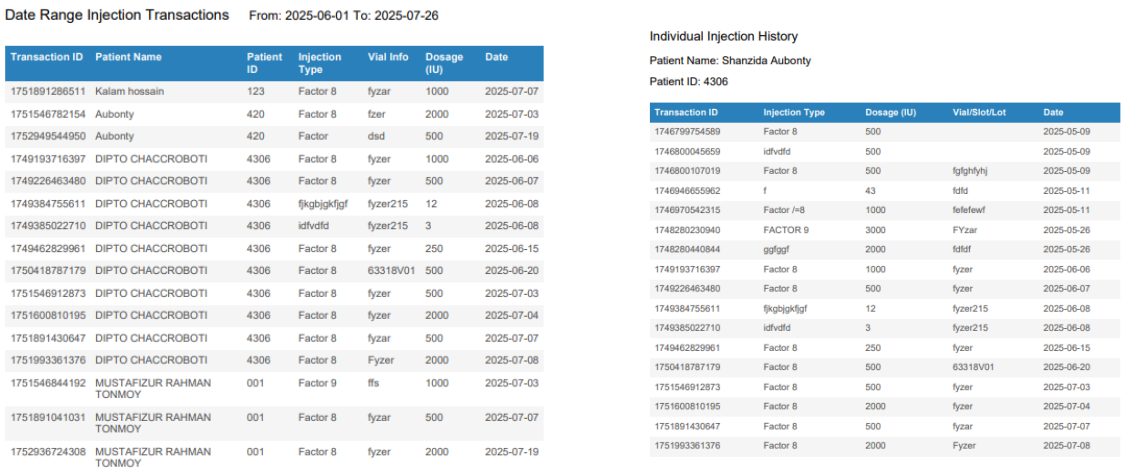


Fig: 3.1.15 (Factor Injection Utilization)

Factor utilization is a very important part of HSB activites where all types of factor

distribution management done by this page figure 3.1.15. Also generated daily,monthly and a specific date wise factor utilization report as well. Below figure 3.1.16 showing the genereted pdf. It also generated the individual patient factor utilization report at any time.

Injection Utilization report Downloaded PDF



Date Range Injection Transactions From: 2025-06-01 To: 2025-07-26

Transaction ID	Patient Name	Patient ID	Injection Type	Vial Info	Dosage (IU)	Date
1751891286511	Kalam hossain	123	Factor 8	fyzar	1000	2025-07-07
1751546782154	Aubonty	420	Factor 8	fzer	2000	2025-07-03
1752949544950	Aubonty	420	Factor	dsd	500	2025-07-19
1749193716397	DIPTO CHACCROBOTI	4306	Factor 8	fyzer	1000	2025-06-06
1749226463480	DIPTO CHACCROBOTI	4306	Factor 8	fyzer	500	2025-06-07
1749384755611	DIPTO CHACCROBOTI	4306	fjkgbjgkfjgf	fyzer215	12	2025-06-08
1749385022710	DIPTO CHACCROBOTI	4306	idfvdfd	fyzer215	3	2025-06-08
1749462829961	DIPTO CHACCROBOTI	4306	Factor 8	fyzer	250	2025-06-15
1750418787179	DIPTO CHACCROBOTI	4306	Factor 8	63318V01	500	2025-06-20
1751546912873	DIPTO CHACCROBOTI	4306	Factor 8	fyzer	500	2025-07-03
1751600810195	DIPTO CHACCROBOTI	4306	Factor 8	fyzer	2000	2025-07-04
1751891430647	DIPTO CHACCROBOTI	4306	Factor 8	fyzar	500	2025-07-07
1751993361376	DIPTO CHACCROBOTI	4306	Factor 8	Fyzer	2000	2025-07-08
1751546844192	MUSTAFIZUR RAHMAN TONMOY	001	Factor 9	ffs	1000	2025-07-03
1751891041031	MUSTAFIZUR RAHMAN TONMOY	001	Factor 8	fyzar	500	2025-07-07
1752936724308	MUSTAFIZUR RAHMAN TONMOY	001	Factor 8	fyzer	2000	2025-07-19

Individual Injection History

Patient Name: Shanzida Aubonty

Patient ID: 4306

Transaction ID	Injection Type	Dosage (IU)	Vial/Slot/Lot	Date
1746799754589	Factor 8	500		2025-05-09
1746800045659	idfvdfd	500		2025-05-09
1746800107019	Factor 8	500	fgfghfyhj	2025-05-09
1746946655962	f	43	fdfd	2025-05-11
1746970542315	Factor /=8	1000	fefefewf	2025-05-11
1748280230940	FACTOR 9	3000	FYzar	2025-05-26
1748280440844	ggfggf	2000	fdfdf	2025-05-26
1749193716397	Factor 8	1000	fyzer	2025-06-06
1749226463480	Factor 8	500	fyzer	2025-06-07
1749384755611	fjkgbjgkfjgf	12	fyzer215	2025-06-08
1749385022710	idfvdfd	3	fyzer215	2025-06-08
1749462829961	Factor 8	250	fyzer	2025-06-15
1750418787179	Factor 8	500	63318V01	2025-06-20
1751546912873	Factor 8	500	fyzer	2025-07-03
1751600810195	Factor 8	2000	fyzer	2025-07-04
1751891430647	Factor 8	500	fyzar	2025-07-07
1751993361376	Factor 8	2000	Fyzer	2025-07-08

Fig: 3.1.16 (Injection Utilization report Downloaded PDF)

Individual Patient Info. (Admin panel of HSB)

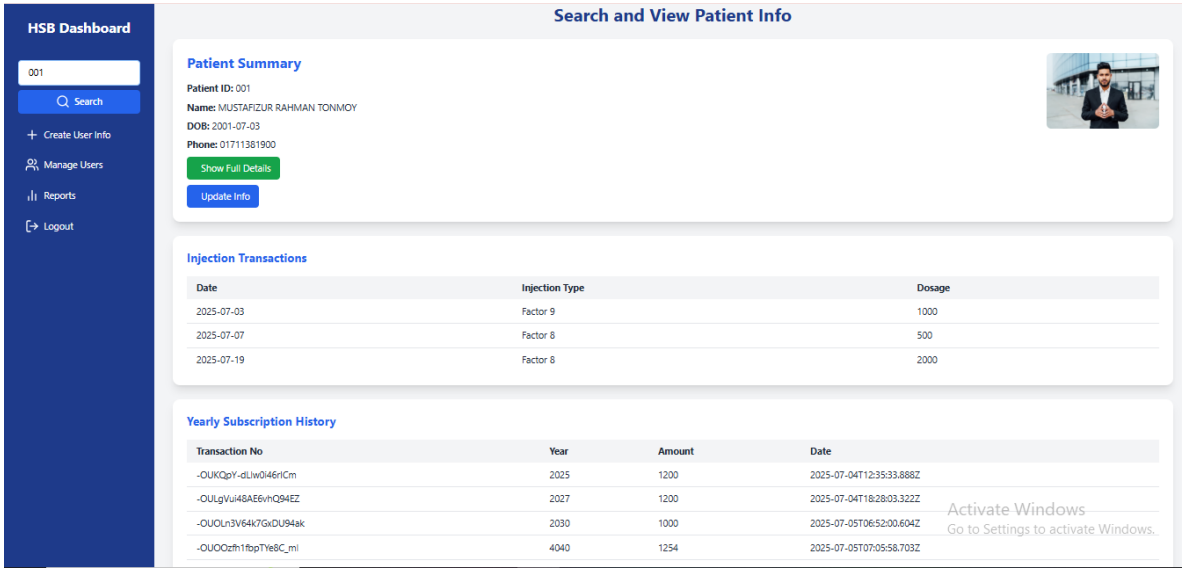
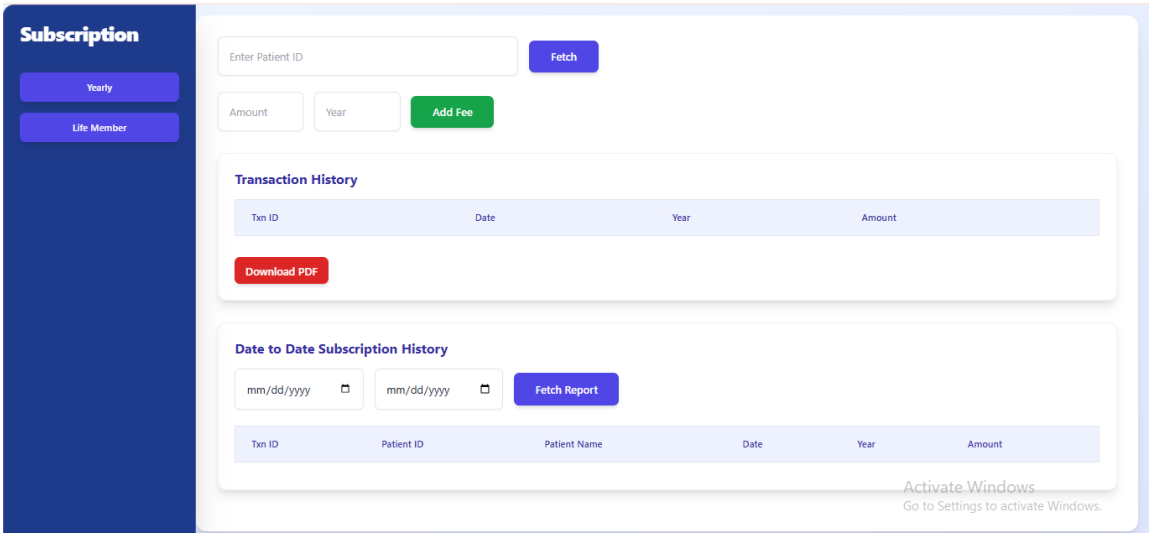
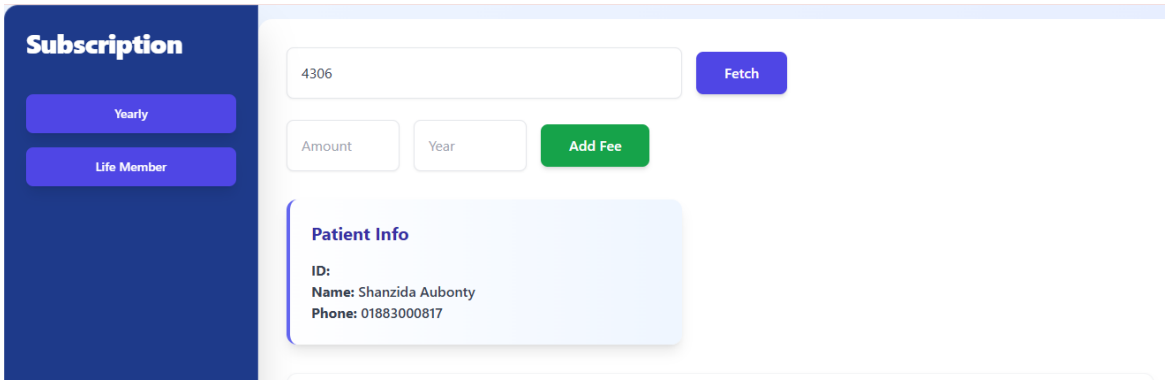


