

**VAXCENTRAL : DESIGN AND DEVELOPMENT OF AN
INTEGRATED VACCINATION SYSTEM**

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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 “VaxCentral: Design and Development of an Integrated Vaccination System”, submitted by **Husni Ara Kabir Saki** and **Shawon Mandal** 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 **15 July, 2024**.

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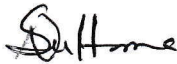

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We hereby declare that, this project has been done by us under the supervision of **Ms. Naznin Sultana, Associate Professor, Department of Computer Science and Engineering** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

The project we proposed “VaxCentral ” is a web application which is designed to revolutionize the vaccination process of our country by using the power of digital technology. With this application we hope for a more efficient, accessible and user-friendly vaccination process. This application will act as a center of vaccination and related information. It will provide users the ability to check their vaccination schedule and users will get a reminder before every dose of vaccination. In this website there will be information available about the vaccine and by doing that we ensure that they can make their own decision about when to take the vaccine and when not. In this app there will be information about the availability of the vaccine. VaxCentral will have a secure and private database to store users’ data and for only research purposes, the data can be used. And the database will provide users with information about the vaccination information of which vaccine they took and which dose is coming. And this information will be crucial for the users because they can fit it into their schedule. By making the vaccination process more transparent and efficient, VaxCentral will not only contribute to individual health but also to public health outcomes. It underscores the potential of digital health tools in enhancing healthcare delivery and promoting health equity. VaxCentral represents a significant step towards the power of technology which we can use to improve the health sector.

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CHAPTER 1

Introduction

1.1 Overview

Everyone has the right to access life-saving vaccines. This project is promoting vaccine awareness and ensuring that vaccines are available to all, and the vaccination cycle should run smoothly without any kind of interruption. In this project, we aim to provide a comprehensive overview of the current state of the vaccination system, including challenges, and future growth opportunities. We will analyze the impact of developing technologies such as artificial intelligence and digital technology and social dynamics on vaccination. Additionally, we are trying to develop a new digital platform for vaccination, which will help us in the upcoming days by tracking our health.

1.2 Background and Present State

Nowadays if we go to any hospital or health center for any vaccination like Varicella (Chickenpox) or DTaP (Diphtheria, tetanus, and whooping cough (pertussis)) then they will give that particular vaccine and then write down the first dose date & next dose date in a vaccination card. So, this is a manual process both for the health center and consumer to remember the date of next vaccination date or what vaccine shouldn't take yet and also keep the track of every data, which consumes a lot of time.

Current Situation: Our nation still frequently uses pen-paper as proof of vaccination, which presents a number of problems such record loss or damage, restricted accessibility, and verification issues.

Desired State: The goal is to move away from paper-based vaccination records and toward a comprehensive digital platform that provides efficient, safe, and easily accessible management of immunization data for all vaccine kinds.

Feasibility Analysis:

We have done some survey about the necessity of the application VaxCentral. We talked to some of the health center workers who is in charge of the data tracking and to the people who seek for vaccination. For health center workers they have to keep track of how many people they have given vaccine every day and also have to check the list every day to remind the people about their next dose of vaccination. They also have to calculate how many doses they have to preserve for people. People also have to go through hassles because they have to carry the health card provide by the health care centers. If somehow, they lost that health card it could cause trouble for both. Also, those who are parents of several child it is very difficult to maintain the dates properly. These are the problems we get from health centers and peoples. Our application “VaxCentral” can meet all of these problems.

1.3 Problem Statement

Vaccination is a crucial aspect of primary healthcare and a fundamental human right, protecting individuals from over 10-15 life-threatening diseases. However, Bangladesh lacks an integrated website or application to automate and manage the vaccination process for its growing population. The current manual system is prone to errors, inefficiencies, and delays, causing people to miss vaccination dates or lose their vaccination cards.

A centralized system for monitoring and automating the vaccination process is essential to address these issues. Such a system would streamline operations, reduce human error, and enhance the overall efficiency of vaccination programs. This project aims to develop an integrated vaccination website that offers comprehensive vaccine management and automated reminders, making the process easier and faster. By replacing traditional methods with a digital solution, we hope to improve individual compliance with vaccination schedules and enhance public health outcomes, aligning with the vision of Digital Bangladesh.

1.4 Objectives

Main motivation behind this integrated vaccination website is to automate the total vaccination cycle and digitalize Bangladesh. As we all know the traditional way of

vaccination is hand-written and the people who want to take those vaccines have to remember the date of vaccination if there are multiple doses of the vaccine. So, there might be a chance of forgetting the date and missing the date or can lose the card of the vaccination. Both the people and the authorities will face the consequences or hassles in this type of situation. By conducting this research, we hope that the process or vaccination cycle will be faster than now and it will be more convenient to both the general people and the management. Additionally, we will take opinions from general people to make the system more convenient.

In this vaccination research paper, we tried to enhance the immunization landscape and guide individuals, healthcare providers, professionals and policymakers. Analyzing today's need for general people and healthcare development, our objective is to find opportunities for development of vaccination practice. During analysis potential risks and challenges are also recognized. Additionally, we aim to explore social dynamics, digital platforms, influence vaccination and contribute to the overall vaccination programme. By doing this, we hope that we will be able to introduce our country to a new dimension of the vaccination system.

1.5 Project Scope and Limitations

As there is no existing integrated vaccination system in Bangladesh, so the project scope and future growth is very high. For user satisfaction, integrating AI chatbots can use in future. The integrated vaccination site can be upgraded by intensifying to include medical professionals and public health activities, integrating telehealth and telemedicine for practical healthcare, and using advanced statistics and analytics for resource distribution. Intensifying parenthood & adulthood care could increase the system's function in healthcare administration, public health, and medical facility improvement in Bangladesh.

The infrastructure needed to support a digital platform for vaccinations is lacking. There is SUROKKHA, but it only works with covid 19. Our app will be available for all vaccines. Strong digital systems, safe authentication procedures, and user-friendly interfaces that are suitable for a variety of users including those with little experience with technology are all necessary for this. Integration with Current Systems: Current healthcare systems, immunization databases, and other digital platforms are not integrated. Data Security and Privacy: There is an issue in the protection of digital

records' security and privacy. Sufficient protocols must be put in place to guard private medical data against illegal access and security breaches.

1.6 Report Organization:

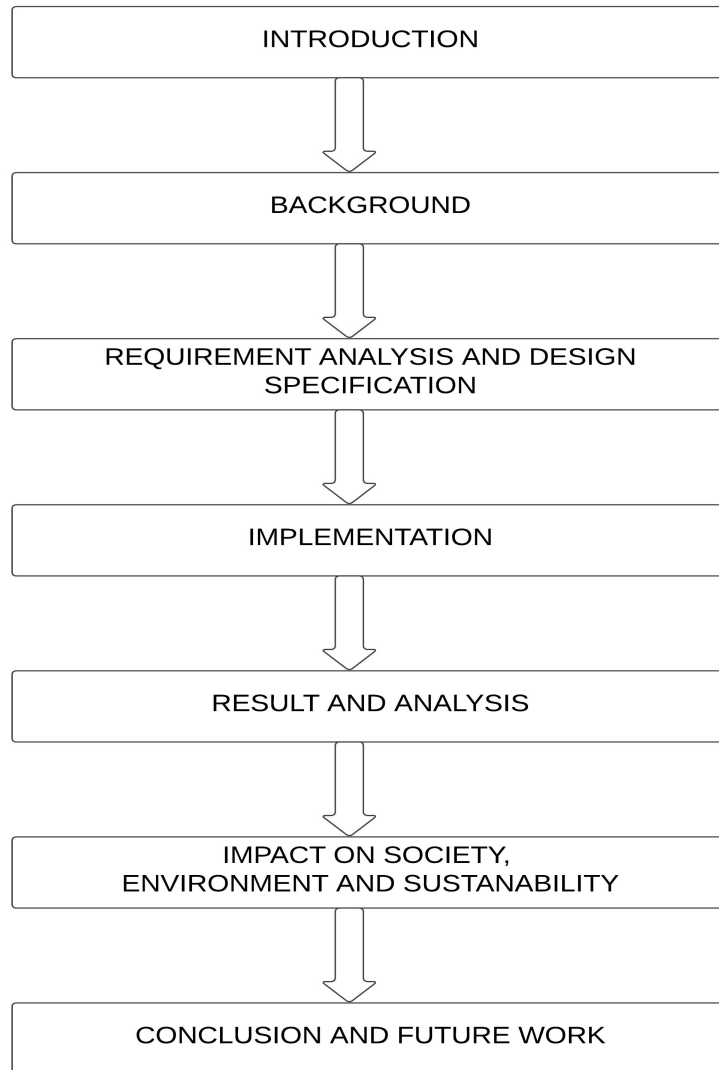


Figure 1.6.1 : Report Organization

This report is structured into seven key sections. The Introduction provides an overview of the project and its objectives. The background analyzes existing research and competitive works in the field. The Requirement Analysis and Design Specification section details the requirements and design for the proposed system. The Implementation section describes the development and deployment of the system. The Result and Analysis section presents the outcomes and evaluates the system's performance. The Impact on Society, Environment, and Sustainability section discusses the broader implications of the project. Finally, the Conclusion and Future Work section summarizes findings and suggests directions for future research.

1.7 Summary

As the development of this integrated vaccination website aims to serve the nation and the country to atomization, that's why it carries several expectations. The interface and functionality will be easy enough so that every class of people can interact comfortably. It will encourage the people to use the application, as they don't have to face any difficulty while using the website. Most important thing is to keep secure the database, if it goes on wrong hand there might have change to misuse through it, so that the people have reliability on it. The website will also provide the information of immunization place, helpline number, search option for both signs up or non-sign-up people for checking eligibility of vaccination and also save the time of healthcare authority by few clicks. Finally, this first vaccination website helped both the people, health care authorities to do their work and digitalized the country. This chapter concludes the necessity of vaccination atomization, integrated vaccination system and how we can overcome the existing problems with this application. Also shown the working procedure or planning of building this web application. Implementation of this project can replace the traditional manual paper-based method.

CHAPTER 2

Background

2.1 Overview

This chapter provides an analysis of existing and competitive works in the field of vaccination management, highlighting challenges and outlining the main functionalities and intended end users of our proposed integrated vaccination website. We examine SUROKKHA in Bangladesh as a local example focusing on COVID-19 vaccine registration, contrasting it with international systems such as the CDC's Vaccine Information Statement in the USA, Vaccines.gov, health.gov.au in Australia, and coronavirus.data.gov.uk in the UK. Our aim is to introduce a comprehensive platform that integrates all vaccine management, addressing current gaps and leveraging technological advancements to enhance vaccination practices in Bangladesh.

2.2 Related Works

In the context of our country, we are aware that there is an existing system named SUROKKHA[1], which exclusively manages the COVID vaccine. Our government implemented it nationwide for easy registration for both dose of COVID-19 and booster dose. This platform allows users to register for only the COVID-19 vaccine. It was necessary and an essential early step toward the idea of Digital Bangladesh.

In the context of foreign countries (USA), there is a Vaccine Information Statement which is the Centers for Disease Control and Prevention (CDC[2]). It is essential for monitoring adverse responses and to keep the vaccination recording. Vaccines.gov[3] is also an American site to increase vaccination awareness. health.gov.au[4] is the Australian website for health where everything is available but on a much larger scale. In the UK the site is called coronavirus.data.gov.uk[5] which is only the stats of coronavirus.