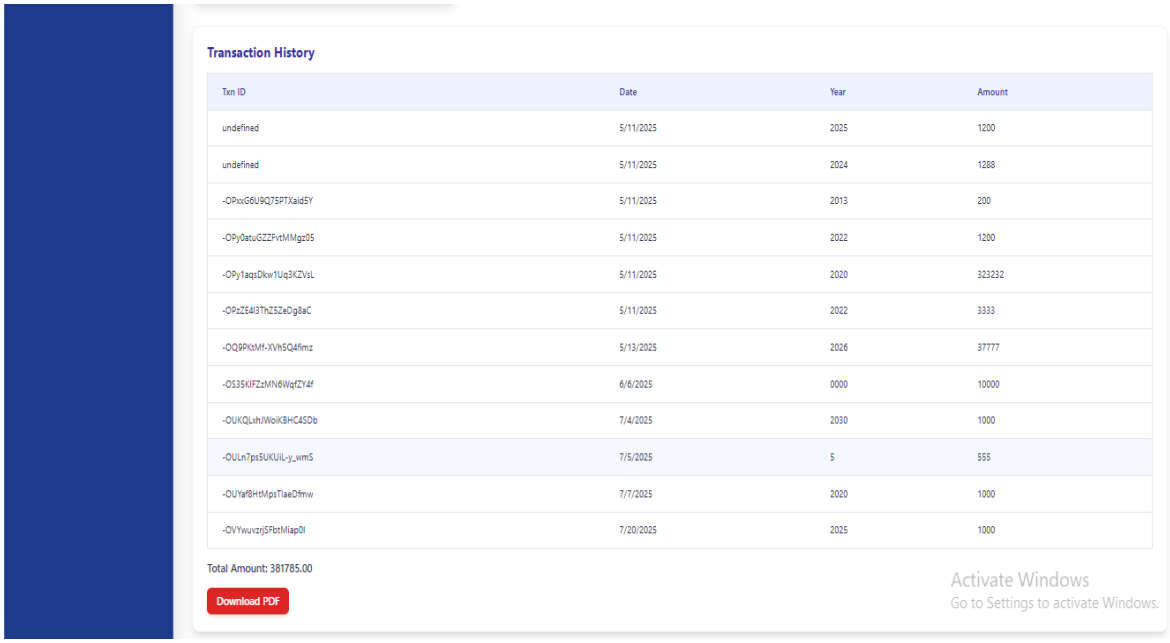
Fig: 3.1.17 (Individual Patient Info.)

In this figure 3.1.17 showing the page where admin can get individual patient information as well. This is done by either smart ID card scanning or Manually ID input as well.

Subscription Fees (Admin panel of HSB)







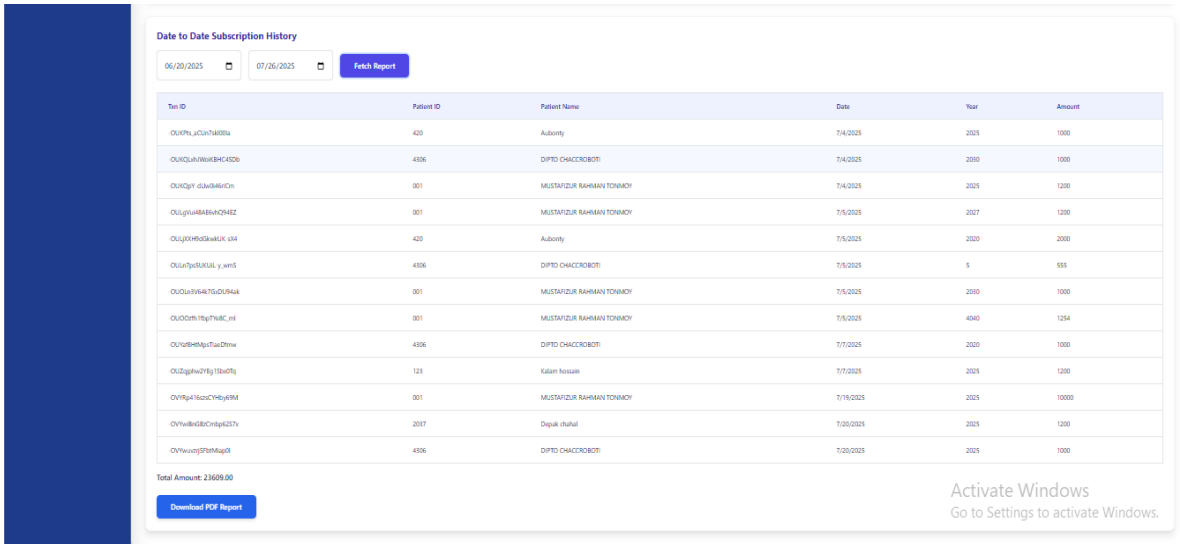
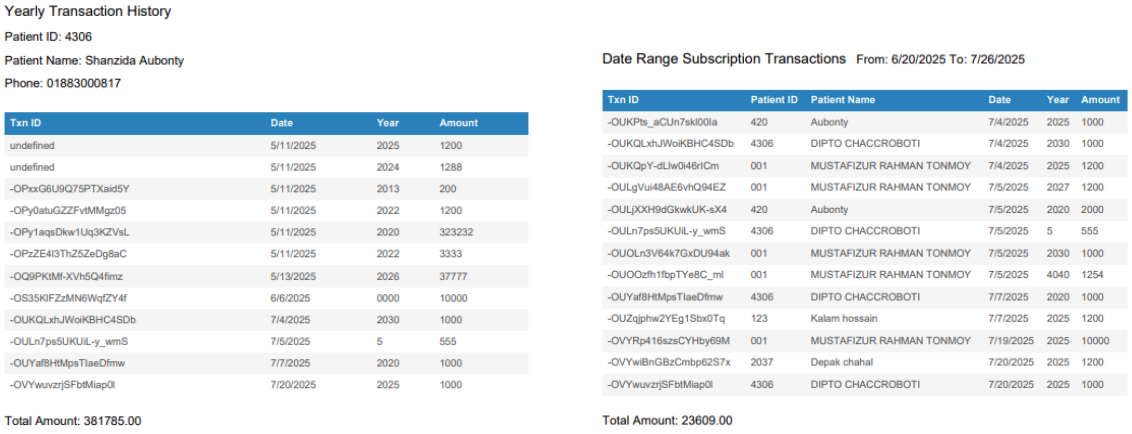


Fig: 3.1.18 (Subscription Fees)

In this figure 3.1.18 shows the subscription fees page where admin can manages all type subscription fees management from patient and generate the transactions reports. Below figure 3.1.19 shows the downloaded report as well.

Subscription Fees report Downloaded PDF



Yearly Transaction History

Patient ID: 4306

Patient Name: Shanzida Aubonty

Phone: 01883000817

Txn ID	Date	Year	Amount
undefined	5/11/2025	2025	1200
undefined	5/11/2025	2024	1288
-OPxxG6U9Q75PTXaid5Y	5/11/2025	2013	200
-OPy0atuGZZFvtMMgz05	5/11/2025	2022	1200
-OPy1aqsDkw1Uq3KZVsL	5/11/2025	2020	323232
-OPzZE4I3ThZ5ZeDg8aC	5/11/2025	2022	3333
-OQ9PKtMf-XVh5Q4fimz	5/13/2025	2026	37777
-OS35KlFZzMN6WqfZY4f	6/6/2025	0000	10000
-OUKQLxhJWoiKBHC4SDb	7/4/2025	2030	1000
-OULn7ps5UKUiL-y_wmS	7/5/2025	5	555
-OUYaf8HtMpsTIaeDfmw	7/7/2025	2020	1000
-OVYwuvzrjSFbtMiap0l	7/20/2025	2025	1000

Total Amount: 381785.00

Date Range Subscription Transactions From: 6/20/2025 To: 7/26/2025

Txn ID	Patient ID	Patient Name	Date	Year	Amount
-OUKPts_aCUn7skl00Ia	420	Aubonty	7/4/2025	2025	1000
-OUKQLxhJWoiKBHC4SDb	4306	DIPTO CHACCROBOTI	7/4/2025	2030	1000
-OUKQpY-dLlw0l46rlCm	001	MUSTAFIZUR RAHMAN TONMOY	7/4/2025	2025	1200
-OULgVui48AE6vhQ94EZ	001	MUSTAFIZUR RAHMAN TONMOY	7/5/2025	2027	1200
-OULjXXH9dGkwkUK-sX4	420	Aubonty	7/5/2025	2020	2000
-OULn7ps5UKUiL-y_wmS	4306	DIPTO CHACCROBOTI	7/5/2025	5	555
-OUOLn3V64k7GxDU94ak	001	MUSTAFIZUR RAHMAN TONMOY	7/5/2025	2030	1000
-OUOOzfh1fbpTYe8C_ml	001	MUSTAFIZUR RAHMAN TONMOY	7/5/2025	4040	1254
-OUYaf8HtMpsTIaeDfmw	4306	DIPTO CHACCROBOTI	7/7/2025	2020	1000
-OUZqjphw2YEg1Sbx0Tq	123	Kalam hossain	7/7/2025	2025	1200
-OVYRp416szsCYHby69M	001	MUSTAFIZUR RAHMAN TONMOY	7/19/2025	2025	10000
-OVYwiBnGBzCmbp62S7x	2037	Depak chahal	7/20/2025	2025	1200
-OVYwuvzrjSFbtMiap0l	4306	DIPTO CHACCROBOTI	7/20/2025	2025	1000

Total Amount: 23609.00

Fig: 3.1.19 (Subscription Fees report Downloaded PDF)

Smart Card Generator (Admin panel of HSB)

In below figure 3.1.20 showing the auto generated patient ID card with QR code as well. This Smart ID card is very essential part of all registered hemophilia patient under hemophilia society of Bangladesh. Admin just input the patient ID and it will auto generated the patient smart ID card.