2.3 Comparison between existing works

There are no direct competitors to our idea in our country. Surokkha covers only one part of a puzzle. And our app will be the knot to tie all the vaccines together. When we are going to break a traditional system and want to replace it with a digital version, it is sure that we are going to face problems. Although SUROKKHA tackles a crucial facet of public health, its purview is restricted to COVID-19 vaccinations alone, resulting in a notable deficiency in the handling of other vital vaccines. Internationally, there are a number of platforms that provide a range of functionalities targeted at improving vaccination campaigns and public health monitoring. These include the Vaccine Information Statements from the Centers for Disease Control and Prevention (CDC) in the USA, vaccines.gov, health.gov.au in Australia, and coronavirus.data.gov.uk in the UK. There are some significant differences between the suggested web application and these previous developments. In contrast to SUROKKHA, which concentrates only on COVID-19 vaccination, the proposed online service seeks to include all vaccinations, offering a complete vaccine management solution. The practice of digitizing vaccinations and providing centralized tracking of all vaccines provided serves to meet a crucial need for more efficient documentation and management of healthcare records. Additionally, the suggested web application gives customers more freedom and control over their health data, enabling them to efficiently maintain their immunization records. To put it simply, current platforms are essential in their own right, but they are frequently limited in terms of capability, accessibility, or scope. In order to close these gaps, the suggested web application provides a comprehensive solution that works well with current systems and adapts to the changing needs of a society that is becoming more and more technologically adept. As we know our country is still young and growing, it will be a good step forward to digitize the vaccination process and take the opportunity offered by current technology. It would be hugely beneficial to our nation to see how such an application integrates with the existing system and maximizes vaccination.

2.4 Open Issues

Despite the potential benefits, several challenges must be addressed for the successful implementation of our integrated vaccination website. Integrating the platform with existing healthcare systems like SUROKKHA is crucial for seamless data exchange. Encouraging adoption among healthcare providers and the public, and addressing

resistance to changing from paper-based methods, is essential. Ensuring data privacy and security, adhering to standards, and addressing disparities in internet access and digital literacy are vital. The system must be scalable to accommodate future population growth and vaccination needs. Robust technical support, regular maintenance, and interoperability with various healthcare software are necessary. Securing funding, navigating regulatory requirements, and implementing continuous evaluation and feedback mechanisms will help create an effective and user-friendly vaccination management system, improving public health outcomes in Bangladesh.

2.5 Summary

End of this chapter, we can clearly see that there is almost no integrated website existing like this one. Additionally, the challenges are difficult to overcome, but the project scope is very high. This vaccination website can play a crucial role by addressing these challenges and can create a successful immunization experience. With its user-friendly interface, robust security measures, and comprehensive features, VaxCentral is poised to revolutionize the way vaccinations are managed and tracked, ultimately contributing to higher vaccination rates and improved public health outcomes. This platform's potential to streamline vaccination processes and enhance accessibility underscores its significant impact on healthcare systems and communities worldwide.

CHAPTER 3

Requirement Analysis and Design Specification

3.1 Overview

Before starting work on a software or website the requirement should be crystal clear or most of the planning should be done. So, in this chapter we will see what kind of software, hardware we will use and also discuss the functionalities through various kinds of models and the terminologies related to this project.

3.2 System Design

System Model:

A system model is a way of showing what a website does and how it works. A system model is also used to understand and improve the system. There are various types of system models: Functional decomposition model, object-oriented model, behavioral model, control flow model etc.

We used a flowchart system model which goes under Control flow model to build the website. Because it is such a type of system that requires flow and sequence of the events in the vaccination process. It helps us to understand the logic of the system in a clear way and it works very well for describing procedural systems such as user login. We used different types of icons to design the system model such as oval rectangles, diamond and arrows.

The diagram of the system model is:

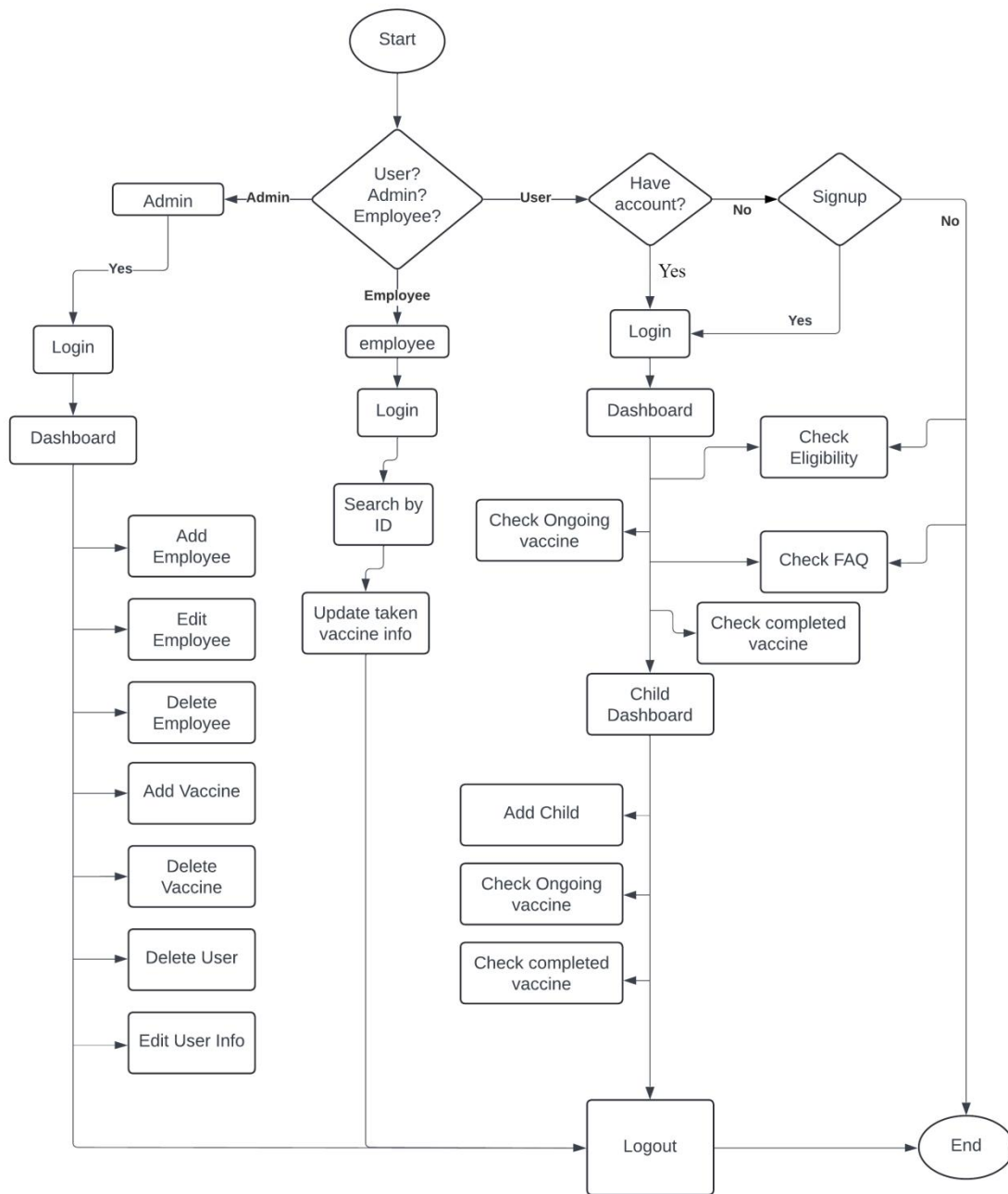


Figure 3.2.1 : System Model using Flowchart System model

BPM :

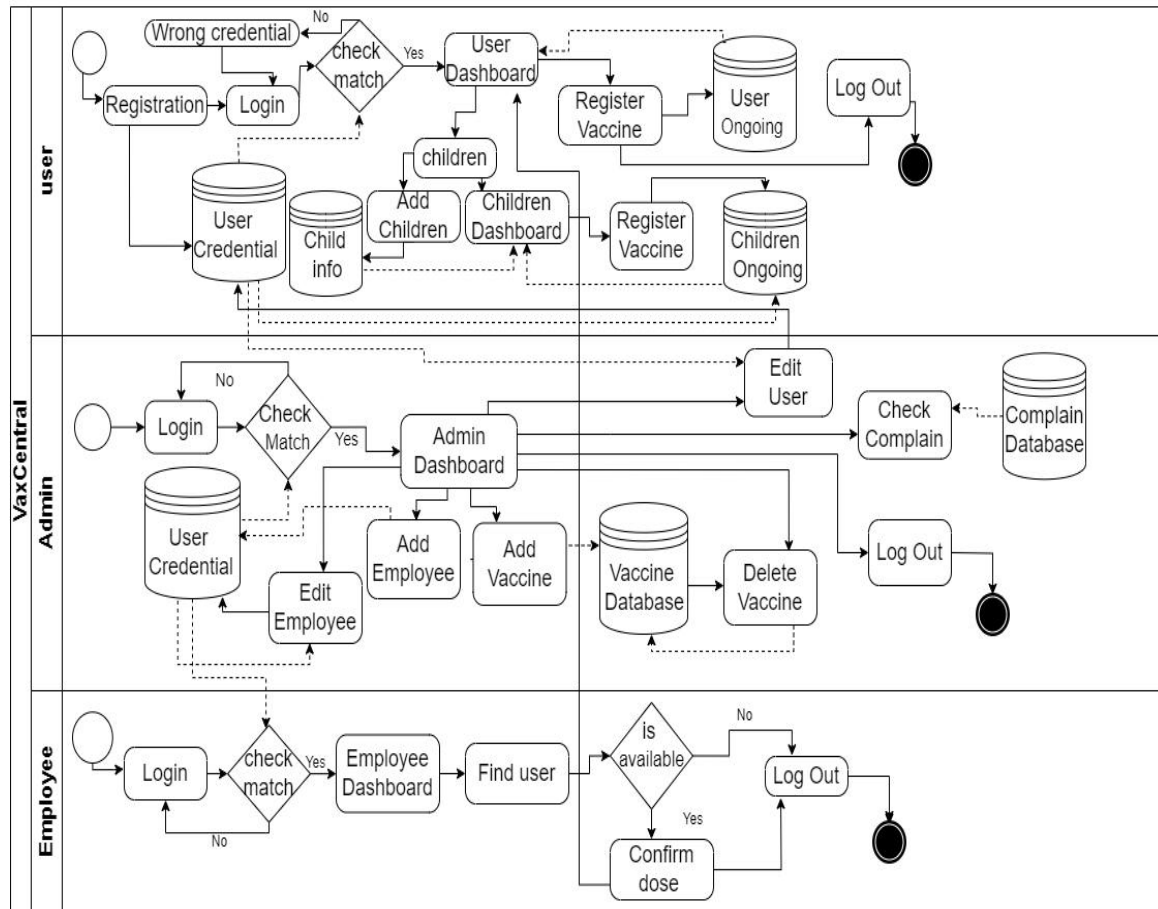


Figure 3.2.2 : Business Process model

The Business Process Model (BPM) diagram for VaxCentral outlines the workflows and interactions between different user roles (User, VaxCentral Admin, and Employee) within the system. The diagram is divided into swimlanes, each representing the activities of a specific role. For Users, the process begins with registration or login, leading to the User Dashboard upon successful authentication. From the dashboard, users can add children, navigate to the Children Dashboard, and register vaccines for themselves or their children. The process includes the option to log out, ending the session. The VaxCentral Admin workflow starts with login verification, followed by access to the Admin Dashboard where admins can manage user information, add or edit employee details, handle vaccines in the Vaccine Database, and address complaints in the

Complaint Database. Admins can also log out to terminate their session. Employees, upon successful login, access the Employee Dashboard to find user information and manage vaccine confirmations and scheduling. They can check user availability, update vaccination records, and log out when done. The BPM diagram also highlights the interaction with various databases that store user credentials, child information, ongoing vaccination processes, complaints, and vaccine details. This comprehensive representation ensures clarity in the processes for registration, login, dashboard navigation, vaccine management, and complaint handling for each role in the VaxCentral system.