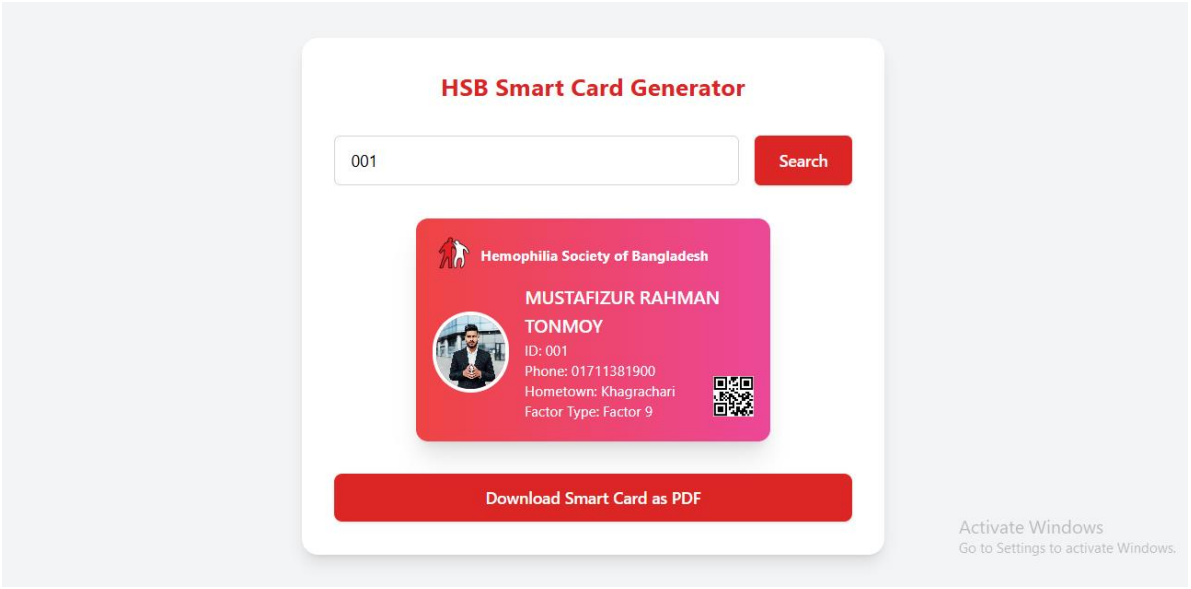
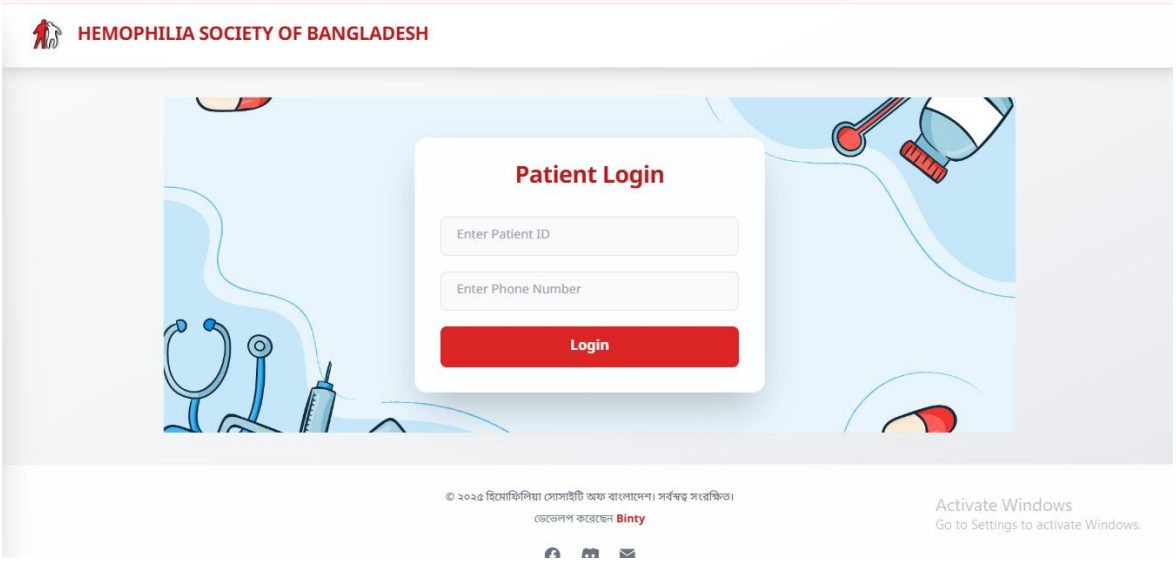
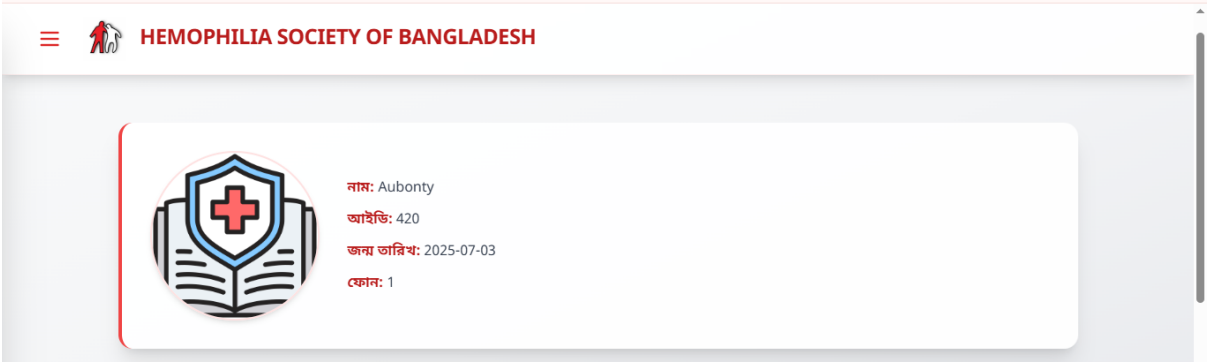


Fig: 3.1.20 (Smart Card Generator)

Patient portal Dashboard & login (Patient portal)





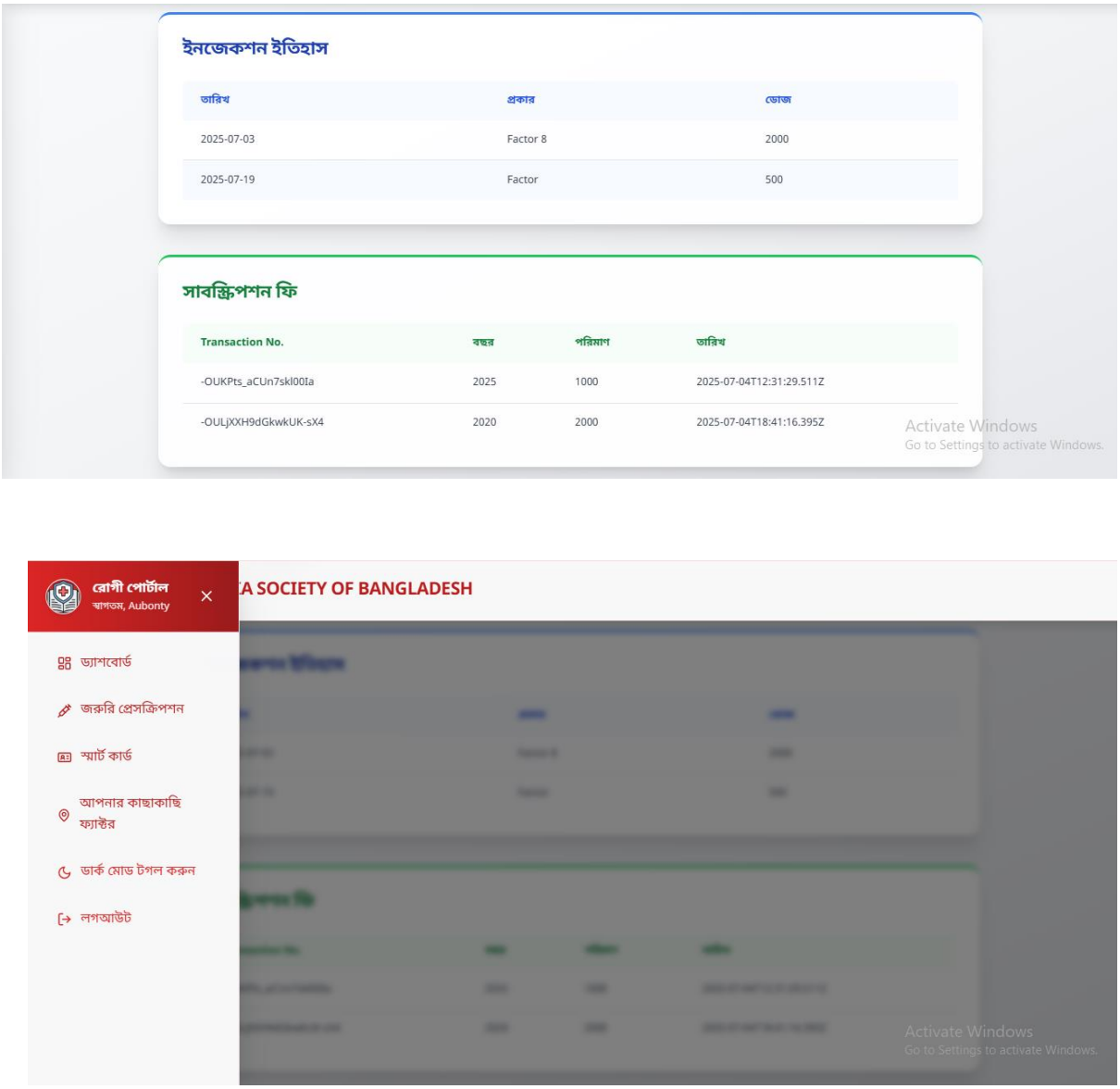


Fig: 3.1.21 (Patient login and portal dashboard)

In that above figure 3.1.21 showing the patient portal activities include patient login, dashboard where all injection transaction and fees transaction available, Emergency prescription system, virtual ID card and Factor near you service to get factor injection in case in emergency situation near your area based on maps as well. This patient portal is play a vital role to support and serve patient as well.

Emergency Prescription (Patient portal)

Below figure 3.1.22 showing the emergeny prescription service page in patient portal where patinet can apply or genereted a doctor authorised prescription only taking factor injection within 24 hours.

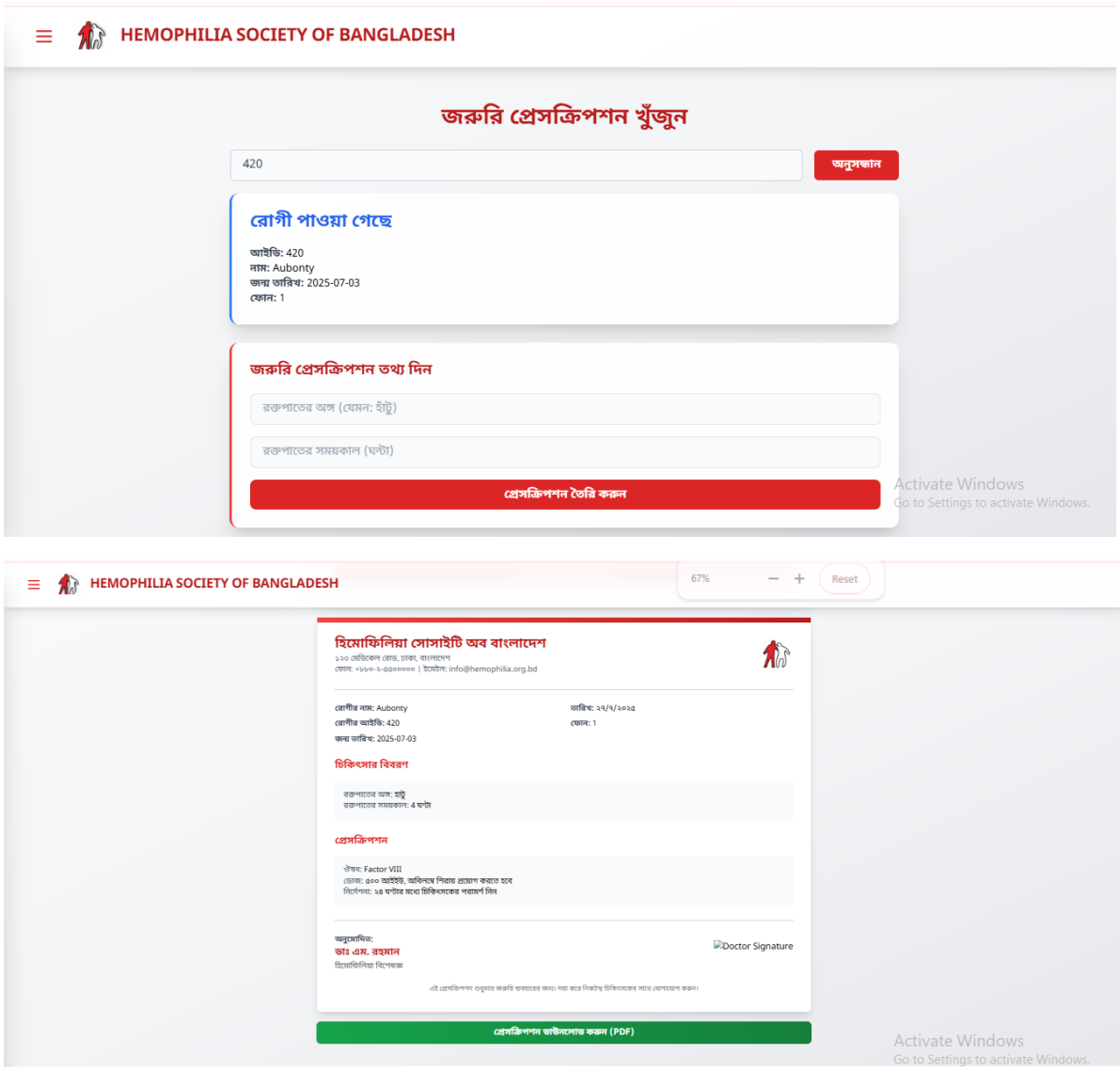


Fig: 3.1.22 (Emergency Prescription)

Virtual Smart Card (Patient portal)

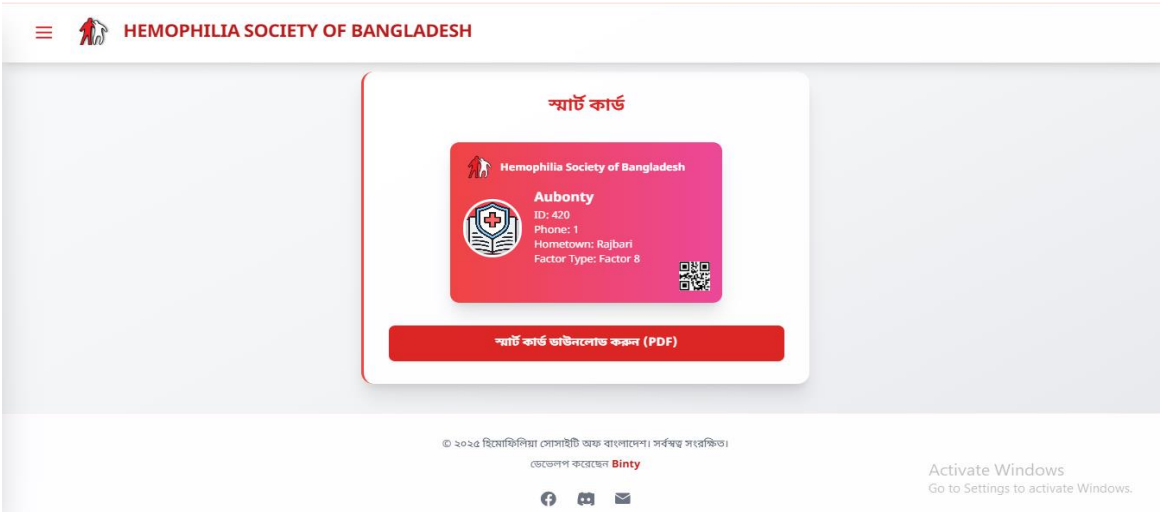


Fig: 3.1.23 (Virtual Smart Card)

Virtual smart card service also provided by this HSB system. Above figure 3.1.23 showing the virtual smart card for all patient portal individually.

Factor Near You (Patient portal)