Use Case Diagram:

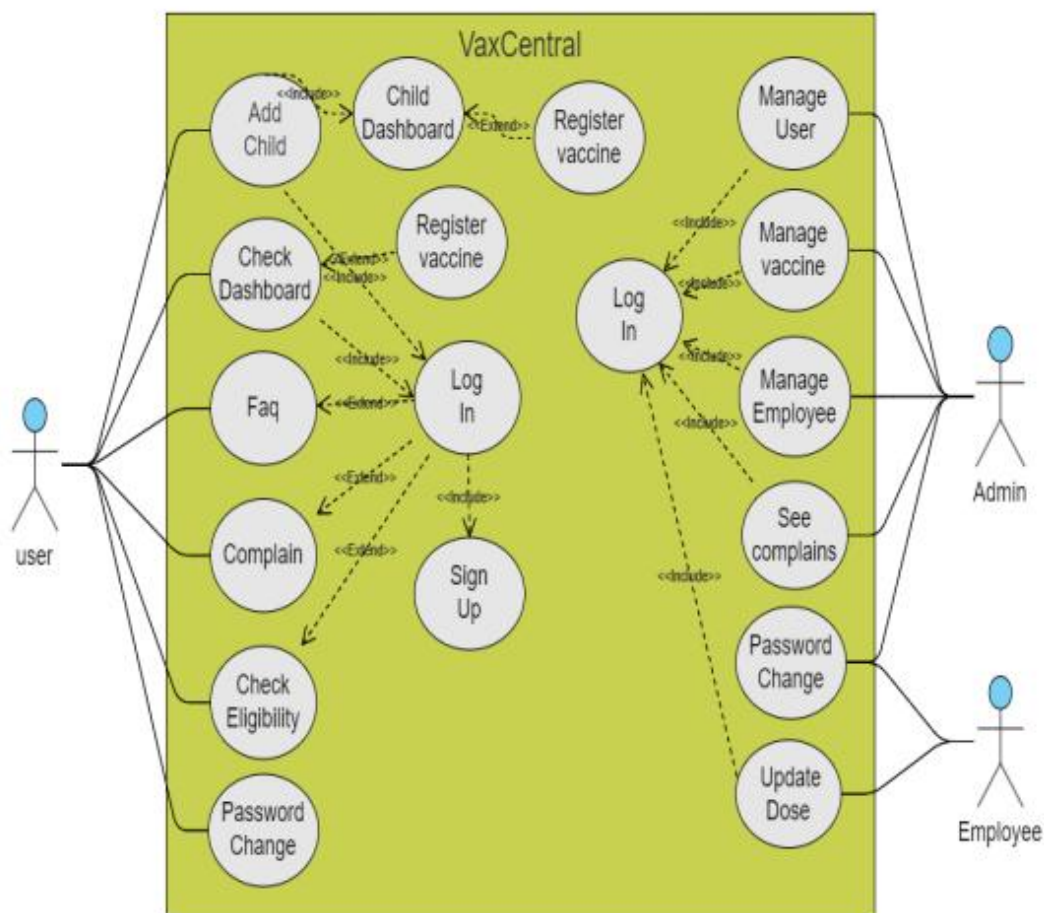
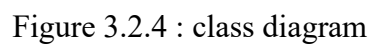


Figure 3.2.3 : Use case diagram

Class Diagram:



For VaxCentral class diagram represent the structure of the system which shows it classes, attributes, method and the relationship between the classes. Here the box shows the classes and the arrows shows the relationships between the classes.

3.3 Hardware and Software Requirement

The software and hardware we will use and already used are mentioned below:

1. Visual Studio code: It is an IDE which is compatible with windows, mac and linux. It is used for many purposes, including web application development. It is user friendly, reliable and easy to use.
2. PC: Any computer that can properly run Visual Studio Code can be used. We used our personal laptop given to us by our university.
3. jmeter : For load testing.
4. postman: For api testing.

Functional requirements:

1. System should allow 3types of users. Admin, Employee, user.
2. When they log in, it should authenticate them with the mobile number and password.
3. It should provide different types of functionalities for different types of users.

Such as for User:

User:

- Register for himself.
- See the dashboard.
- Check Eligibility of the vaccine.
- Register for the kids.
- See the dashboard of child.
- Check Eligibility of the vaccine.
- can send a complaint using contact.
- can change password

Employee:

- Update Completion information.

- can change password

Admin:

- Manage Accounts.
- Add a vaccine.
- Delete a vaccine.
- Update a vaccine.
- can change password

4. System should store the user's data and records in a secure database.

Non-functional requirements:

1. The system should be user friendly and easy to use.
2. It should be reliable and up to 24/7.
3. System should be secure.
4. It should be maintainable and adaptable to technological changes.

Terminologies:

Admin: This role is the most important role of this system. Admin can manage all accounts and if any vaccine comes out admin can add it to the website and also update and delete if needed.

Employee: This role is like a nurse who updates the completion status using the user id of the user when a dose is given.

User: A user can register for his/her child. Suppose a child is 5 years old. He/she can't register for themselves. So, a user has to open an account, and then the user will be able to register a vaccine for his/her child. And he/she can control the account. user can also register for themselves and see the ongoing ,completed and available vaccines for themselves and child too.

Vaccine completion: This will be activated when all doses of vaccine are given. The completed vaccine will be added to the completed vaccine list.

Dashboard: This is the main interface of a user. Here the user will be able to see almost all information he needs to know. Suppose a parent will be able to see how many doses of vaccine is left for which child, the date etc. and in the children section user can see the child's info too and separately their dashboard.

Eligibility: Eligibility means the availability of something. There are many vaccines that have to be taken at some age. So, a user will be able to check the eligibility of vaccines according to their age.

Performance: This means the system's efficiency and speed. It ensures that the user has a smooth experience while using the system.

Scalability: This is the system's ability to handle a growing amount of work and its potential to be enlarged to accommodate growth. It ensures that the system can effectively manage an increasing number of users and vaccines.

3.4 Project Management and Financial Analysis

Project Management

- **Project Objectives:**

- A. Develop a vaccination site both for health care centers and vaccine seekers to run the vaccination process smoothly
- B. Give a solution for huge data management and vaccination supply flawlessly to the health care centers. Vaccine seekers can manage their vaccine doses easily with the help of VaxCentral.
- C. Replace the traditional hand written method which will help both.
- D. Educate people about vaccination importance. So that the lack of vaccination disease can be prevented, also can reduce the newborn death rate.

- **Resource Planning:**

- A. **Equipment and Tools:**

- Development and Testing Servers
- High Performance PC
- Version Control System

- B. **Software and Technologies:**

- **Front-End Technologies:** HTML, CSS, Tailwind CSS, Daisy Ui, JavaScript, React Js
- **Back-End Technologies:** Node Js, Express Js
- **Database Management System:** MongoDB

- **Server Hosting:** vercel
- **Front end hosting :** netlify

C. Data and Content:

- **Website Information:** Taken from the health database
- **Profile Information:** Given by the users through login

D. Training and Skill Development:

- UI & UX design
- Framework React Js, Tailwind CSS

● **Risk Management:**

Risk management for VaxCentral website involves a SWOT analysis (Strength, Weakness, Opportunities, Threats) can help to evaluate the process.

○ **Strengths:**

1. Can access to medical professionals
2. Have strong technological infrastructure
3. Make partnerships with healthcare organizations
4. Keep track record of reliable information

○ **Weaknesses:**

1. Can maintain limited resources
2. The target audience have low awareness
3. Data security vulnerabilities
4. Dependent on external factors

○ **Opportunities:**

1. Nowadays increasing the demand for online health services
2. Can collaborate with healthcare providers
3. Integration of innovative technologies

○ **Threats:**

1. Misinformation impacting public health

2. Cybersecurity threats
3. Public health emergencies

By addressing all of these risks the VaxCentral website can effectively encourage vaccination and can contribute to public health areas.

Financial Analysis:

Table 3.4.1: Estimated Cost for VaxCentral Development

SN	Components	Estimated Cost (BDT)
01	Doing Online Course or Training for learning new technologies	1000-1500
02	Documentation and Report Writing	1500-2000
03	Miscellaneous	2000-3000
04	Contingency	750-1000
	Total Estimated Cost	5250-6500

3.5 Summary

With the help of this chapter's analysis, we will be able to proceed with our work without any confusion. The work will be more organized with its guidance. To carry out VaxCentral properly, the necessary guidelines must be followed. Moreover, this chapter is essential for conducting the next phases of the system. It provides a clear roadmap and sets the foundation for the implementation and testing stages. By adhering to the insights and recommendations outlined here, we can ensure a smooth and efficient development process, ultimately leading to a successful and reliable vaccination management platform.

CHAPTER 4

Implementation

4.1 Overview

VaxCentral is an integrated vaccination system which vision meets reality. Here, we are building a strong foundation with secure database and user-friendly design HTML, CSS, Tailwind CSS, JavaScript and React, focusing on two main thing that are ensuring data security (back-end) and easy to use on different devices (front-end). To meet everyone's need we are creating custom dashboards for executive parents, adults and admin. Also, we are testing to make sure that everything works perfectly.

4.2 Prototype Design

The VaxCentral prototype, created using Figma, embodies a blend of functionality and aesthetics aimed at delivering a seamless user experience. The design process focused on several key principles:

1. **User-Centered Design:** Every aspect of the prototype was crafted with the user in mind. This includes intuitive navigation paths that guide users effortlessly through the platform. Clear call-to-action buttons and prominent information displays ensure that users can easily find the vaccination information and services they need.
2. **Visual Consistency and Clarity:** A cohesive design language was established through consistent use of typography, color palette, and iconography. This not only enhances visual appeal but also improves readability and comprehension of content across different sections of the prototype.
3. **Accessibility and Responsiveness:** Accessibility features were integrated to ensure that the prototype is usable by individuals with diverse needs. This includes adherence to accessibility standards for color contrast and text size, as well as responsive design elements that adapt seamlessly to various screen sizes and devices.

4. **Interactive Elements:** Interactive elements such as dropdown menus, interactive maps for locating vaccination centers, and form inputs were designed to be both engaging and functional. These elements facilitate user interaction while maintaining a streamlined interface.
5. **Feedback and Iteration:** Throughout the design process, feedback loops were implemented to gather insights from potential users and stakeholders. This iterative approach helped refine the prototype, ensuring that it meets the needs and expectations of its intended audience effectively.

Overall, the VaxCentral prototype in Figma represents a comprehensive solution designed to provide accessible, clear, and user-friendly access to vaccination-related information and services

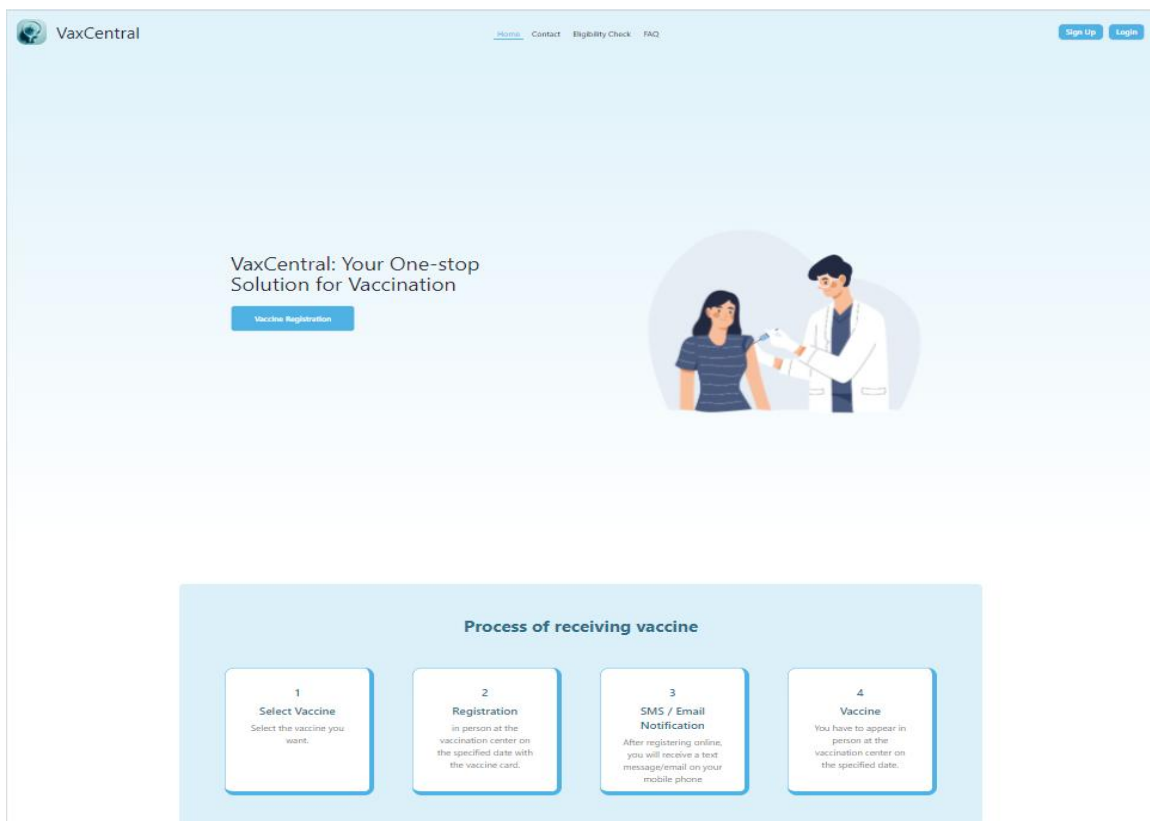


Figure 4.2.1 : Prototype Landing page:

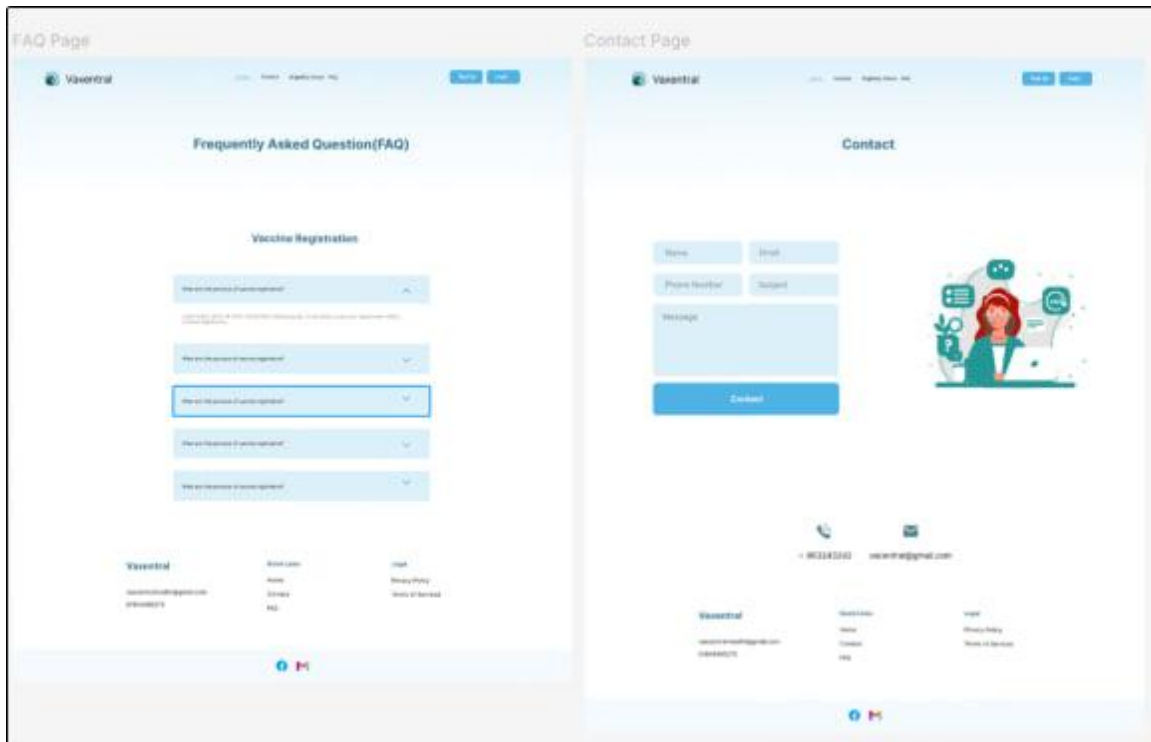


Figure 4.2.2 : faq and contact page)

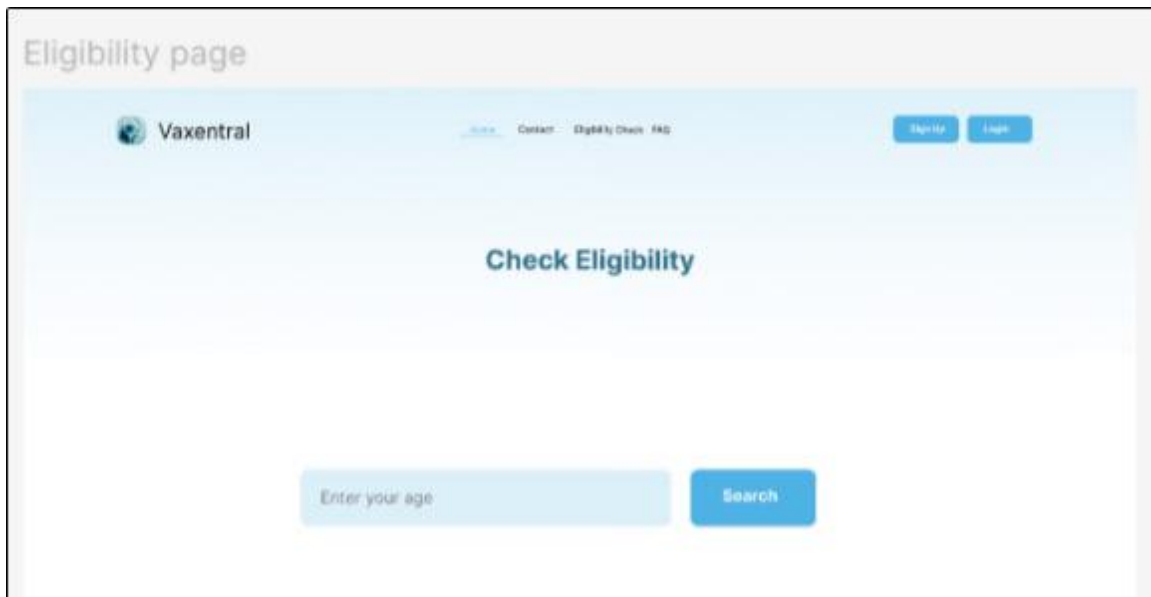


Figure 4.2.3 : Eligibility page)

Login Page

 VaxCentral

Login

Username
Type your username

Password
Type your password

[Forget password?](#)

LOGIN

New user? [Sign Up](#)

Figure 4.2.4 : login page

signup

 Vaxentral

Sign Up

Full Name
Type your username

NID Number
Type your NID number

Mobile Number
Type your mobile number

Date of Birth
Enter your date of birth

SIGN UP

Already have an account? [Login here](#)