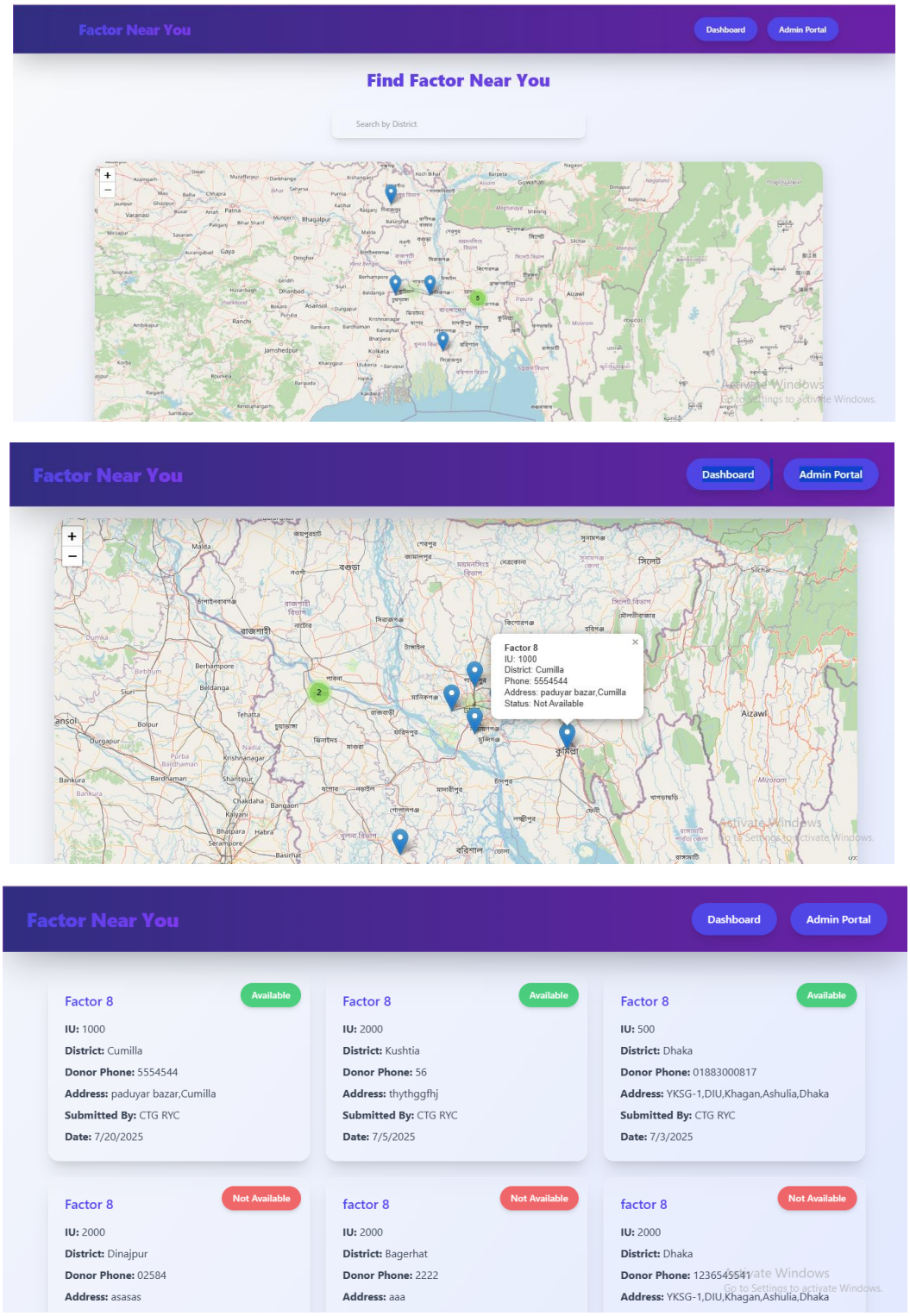
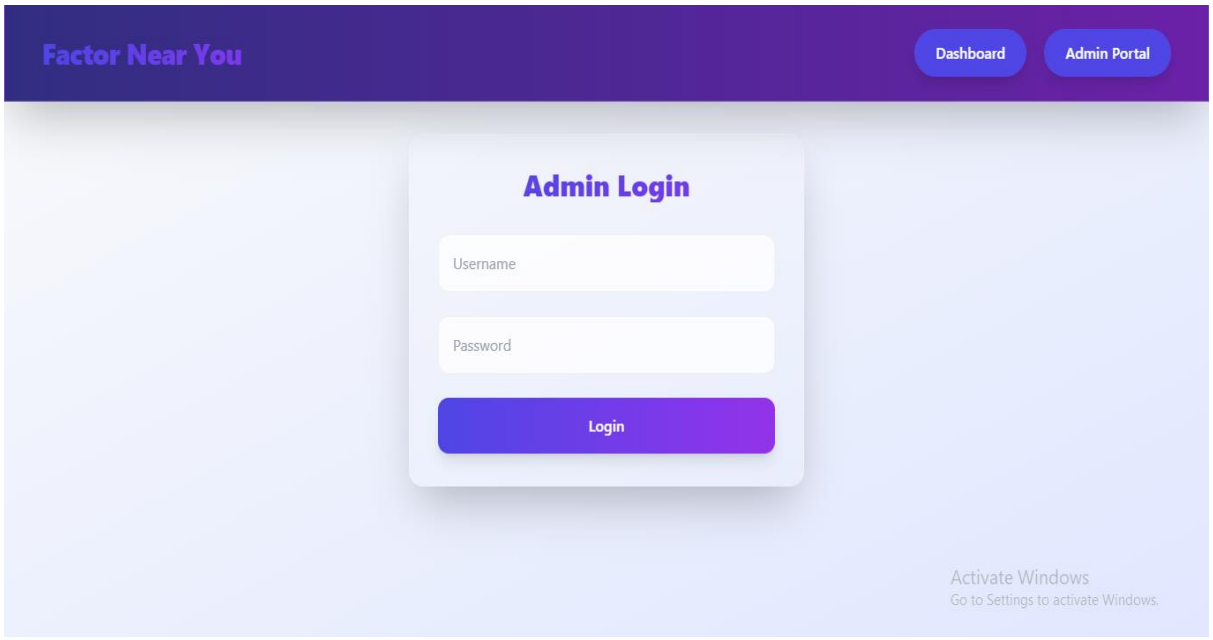
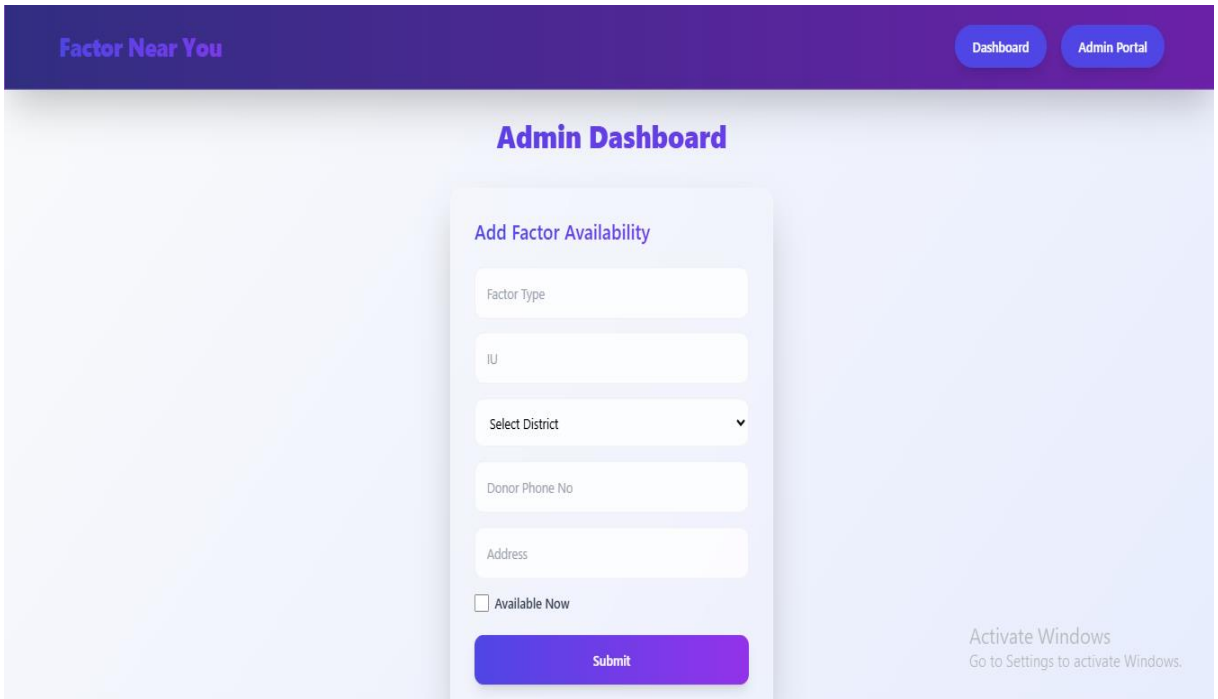


Fig: 3.1.24 (Factor Near You)

Factor near You service for hemophilia patient in Bangladesh is a remarkable achievement. As we know that many hemophilia patients face bleeding problem any time but some times they don't have enough factor injection as well. By Factor near You service patient can check the availability of factor injection near his area based on map and location as well. Figure 3.1.24 above showing the activities.

Factor Near You Admin Control By RYC members (Patient portal)





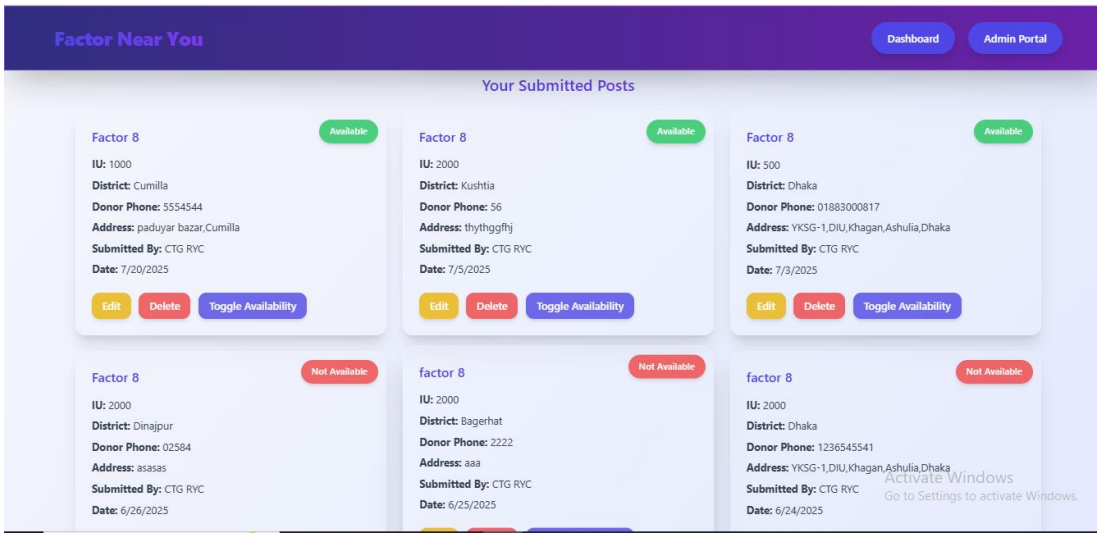


Fig: 3.1.25 (Factor near you admin)

In this figure 3.1.25 showing the admin portal of Factor near you which is control by RYC (Regional Youth Committee) under hemophilia society of Bangladesh. RYC members are always searching for extra factor injection from donor and collect those information and upload to this Factor near You so that patient can get inform.

3.2 Detailed Methodology and Design

In this section the alternative strategies given a consideration during the design time are explained, the motivations behind the final technical choices are provided and the tools adopted to satisfy the functional and non-functional needs of the system are explained. In below I am sharing the Methodology steps:

1.Problem Identification

The first step to defining the key issue in Hemophilia care in Bangladesh. There was no digital support system available to patients, and all the work was done manually at the Hemophilia Society of Bangladesh (HSB). Physical movement of patients to Dhaka to get registered, get prescriptions or collect factors was a waste of time and money. The awareness of this issue allowed us to formulate the objective of developing an entire digital solution that would alleviate the sufferings of patients and enhance the services delivery.

2. Stakeholder Involvement

Then I have engaged with the key stakeholders: Hemophilia Society of Bangladesh officers and patients. Officers discussed their problem with patient records, fees, and factor stock. Patients described their problems with access to timely treatment, the

absence of information online, and emergency problems. Such engagement meant that the system would respond to actual needs.

3.Requirement Collection

After that I am going to start collecting all kinds of requirements from patients and HSB officers as well. These were patient registration, retention of a patient database, tracking factor use, subscription fee management, issuing smart cards, emergency prescription and educational content. Gathering requirements helped to identify what the platform needs to have. Still they give me new requirements that they need and still it going to update and add new features.

4.System Design (Admin Panel)

During this phase, we have created the system architecture. The design was intended to ensure that the system was modular, easy to use, and secure. It contained the Admin Panel. Admin Panel has been developed on behalf of HSB officers. It involved registration of patients, managing databases, monitoring of factor usage, tracking subscription fees and the production of smart cards. It was aimed at minimizing paper work and speeding up and simplifying the management. Firebase database used to store and read data backend. Frontend technologies like- HTML5, Tailwind CSS and JavaScript and different libraries used and JavaScript also use for backend as well.

5. System Design (Patient Portal)

Patient portal is created for patient care directly by patient. There is a option to see the injection transaction, subscription fees transaction, emergency prescription generation, online smart patient id card and factor near you to find factor injection in any emergency situation as well.

6. System Design (Public Site)

Alongside the portal, we developed a public website. This part of the system shares general information about Hemophilia, news updates, and online education. It also helps raise awareness in society and gives patients and families easy access to knowledge.

7. Integration

Once all the components were completed, we connected the with the Patient Portal and Public Website into one system and Admin Panel is in different platform. Integration allowed the seamless communication of information and data between all modules and created a complete ecosystem of Hemophilia care.

8. Testing

Testing phase is very important for all types of software development as well. In this project we have done many steps of functional, non-functional, manual, white box, black box testing as well for the usability, security, speed, and functionality checks. Bugs, login problems, and database errors were detected and fixed.

9. Deployment

The last phase is the deployment of the system. Initially, it was hosted in GitHub to test out the platform, and since it is easy to find the problems, visualize the mistakes, and receive the feedback of the users. Once tested successfully, it was deployed with again GitHub. Firebase provided real-time data processing, high security, and scaling. The platform could be used immediately after the launch by the patients and HSB officers. This deployment was the official introduction of digital Hemophilia care in Bangladesh and the precursor to its utilization over time and its growth.

Alternative Approaches:

1.Server-Side PDF Generation: Solutions like using Node. js pdf generation on the server were considered. But they would add latency, back-end complexity, and hosting costs. Therefore, client-side PDF generation with jsPDF and html2canvas was chosen to provide rapid, browser-based prescription generation which is compatible with an offline environment.

2.Native Mobile Applications: Native apps (iOS/Android) were present in early planning. But I needed to develop fast, support many devices, and keep centralized maintenance, so I planned a Progressive Web App (PWA) configuration. It enables cross-platform availability from any device that has a web browser, and we can look forward to offline usage features.

3.Google Cloud Storage for Uploading Images: Although Firebase Storage or Google Cloud Storage became a potentialors for image uploads (like profile pictures, smart card QR images), it when avoided because price, permission abstraction, and storage rule. But we decided to added ImgBB API for image hosting. It is a dependable, affordable and lightweight image API serving our purpose without having to manually manage backend storage.

Final Design Choice

After considering the pros and cons of such alternatives, the final architecture was

decided by considering in the following factors: real-time performance, modularity, scalability, affordability and user experience.

1.Frontend: One of a kind web application made in the form of modules with HTML5, Tailwind CSS and JavaScript (ES6+) makes it fast, responsive and easy to maintain. The app does not support Bangla rendering fonts, which Google (under Noto Sans Bengali font) can be seen as a great tool for local language support.

2.PDF & QR Code Tools: Emergency prescriptions are downloaded in PDF using jsPDF and html2canvas. QRCode. js that dynamically generates QR codes for the patient smart cards.

3.Image Storage: All user uploaded or system generated images (smartcards etc.) are hosted through imgBB over their image upload API. It lightens the backend, makes rendering images faster and makes deployment easier.

4.Backend: The platform that was chosen as the Backend-as-a-Service (BaaS) was Firebase primarily because of the pre-built authentication, real-time database and scalability. Firebase for role-based access management for tight control over the data visibility between admin, patients, and doctors.

5.Design & UX: A clean, accessible user interface – thanks to Tailwind's utility-first approach, Lucide Icons, and responsive grid.

3.3 Project Plan

The below Table 3.3 show the overall project plan to implement this HSB project.

Table 3.3: Project Plan Table

Task	Duration	Status
Requirement Analysis & Planning	3 weeks	Completed
UI/UX Design with Tailwind & Lucide	2 weeks	Completed
Smart Card Generator (QR Code API)	1 week	Completed
Emergency Prescription (jsPDF/html2canvas)	2 weeks	Completed
Patient Management System (Firebase)	2 weeks	Completed
Admin Panel Features (Reports, Access)	2 weeks	Completed
Real-Time Features (Donor Map etc.)	1 week	Completed
Final Integration & Optimization	1 week	Completed

Testing and Debugging	1 week	Completed
Documentation & Report Writing	2 weeks	Completed
Final Presentation Preparation	1 week	In Progress

3.4 Task Allocation

This is a Solo project, the same developer goes through all stages from the designs, to installing the backend and developing new features, and then testing and deploying everything. The major tasks from week 12 to week 48 are presented in the following Table 3.4.

Table 3.4: Task Allocation Table

Tasks	Weeks																		
	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Requirement Gathering																			
UI/UX Design																			
Frontend Development																			
Firebase Backend Integration																			
Smart Card QR System (imgBB API)																			
Emergency PDF + Prescription Logic																			
Admin Panel + Report Generator																			
Factor Near Yout																			
Patient portal																			
Testing & Debugging																			

Final Integration & Bug Fixes																			

3.5 Summary

In this, Chapter 3 presented the detailed method and design approach used in realizing the hemophilia patient information management system. It started with a brief explanation of the SDLC model and described the system design and its functional, non–functional requirements. Topics involving the DFD, UI design, and the technologies utilized were covered. The justification of certain technologies and architecture choice, i.e. Firebase, client-side PDF generation, and QR code logic using the imgBB API, was also discussed in the chapter. A clear project plan and task allocation was provided for ease of progression. Such systematic approach, makes the application scalable and human-centered that is lacking in current solutions.

Chapter 4

Implementation and Results

This chapter presents a description of the development environment, an evaluation of the features and a testbed overview, along with its achievements.

4.1 Environment Setup

The system was implemented as a modular web application with frontend coded in HTML5, Tailwind CSS, and JavaScript (ES6+). The app used Firebase as the backend service to provide a real time database. Key tools and APIs utilized include the following:

1. Tailwind CSS: For responsive UI design
2. Firebase: Store data that updates in real-time.
3. jsPDF + html2canvas: For generating PDFs on the client side.
4. QRCode.js: To automatically generate QR code for the patient smart card with contain Patient ID number as well.
5. imgBB API: RESTful (Representational State Transfer) methods to interact with the API for image hosting.
6. Lucide Icons + Google Fonts: For that modern type and icon design.
7. Github: Version control and collaboration were managed using **Git** and **GitHub.**

Development was done using **Visual Studio Code** and we were primarily testing in Google Chrome, and used responsive design testing across desktop and mobile sizes.

4.1 Testing and Evaluation

Testing is very important part for development process of any software. It helps to finding bugs, improving performance and securing any project from vulnerabilities. I evaluate the function and reliability of the system under various testing schemes for a smooth and safe user experience. Such as-

Functional Testing: This Table 4.1 shows the full functional testing for this project. All testing done by manually as well. I don't use any auto testing method to test my project as well.

Table 4.1 Functional testing table

Test Type	Purpose	Application in Project
Unit Testing	Test individual functions for correctness.	QR code generation, patient data input forms and PDF export individually.
Integration Testing	Ensure that all components are interact correctly.	Verified proper integration between frontend, Firebase database, and IMGbb image upload API.
System Testing	Validate the complete system as a whole.	Tested full workflows including login, smart card generation, emergency prescription retrieval, and donor search.
User Acceptance Testing	Simulate end-user validation that system meets business needs.	Feedback from mock HSB officers and test patients confirmed usability and business value.
Regression Testing	Check again and again to see if new updates remain same	After adding features like injection fee tracking, older test cases were re-run to verify system stability.

Non-Functional Testing: This Table 4.2 shows the full non-functional testing for this project.

Table 4.2: Non-functional testing table

Test Type	Purpose	Application in Project
Performance Testing	Evaluate system speed and responsiveness.	Checked load times for login, smart card creation and firebase activities.
Load Testing	Evaluate how the system behaves under anticipated user load.	Check if the number of user become high then how the system behave.
Scalability Testing	Make sure the system can scale to user/data volume.	Tested Firebase's dynamic scaling by increasing patient and donor records.

Security Testing	Test vulnerabilities and verify access security.	Database (rules to block access by non-authenticated users and access to administration section) and firebase authentication.
Usability Testing	Assess user-friendliness and ease of navigation.	Mock testing with HSB officers confirmed Bangla font support and responsive design across devices.
Compatibility Testing	Verify cross-platform/device/browser compatibility.	Ensured proper operation on Chrome, Firefox, Android, iOS, and Windows.
Reliability Testing	Test stability and equivalence of system response	Reply operations such as adding data and generating QR worked fine, which means that the system was not crashed.
Maintainability Testing	Evaluate ease of maintenance and updates.	Use of Tailwind CSS, Firebase, and IMGbb ensures easier debugging and future upgrades.
Portability Testing	Confirm access across different environments.	PWA structure allows access from any device with a modern browser, no need for installation.

Manual Testing:

In Manual testing, there are no automation tools to validate basic functionality, It tested manually such as login process, patient registration process, generation of the QR code and bringing the emergency prescription incurred by the patient into display. It was tested on both desktop and mobile to be responsive and to be able to display Bengali font properly. HSB Officer Test subjects and feedback of HSB officers and test patients was valuable in detecting usability problems at an early stage. This made data management with Firebase and IMGbb easy and the user experience dependable during development.

White Box Testing:

As a personal project, internal testing was carried out with access to the code and logic of the system. This meant unit testing critical functions, such as QR code generation,

Firebase data management and image upload enabling a high level of code coverage and guaranteeing the validation of different execution paths.

Black Box Testing:

And with least help of internal code and just through inputs as well as expected outputs testing was also performed. This strategy has been applied in functional and non-functional testing as well to represent real user interactions and to validate the system's behaviour in end user interaction level.

Security Testing:

Security testing is done to deny unauthorized access to the system and not to be attainable under attacks. Here, we made use of the rules Firebase provides us for security, restricting user access based on their roles. And these rules permit only certain authorized persons (admins and authenticated patients) to take actions such as reading, writing and otherwise fetching and manipulating data, thus guarding the privacy of personal data.