Figure 4.2.5 : Signup page

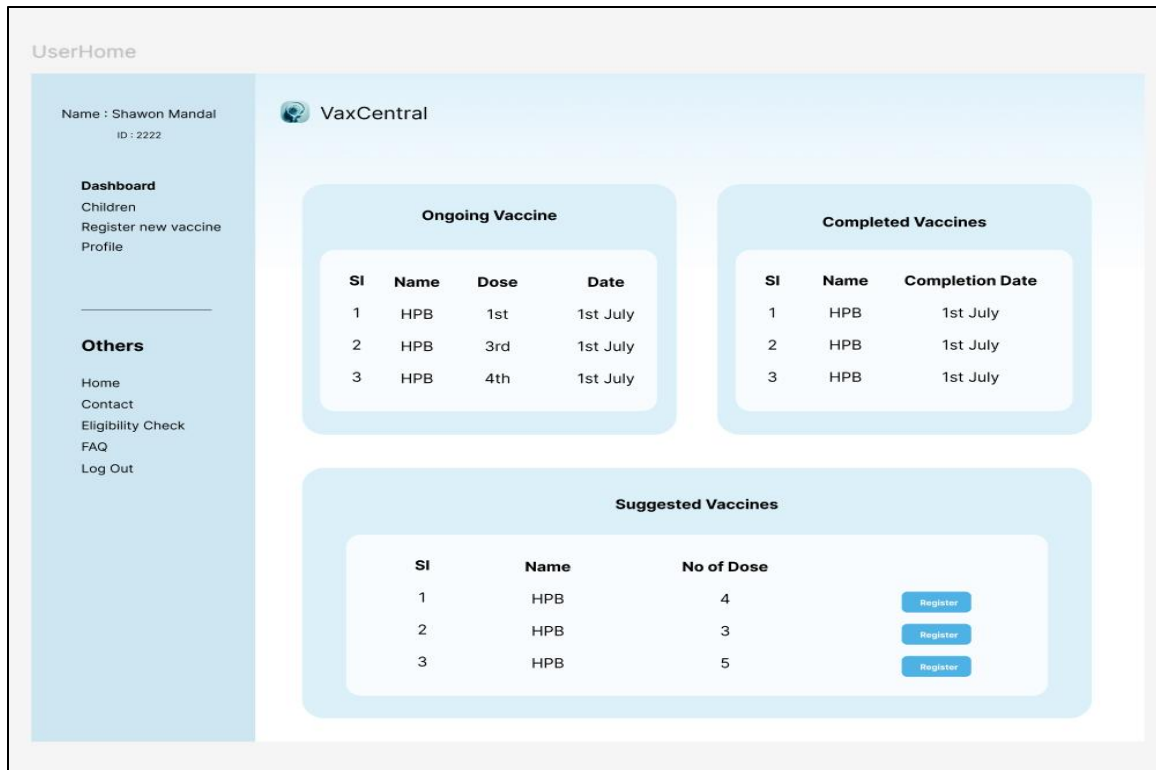


Figure 4.2.6 : user dashboard

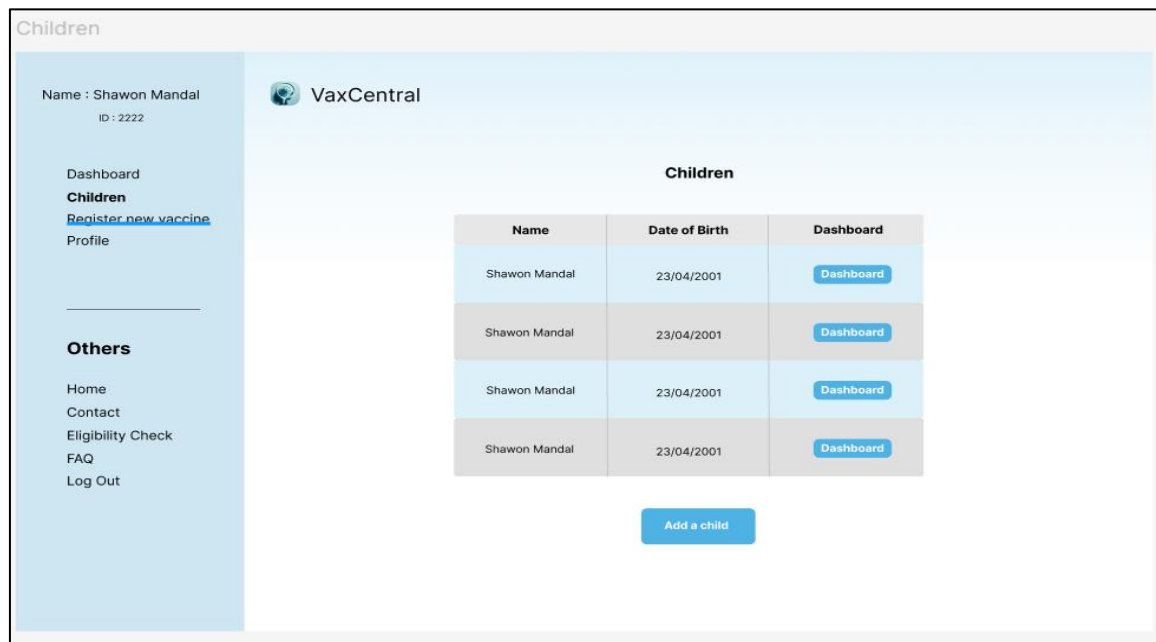


Figure 4.2.7 : children page

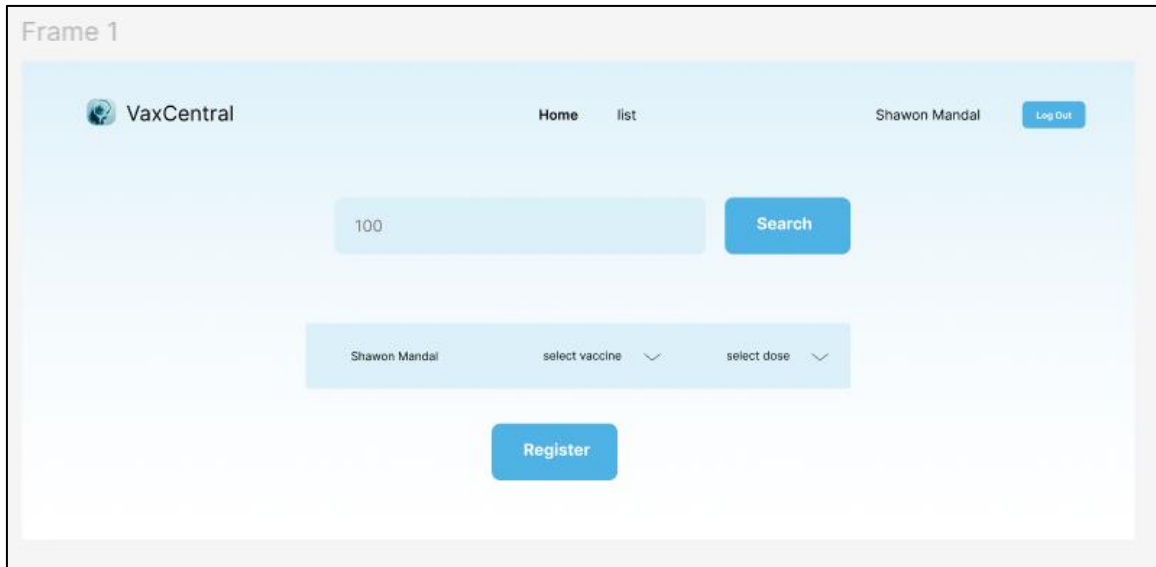


Figure 4.2.8 : Employee Dashboard

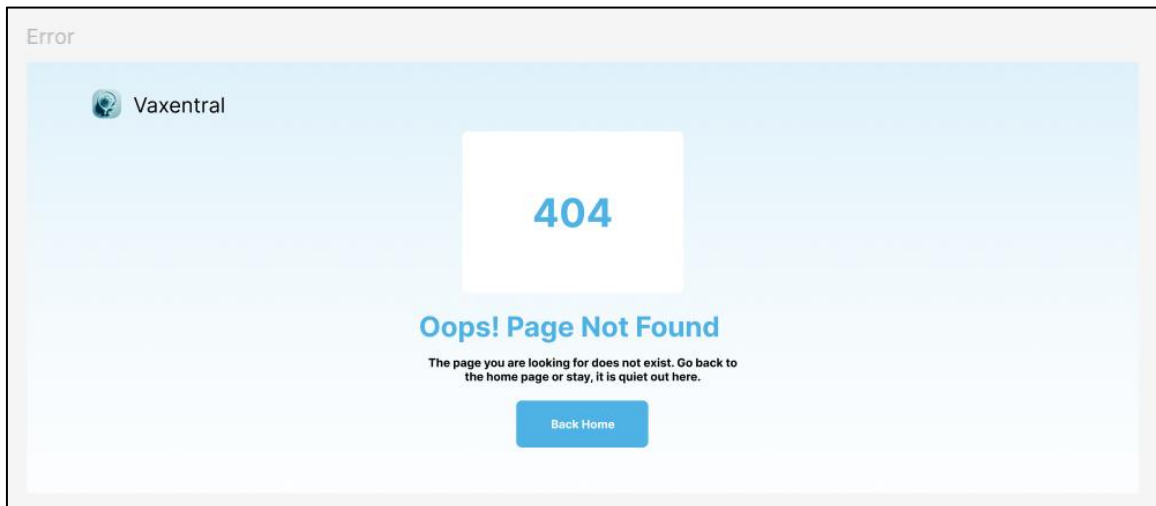


Figure 4.2.9 : Error Page

4.3 System Testing

Table 4.3.1: Test Case for Application

Test Case Type	Details	Expected Result	Actual Result	Status	Date
Log in	Admin, user and employee log in	Logged in	Logged in successfully	Pass	15/05/2024
User Registration	For creating new user account	Create new user account	Account created successfully	Pass	15/05/2024
Vaccine Registration	Entry for new vaccine	Register for new vaccine	Registered successfully	Pass	15/05/2024
Update Profile	For edit user information	Information Update	Updated successfully	Pass	15/05/2024
Add Vaccine	Entry for new vaccine in the list	Entry new vaccine	Added successfully	Pass	15/05/2024
Remove Vaccine	For remove vaccine	Remove vaccine form	Removed successfully	Pass	15/05/2024

	from the list	the list			
Change password	For changing the password using mobile number	Change the password	Changed successfully	Pass	15/05/2024
Check Eligibility	For checking which vaccine should taken	Show eligible vaccine list	Showed successfully	Pass	15/05/2024
Contact	For user to contact admin	Contact to admin	Contacted successfully	Pass	15/05/2024

load testing: As our website is deployed in netlify and vercel. as they are free hosting site. we did load test, but the hosting is not capable of too much load.

Table 4.3.2: load test

Lab el	# Samp les	Av era ge	Med ian	90% Line	95% Line	99% Line	Min	Max	Erro r %	Thro ughp ut	Rec eive d KB/ sec	Sent KB/ sec
hom e	4000	142	162	248	333	509	49	141 6	0.00 %	8.00 466	6.92	0.97
faq,c onta ct	4000	102	56	191	267	414	48	130 3	0.00 %	15.9 9597	13.8 1	1.96
TOT AL	8000	122	61	215	304	477	48	141 6	0.00 %	7.31 38	6.32	0.89

Api testing:

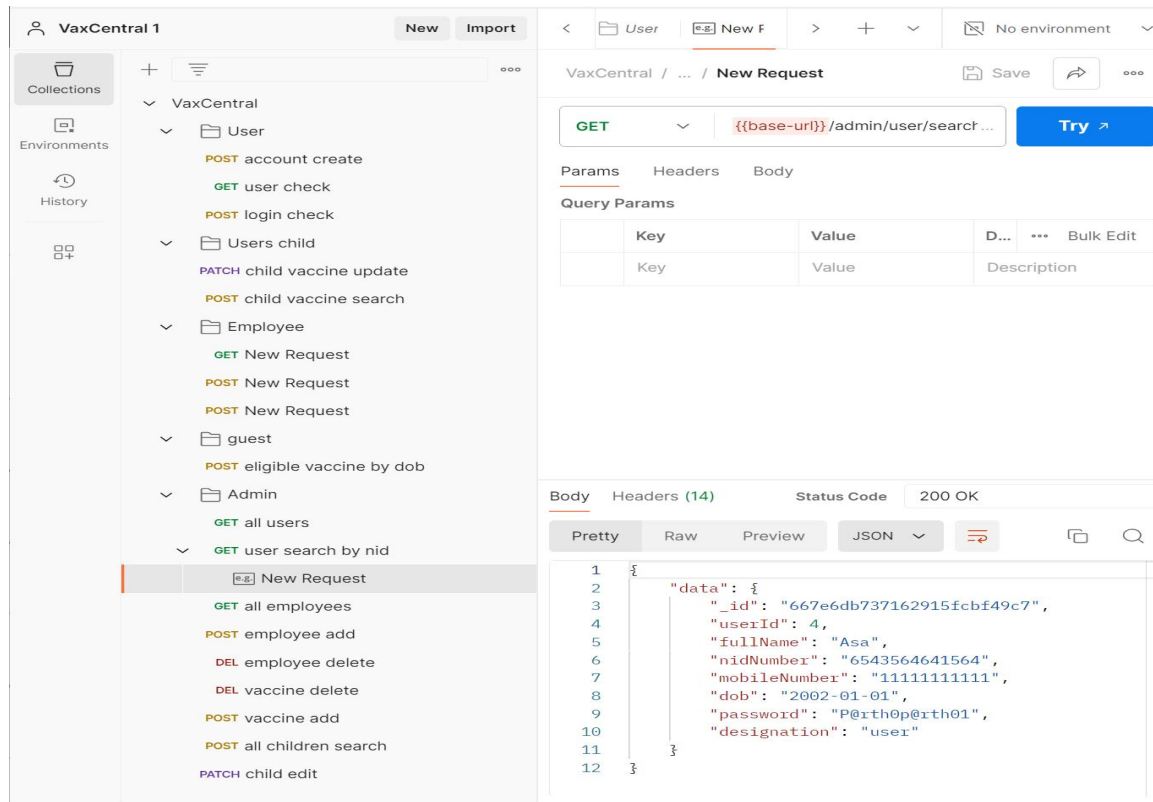


Figure 4.3.1 : API test

4.4 Summary

In this chapter we have discussed the implementation phase and testing phase of VaxCentral. To create a secure and error free system this is a mandatory phase. For maintaining the security of systems information, we have used node and express in the back end. And for easy accessibility we have used HTML, CSS, Tailwind CSS, React etc. for the front-end work, for the database we used mongodb. All this makes the system more user friendly, and also gives a solution to simplify vaccination procedures.

CHAPTER 5

Result and Analysis

5.1 Overview

After developing and implementing the VaxCentral website, we achieved satisfying results in terms of system performance and public health impact. Hosted on Netlify for the frontend and Vercel for the backend, the website demonstrated robust performance with fast load times and high uptime. The simulations showed that VaxCentral effectively raised awareness about vaccination schedules, benefits, and safety, leading to increased engagement and positive public health outcomes. This chapter provides an overview of the simulation results and the overall performance of VaxCentral.

5.2 Simulation

A recent simulation of the VaxCentral website revealed promising results, particularly in user engagement and public health impact. Users delved deeply into the website, spending considerable time navigating the extensive resources. This in-depth exploration suggests the website is not only informative but also captivating, potentially leading to better knowledge retention. Even more promising, the simulation indicated a significant positive influence on public health awareness. The platform appears to be a powerful tool for disseminating vital vaccination information. By providing easy access to a wealth of resources, VaxCentral has the potential to empower the public with the knowledge they need to make informed decisions about their health. These successes can likely be attributed, in part, to the user-friendly design and intuitive navigation of the VaxCentral frontend. The provided screenshot exemplifies this strength, showcasing a website that is both easy to navigate and effective in conveying crucial public health information in a clear and engaging way.

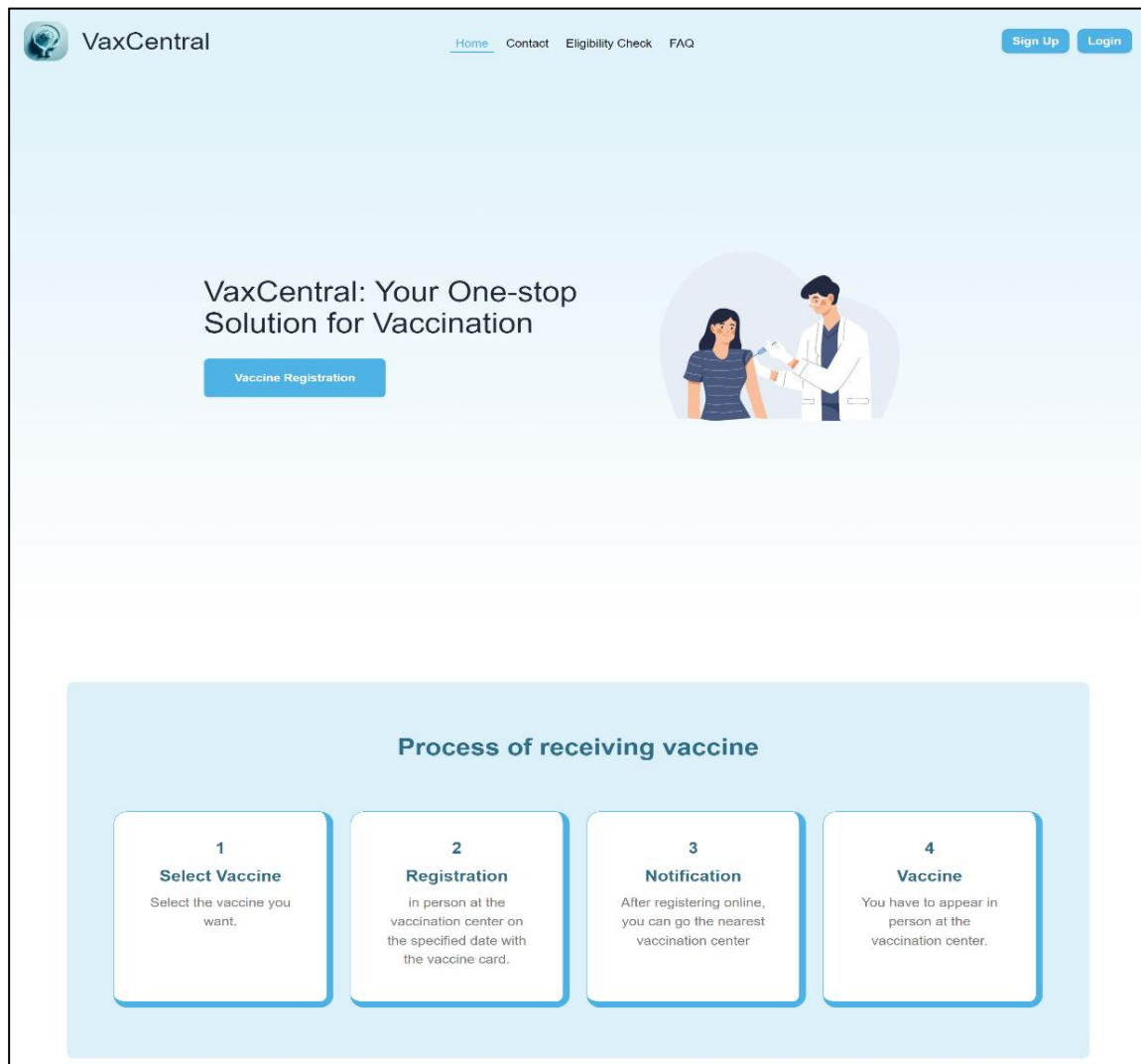


Figure 5.2.1 : Landing page

when a user clicks the link of our website this is the page where he/she will land. In here they can see that there are signup, login option. If he/she already had an account they can log in. If he/she don't have then he/she can open a account. And in this page there are given the process of registration of a vaccine and other things.

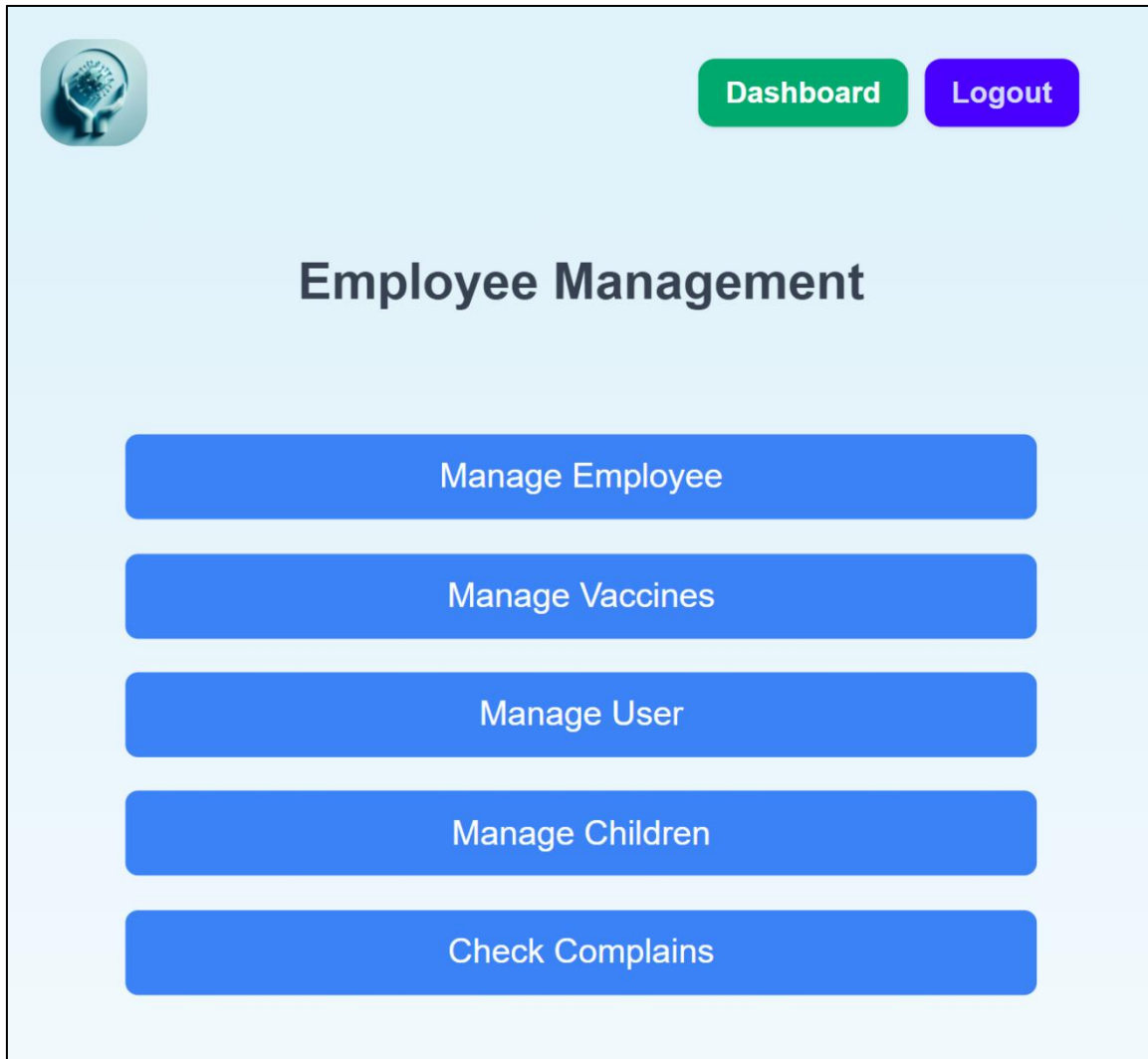


Figure 5.2.2 : Admin Dashboard page

After logging with the Admin credential admin will see These options and this is the admin dashboard Here. He will get five options, manage employee, manage vaccine, manage user, manage children and check the complaints.