4.2 Results and Discussion

Below table 4.0 showing the result of this project that I have got as well:

Table; 4.0 (Result and Analysis)

Point	Result
System Design	Successfully developed
Emergency Service	Factor near you, Prescription & QR smart cards implemented
Backend	Integrated with Firebase
Features	Donor, emergency & fee management added
Usability	Easy, time-saving
Performance	Reliable with low latency
Limitation	Offline support missing
Outcome	Useful for hemophilia patient care

The system was successfully designed with fulfilling the main goals of the project such as that of providing emergency prescription, generating smart cards with QR codes, and that of integrating seamlessly with the Firebase backend. Testing validated the

reliability, responsiveness and compatibility of the application on devices including specific support for Bengali font. This system, as compared to the current developed platforms like Hemophilia Society of Bangladesh website and WFH's Website, provides extra features such as donor management, emergency service, and injection fee management, which are missing in the available response system. As an additional plus, the system greatly streamlines patient management for HSB admin officers with an easy to use dashboard for tracking patient records, treatment schedules, and payments. Test users reported that it was easy to use and very good in time consumption. It will be a web based mobile application so that patient can easily get access on it. With this kind of project which is useful for hemophilia care we already tried to contact with WFH coordinator so that this project can be available world-wide for all hemophilia patient care not only in Bangladesh.

During this process, hurdles like real-time sync, and QR code generation was achieved taking into account the architecture and the client-side rendering approach applied. Performance was proved to be within acceptable thresholds under realistic loads for users, maintaining low latencies in key features. However, some limitations like offline support is some of the scope of improvements. On the whole, the outcomes confirmed the design of the system and the potential usefulness for the management of hemophilia patient care in Bangladesh.

4.3 Summary

This chapter discussed about the implementation environment, testing strategies, evaluation results and discussion of the developed system. The results demonstrate that the project successfully fulfills its key objectives, providing enhanced emergency prescription access, donor and injection fee management, and efficient patient administration for HSB. Testing confirmed the system's reliability, usability, and performance across devices, with positive user feedback. Comparative analysis showed clear improvements over existing platforms. The chapter concludes with a discussion of challenges faced and opportunities for future enhancements.

Chapter 5

Engineering Standards and Design Challenges

This chapter talks about the engineering principles adhered to in designing this project, its social responsibility and environmental, sustainability, financial, and the relation of the project with complex engineering problems and projects.

5.1 Compliance with the Standards

Standards make sure that a system is reliable, secure and interoperable. In this project, software and hardware, as well as communication standards had to be met.

5.1.1 Software Standards

For making this HSB project we have followed all kinds of Software engineering standards that we needed. I have followed ISO/IEC 25010 standard which emphasizes usability, reliability, maintainability, and security for modern applications as well. This project has been made with very modern technology stack such as- HTML5, Tailwind CSS, JavaScript (ES6+), and Firebase Realtime Database. I have also used some libraries such as jsPDF, html2canvas, QRCode.js, Lucide Icons, and Leaflet.js. JavaScript (ES6+) provided for both frontend and backend development which help me to done this job very efficiently as well. It also provides many libraries so that I can add the functionalities what I want. Tailwind CSS provided a best UI experience in both mobile and pc responsive. I have used Visual Studio (VS) code software for developing this whole project as well. It provided a great environment for developing any kind of project easily. Github helps me for version control of my system also I have used github hosting for deployment and provide the hosted link to Hemophilia society of Bangladesh officers to use it for testing purposes. I have used firebase real-time database which provide me a instant and online friendly data read, write and other activities.

Pros: Real-time updates with Firebase, Lightweight, responsive UI with Tailwind CSS. Easy integration with APIs. Low cost and scalable, Easy to handle.

Cons: This technology is not directly provided any kind off offline uses, it will be shut down if internet connection lost, html2canvas is provided a little bit security during image to pdf generation suitable.

Rationale of selection: These technologies has been selected for easy to implement, scalability, security, and real-time performance. It making a practical and sustainable for this project as well.

5.1.2 Hardware Standards

To implements this project, testing and others server setup working we use Asus vivobook series laptop with configuration intel core i5 processor with 8GB DDR4 RAM, 525GB SSD. The full development plan has been done with this hardware activities as well. This setup was excellent for coding, using Firebase integrations, and managing design tools such as VS Code and GitHub. The development hardware done multitask such as: it could run simulations, test the Progressive web system. Furthermore, the firebase online real-time database, and the cloud hosting service served as the backend infrastructure, and there was no requirement for conventional servers and high up-time. Other options like a dedicated server on the ground or using a more powerful hardware were examined, but this deployment (in size of the project) offers the best compromise between cost and efficiency.

Pros: Great, dependable performance with the i5, SSD and 8GB ram, Portable and lightweight development environment, Firebase online server eliminates the hassle of a local server maintenance, Cost-effective compared to dedicated hardware.

Cons: The machine only had 8GB of RAM, it was lag when we were running various processes at the same time, we had a mid-tier processor (i5) which was extremely slow to run big simulations compared to an i7/i9 and no dedicated GPU, which made running something visually intensive such as map rendering, almost a thing we had to schedule at night and hope to come out ok the next day and single machine dependency, meaning if the laptop held the development, it would not be backed up by additional hardware.

Rationale of Selection: This hardware setup has been selected for its cost-effectiveness, portability, and sufficient performance**,** while Firebase cloud database provide scalability and reliability without extra infrastructure burden.

5.1.3 Communication Standards

Communication standard is mandatory in this project to ensure data flow, security, and coordination across the system. The Firebase Realtime Database was used for real time store and retrieve the patient, donor, Prescription information. This was the key of the instant information in order for administrators, officers, and patients to use in time, for the normal operation of emergency prescriptions, smart card issuing, and donor tracing. The Firebase platform naturally adheres to international security standards like ISO 27001 and SOC2 which also adds an additional layer of security and ensures anyone's project information is being treated by the best practices in the industry. For version control and codebase handling, GitHub was utilized, providing a very streamlined means to keep track of code changes, work together to build/maintain software despite being a solo project. With Firebase and GitHub the team had a strong, stable, and trackable communication flow for work and project management.

Pros: Realtime data communication and secure relay access for patient, donor and prescription information is done with the help of firebase and organized version control and easy project tracking is done with GitHub.

Cons: Full dependency on internet connectivity, limited offline functionality and reliance on third party platforms will at times effectively disrupt the service.

Rationale: For the purpose of system communication, Firebase and GitHub were selected as they are cost-effective, reliable platforms for ensuring smooth operation, reduced system development complexity, and future operational scalability for system updates.

5.2 Impact on Society, Environment and Sustainability

This section outlines that the impacts on the patients and on the ethical and social aspects of the HSB project and on the ecosystem too.

5.2.1 Impact on Life

As we know that Hemophilia patient in Bangladesh are facing many problems with bleeding situation as well. Beside that they don't have any online systemic platform to get service from only one Hemophilia patient care organization in Bangladesh is Hemophilia society of Bangladesh. In any emergency case they need to come to Dhaka for service and in Hemophilia society of Bangladesh, they doesn't have any online system

to manage the transaction of injection, fees and others activities in office. This project is a game changer for the hemophilia patient and Hemophilia society of Bangladesh office also.

The safety and patient care for hemophilia patients in Bangladesh has been greatly enhanced. Emergency prescriptions, smart card identification and real-time tracking of donor help hasten treatment follow up and control injections, and greatly reduce the possibility of complications during bleeding episodes. This directly relates to the increased quality of life and improved accessibility to care.

5.2.2 Impact on Society & Environment

In our society, we always saw that patient with hemophilia disorder who facing any kind of bleeding problem they need factor injection to cure from it. For that he need to travel to Dhaka main office to collect factor injection and there is a huge time and cost wasting in this process. HSB office also don't have any systematic platform to manage all kind of work easily. As a results Bangladeshi Hemophilia society is not able to show their efficiency to the society as well.

The elimination of paperwork, the minimization of administrative burden, and the maximization of administrative burden can all be achieved through increasing the flow of healthcare services. The environmental impact of this solution is negligible because it is web-based, utilizes cloud storage (Firebase) and APIs, and does not rely on any physical infrastructure. Society gains from unrestricted access to online awareness, education, and improved healthcare collaboration.

5.2.3 Ethical Aspects

Basically, this project is ensure the security and data privacy through Firebase real-time database and Role-based access control (RBAC). The patient file is secure and access is only available to authorized HSB officers within their operational role. This is to protect sensitive information like medical records and emergency prescriptions. The design, more ethical than most, included taking informed and uncoerced consent for patient data usage, secure sensitive data, and abiding by cross-border data privacy regulations of health care IT. Moreover, Firebase compliance to data security internationally recognized frameworks like SOC 2 and ISO 27001 provides added confidence data is treated in accordance to information security best practices. The project equally emphasizes patient safety and regulatory compliance so as to attain trust and reliability

in data governance.

5.2.4 Sustainability Plan

The system is built for long-term use, with some persistent backend such as scalable Firebase back end and progressive web app architecture. This also means that we can expand the platform in the future without restriction, expanding into new learning modules, mobile app development or advanced reporting and analytics all without necessarily having to change the underlying architecture significantly. The system achieves high maintainability, is cost effective, produces low environmental impact in the market, and supports rapid growth through sustainability and scalability in long term by utilizing public cloud services and widely supported open-source libraries.

5.3 Project Management and Financial Analysis

It is a very important part while developing this project, there are many expenses need for purchasing online tools and subscription to use. For management this project financial analysis plays a vital role here. In below table:5.1 show the estimated financial analysis for this project. Please note that the funding for this project get from Hemophilia society of Bangladesh.

Table: 5.1 (Estimated Financial analysis)

Item	Cost (BDT/month)
Firebase Hosting (Free Tier to Paid)	2,750
IMGbb API Subscription	1,100
Mobile Internet(Emergency)	2,200
Domain & Hosting (will be needed)	5,500
Maintenance, updates	1,100
Miscellaneous (Printing, Backup Storage)	500–1,000
Total	**13,150–13,650**

5.4 Complex Engineering Problem

5.4.1 Complex Problem Solving

In this table:5.2 showing the mapping of complex problem solving for this project as

well based on mention criteria below such as-Knowledge, analysis, familiarity, stakeholder etc. Selected (✓) point will discuss below the table.

Table 5.2: Mapping with Complex Engineering Problem.

EP1 Dept of Knowledge	EP2 Range Of Conflicting Requirements	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent Of Stake-holder Involvement	EP7 Interdependence
✓		✓	✓	✓	✓	✓

Mapping Discussion-

EP1: I need to applied modern technology stake implementing this HSB project like-HTML5, Tailwind css, JavaScript and Firebase real-time database analysis with the full knowledge. Also need to learn the history of Hemophilia patient care in Bangladeshi office. Need to learn the working procedure of Hemophilia society of Bangladesh.