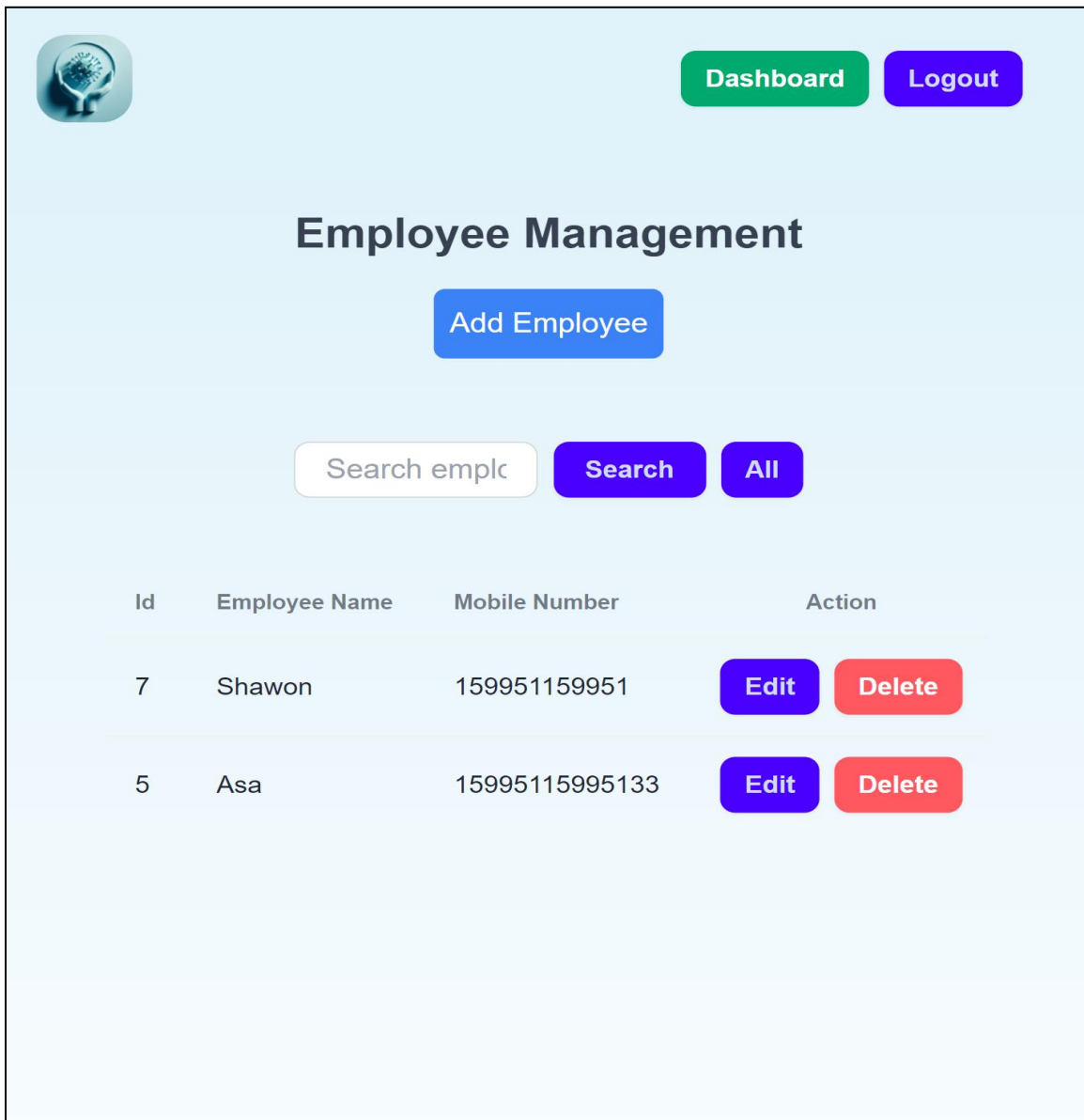
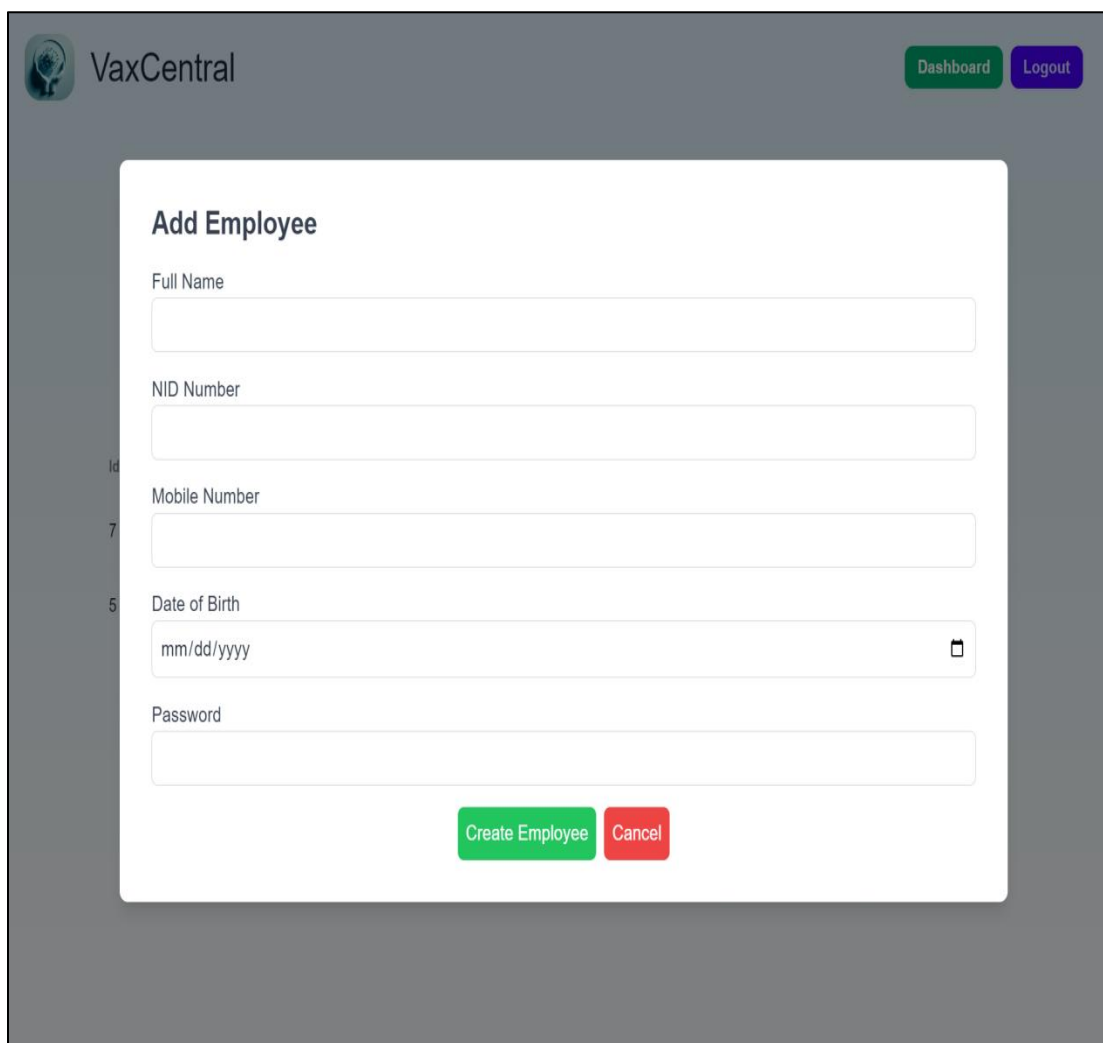


Figure 5.2.3 : Employee Management page

After logging with the Admin credential admin will see These options and this is the admin dashboard Here. He will get five options, manage employee, manage vaccine, manage user, manage children and check the complaints.



The screenshot shows a web application interface for VaxCentral. At the top left is the VaxCentral logo. At the top right are two buttons: 'Dashboard' (green) and 'Logout' (purple). The main content area features a white box titled 'Add Employee'. Inside this box are five input fields: 'Full Name', 'NID Number', 'Mobile Number', 'Date of Birth' (with a date picker icon and placeholder 'mm/dd/yyyy'), and 'Password'. At the bottom of the white box are two buttons: 'Create Employee' (green) and 'Cancel' (red).

Figure 5.2.4 : Add Employee

In this form, there will be five fields: name, nid number ,mobile number ,date of birth and password. Admin will fill up this form and give the Password to the employee. With this credential employee can login to their portal.

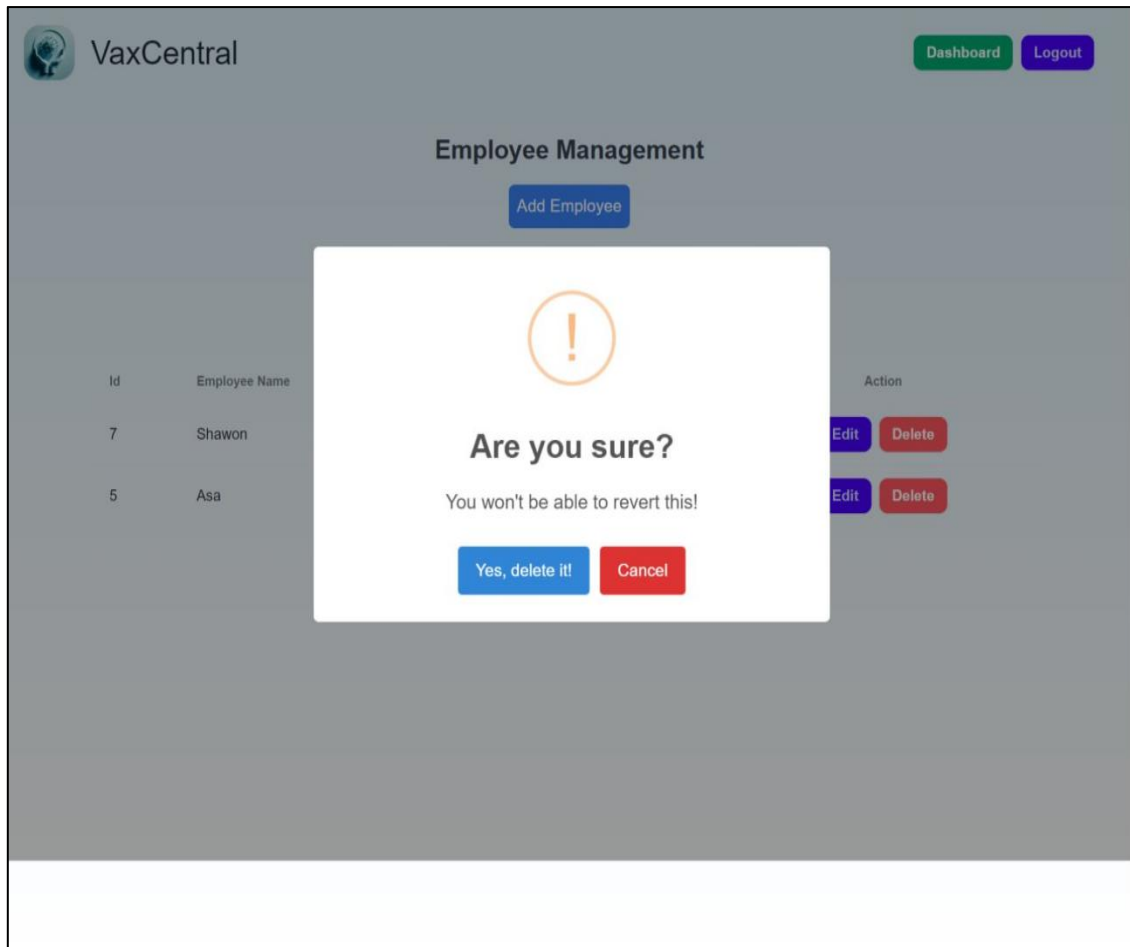


Figure 5.2.5 : Delete Employee

If the admin wants to delete an employee, then the admin will click the delete button and there will be a pop-up, if you want to delete the user, If clicked yes, then it will be deleted. If clicked Cancel. It will not be deleted.