EP3: Required to ensure the system work perfectly in any time need to test a various testing way as well, which is make by simultaneously. Also check the security issue for patient database and other official medical data.

EP4: As I have been seen some patient with hemophilia who studying in our university (DIU). I get information about their disorder and know about the hemophilia society of Bangladesh who serve hemophilia patient but the they don't have any systematic infrastructure as well.

EP5: As you have already known that this is a web-based system for serving hemophilia patient through Hemophilia society of Bangladesh, there will be lots of chance to update the existing code for adding new type of features for hemophilia patient and admin as well for smooth transaction. Not only Bangladesh, this project can be usable around all NMO countries under World Federation of Hemophilia (WFH)

EP6: Hemophilia Society of Bangladesh is play a main role of stakeholder involvement.

They support me to share about my planning for Hemophilia society of Bangladesh and provided all types of support like-funding, assigned as a Core developer of there organization for making this project. Also WFH showed interest when officers of HSB share them about this project.

EP7: This HSB project is not solve a single problem. There is a challenge on high level with many subproblems (e.g. data security, ease of use, real-time communication). Every element relied on proper overall integration to deliver an operable and dependable answer.

Mapping with Knowledge Profile

The below table (table:5.3) shows the mapping of EP1 with knowledge profile:

Table 5.3: Mapping with knowledge Profile

K1 Natural Science	K2 Mathematics	K3 Engineering Fundamentals	K4 Specialist Knowledge	K5 Engineering Design	K6 Engineering Practice	K7 Comprehension	K8 Research Literature
	✓	✓	✓	✓	✓	✓	✓

K2: For making QR based Id card system I need generate QR code based on patient ID number, Shorting list the patient in ascending or descending order, Search Patient information, transaction history by patient registered id as well.

K3: Engineering fundamental for software development included Software development life cycle (SDLC) model; Iterative model, Software testing. Applied in building system architecture and core web functionalities.

K4: For making this web-based system for hemophilia patient in Bangladesh, I have learnt more core information about a very unknown bleeding disorder hemophilia. I have also learnt to work with lots of libraries, framework and online real-time database as well.

K5: Software development process diagram (Iterative), Implementation process architecture included- requirements analysis to step by step implementation and testing, use case diagram, Data flow diagram (DFD) also shown here to flow the data of these system, Use case diagram.

K6: Implementing Firebase's rules and real-time database setup, GitHub version control, coding styles etc. are all part of the practical engineering execution. Without this engineering practice, the system wouldn't be maintainable or scalable (future updates, bug fixes, database growth).

K7: The initiative safeguards managing sensitive patient data in an ethical way, and upholds public safety. It is good for hemophiliacs because it aids by quick access to emergency and donor information that lead to better treatment possibilities. It's inclusive in that it supports both Bangla and English, and economical by utilizing cloud services – a sustainable solution.

K8: I have overviewed some research paper based on hemophilia. I get lots of knowledge from this paper guideline about hemophilia. As a very uncommon disorder it is must be needed some to learn about this unknown disorder by reading research literature. The literature that I have been learnt is give me more clear knowledge about the hemophilia and care guideline.

5.4.2 Engineering Activities

In this section, I have mapped engineering activities (EAs) among stages and multiple aspects of complex engineering problems. It focuses on knowledge regarding which type of EAs have impact on resources, societal impact, innovativeness, and problem familiarity. A summary is shown in Table 5.4 for the relationships of each EA and corresponding influence factors.

Mapping with Complex Engineering Activities

Table 5.4: Mapping with Complex Engineering Activities

EA1 Range of resources	EA2 Level of Interaction	EA3 Innovation	EA4 Consequences for society and environment	EA5 Familiarity
✓	✓	✓	✓	✓

EA1: There are different types of resources used in this project. With combined huge requirements gathering from patients and HSB officers, some existing system for

hemophilia patient care, open source libraries etc.

EA2: There are very high level of interaction with hemophilia patients and HSB officers about the project and what type of problem they have face for lacking this system and what kind of solution will be better for them as well.

EA3: As you know that there is no online systematic infrastructure for Hemophilia society of Bangladesh. So, this project is one of the web-based system for hemophilia management and care. Emergency prescription for hemophilia patient and factor near you for finding factor injection nearby is one of the innovative works that I have done through this project as well.

EA4: Impacts on health care in Bangladesh particularly for hemophilia patients, the HSB project has important implications for healthcare in Bangladesh, and more specifically for hemophilia patients. It contributes to patient safety and quality of care by allowing for real time data, emergency prescriptions and donor tracking. It is internet-based to cut down on paperwork and environmental waste, although placing so much of the project in the hands of internet connectivity is a challenge you can only get so far ahead of.

EA5: I have some previous knowledge about the very rare disorder hemophilia from my friends who have it and know about their administrative activities of the main office.

5.5 Summary

The engineering standards, design difficulties, and social consequences of the HSB project are described in this chapter. Use of software standards and modern technologies (i.e., HTML5, Tailwind CSS, JavaScript, Firebase) supported usability, reliability and maintainability, and real-time data processing. Development was well supported on the hardware (Asus Vivobook) and data exchange (for secure, synchronized data flow) was deployed through Firebase and GitHub. It serves patients through emergency prescriptions, smart card identification and donor tracking and lowers administrative burden and increases accessibility. Ethical safeguards and sustainable strategy preserve data safety, expandability, and usability in the long term. Sophisticated engineering issues were solved by combining healthcare knowledge, secure web habits and low-level scientific engineering work.

Chapter 6

Conclusion

This chapter provides a complete overview of the results of the project, the limitations we encountered during its development, and the suggestions for the future work to improve the functionality and use of the system.

6.1 Summary

The goal of this project is to develop and design a complete web-based management system for the hemophilia patient which is operated under the Hemophilia Society of Bangladesh (HSB). The proposed system has effectively fulfilled the core goals through the features it has introduced for granting immediate prescription, generating patient smart cards encoded with QR codes, and managing the factor and it's donor information and patient activities management. Integration with Firebase guarantees instant data updates and flawless backend performance. Patient portal for hemophilia patients are catered through Bengali language support and responsive UI which is responsive to different devices. The system tackles the unaddressed needs in the systems available (HSB website and WFH's website) such as donor management, emergency services, and a simplified management of patient data for the HSB administrators. Meticulous manual and partially automated system testing resulted in the verification that the system is reliable and user friendly. Test users' feedback highlighted the user-friendly interface and efficiently designed workflows, evidencing an opportunity for the system to greatly enhance hemophilia patient care management.

6.2 Limitation

Even though it had resulted in successful deployment, a number of limitations were discovered through out the development process.

1. Native Mobile Apps: It Can be used as a Progressive Web App, which means that it can not be used offline and has no mobile-specific features.
2. Manual Testing: The majority of testing is currently performed manually, and may slow down as the system expands.
3. Third Party Image Hosting: Involves the use of IMGBB to store images that pose

questions of reliability and long-term privacy of data.

4. Internet Dependency: It requires that it has a stable internet connection to run Firebase operations that could be problematic in locations with low internet access.
5. Minimal Security: Advanced security features, such as multi-factor authentication and enhanced encryption have not been implemented.

6.3 Future Work

In order to overcome these limitations and to extend system functionalities, several future directions are foreseen. Native mobile app for Android and iOS will help – increase accessibility, provide for offline mode, use device-specific features to save user time. The more that you can test automatically, the more reliable and maintainable the system. Moving image and file storage to more powerful cloud services such as Google Cloud Storage or AWS S3 will improve the security and longevity of data. Focusing on enhancing system security with multifactor authentication and encryption of data to ensure that patient information data is safe will be an important part of our security initiatives. Other features such as booking appointments, real-time emergency notifications, enhanced analytics for patient health monitoring, and APIs for interoperability with external health system could enhance the support for HSB's agenda to improve hemophilia services all over Bangladesh. Iterative improvements will progress the system better and better over time in response to the continuous feedback from the user base. This project is not only made for Bangladeshi hemophilia patient, but also we will share this project to all over the world all NMO countries under WFH for hemophilia care as well.

References

[1] D. Chaccroboti, B. R. Mitra, and M. U. Mojumdar, "HemoData: A Comprehensive Dataset for Hemophilia Diagnosis and Research." Mendeley Data, Nov. 25, 2024. doi: 10.17632/962WD8BCH4.1.

[2] A. Srivastava *et al.*, "Guidelines for the management of hemophilia," *Haemophilia*, vol. 19, no. 1, Jan. 2013, doi: 10.1111/j.1365-2516.2012.02909.x.

[3] N. Islam *et al.*, "Clinical profile and demographic characteristics of moderate and severe hemophilia patients in a tertiary care hospital of Bangladesh," *Orphanet J Rare Dis*, vol. 17, no. 1, Dec. 2022, doi: 10.1186/s13023-022-02413-7.

[4] L. W. Hoyer, "Hemophilia A," *N Engl J Med*, vol. 330, no. 1, pp. 38–47, Jan. 1994, doi: 10.1056/nejm199401063300108.

[5] S. Islam, A. A. Morshed, and Z. J. Khan, "Hemophilia in Children," J. paediatr. surg. Bangladesh, vol. 6, no. 2, pp. 54–63, May 2016, doi: 10.3329/jpsb.v6i2.27750.

[6] P. M. Mannucci, "Hemophilia therapy: the future has begun," *Haematologica*, vol. 105, no. 3, pp. 545–553, Mar. 2020, doi: 10.3324/haematol.2019.232132

[7] Hemophilia Society of Bangladesh- https://hemophiliabd.org/; checked by 07-04-25

[8] Word Federation of Hemophilia- https://wfh.org/; checked by 15-05-25

[9] National Hemophilia Foundation (NHF) Website, USA: https://www.hemophilia.org; checked by 15-05-25

[10] CMC (Christian Medical College), Vallore, Chennai, India- https://www.cmch-vellore.edu/; checked by 24-06-25

[11] Popular Diagnostic Centre Ltd - https://www.populardiagnostic.com/; checked by 05-07-25

[12] BRB Hospital LTD- https://www.brbhospital.com/; checked by 05-07-25

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