VaxCentral
Dashboard
Logout

Vaccine Management

Add Vaccine

SL	Vaccine Name	Disease Name	Total Dose	Age	Gap	Action
1	BCG	Tuberculosis	1	1 - 365 days		Delete
2	Pentavalent	Diphtheria, Pertussis, Tetanus, Hepatitis B, Haemophilus Influenza B	3	42 - 365 days	28,28	Delete
3	PCV	Pneumococcal Pneumonia	3	42 - 365 days	28,28	Delete
4	OPV	Polio myelitis	4	42 - 365 days	28,28,28	Delete
5	MR	Measles Rubella	1	270 - 365 days		Delete
6	Measles	Measles	1	455 - 1825 days		Delete
7	TT (Tetanus Toxoid)	Tetanus	5	5475 - 10950 days	28,183,365,365	Delete
8	DTP	Diphtheria, Tetanus, Pertussis	5	42 - 3650 days	60,60,180,1460	Delete
9	MMR	Measles, Mumps, Rubella	2	365 - 3650 days	1460	Delete
10	Pfizer-BioNTech COVID-19 Vaccine	COVID-19	2	1825 - 36500 days	21	Delete
11	Hepatitis A	Hepatitis A	2	365 - 7300 days	180	Delete
12	Varicella	Chickenpox	2	365 - 3650 days	1460	Delete
13	Rotavirus	Rotavirus	3	42 - 245 days	60,60	Delete

Figure 5.2.6 : Vaccine Management page

In this page admin can add Any new vaccine with Specific gaps and dose numbers. And if you want, he can also delete Any of the vaccine.


VaxCentral

Dashboard
Logout

Vaccine Management

Edit vaccine

Vaccine Name
Disease Name
Total Dose

Minimum Age
Maximum Age

ye: mc we da: ye: mc we da:


Add vaccine
Cancel

SL	Vaccine Name	Disease Name	Total Dose	Minimum Age	Maximum Age	Action
1	BCG					Delete
2	Pentavalent					Delete
3	PCV					Delete
4	OPV					Delete
5	MR					Delete
6	Measles	Measles	1	455 - 1825 days		Delete
7	TT (Tetanus Toxoid)	Tetanus	5	5475 - 10950 days	28,183,365,365	Delete
8	DTP	Diphtheria, Tetanus, Pertussis	5	42 - 3650 days	60,60,180,1460	Delete
9	MMR	Measles, Mumps, Rubella	2	365 - 3650 days	1460	Delete
10	Pfizer-BioNTech COVID-19 Vaccine	COVID-19	2	1825 - 36500 days	21	Delete
11	Hepatitis A	Hepatitis A	2	365 - 7300 days	180	Delete
12	Varicella	Chickenpox	2	365 - 3650 days	1460	Delete
13	Rotavirus	Rotavirus	3	42 - 245 days	60,60	Delete

Figure 5.2.7 : Vaccine add

In this page admin can add Any new vaccine with Specific gaps and dose numbers. also with minimum and maximum years to take the vaccine. Over and under this range of people can't register the vaccine.

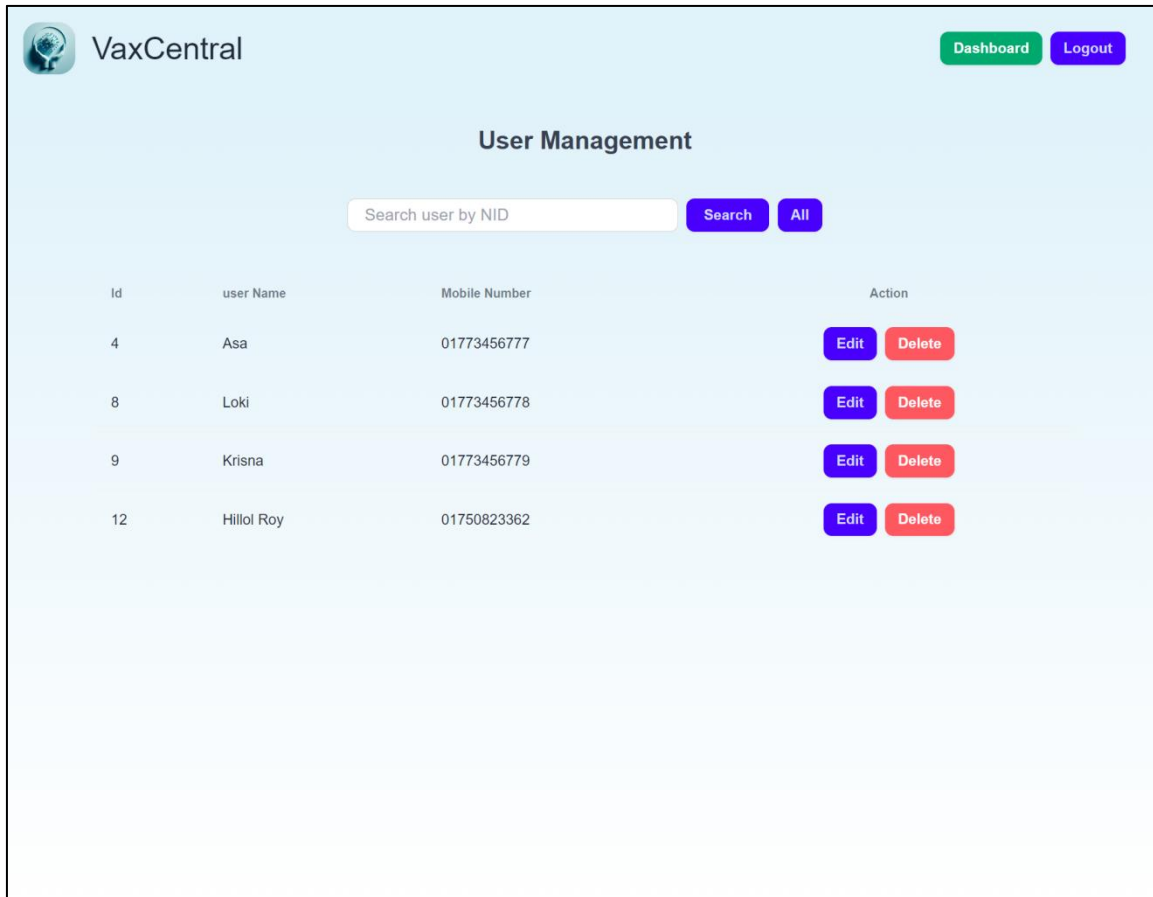


Figure 5.2.8 : User Management page

In this page admin can manage the user. He can search for an user by using the nid. He can also all the users by clicking all button and he can also edit and delete any user data.

The screenshot displays the VaxCentral User Management interface. At the top, there is a header with the VaxCentral logo and navigation buttons for 'Dashboard' and 'Logout'. The main section is titled 'User Management' and includes a search bar labeled 'Search User by NID' with 'Search' and 'All' buttons. A modal window titled 'Edit user' is open, containing the following fields:

- Full Name:
- NID Number:
- Mobile Number:
- Date of Birth: (with a calendar icon)
- Password:

At the bottom of the modal are two buttons: 'Edit User' (green) and 'Cancel' (red). In the background, a table of users is visible with columns for 'id', 'user Name', and 'action'. The table contains four rows of data:

id	user Name	action
4	Asa	<button>Delete</button>
8	Loki	<button>Delete</button>
9	Krisna	<button>Delete</button>
12	Hillol Roy	<button>Delete</button>

Figure 5.2.9 : Edit User

When clicked edit, then the admin will see a form like this Where there will be full name , nid number, mobile number, date of birth and password of the clicked user. Then the admin can change any of it. And when clicked edit users, then the user information will be edited.

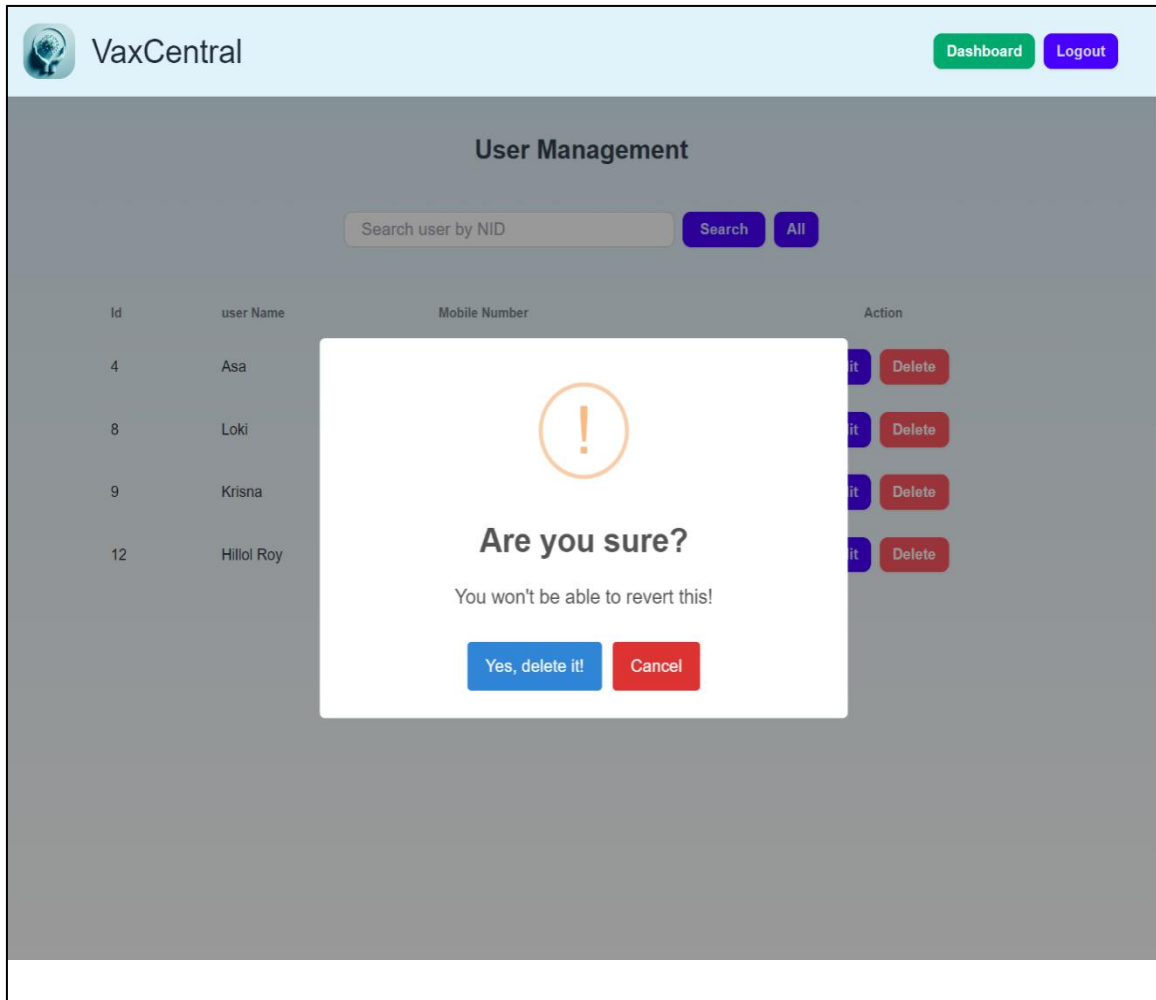


Figure 5.2.10 : Delete User

If the admin wants to delete an user, then the admin will click the delete button and there will be a pop-up, if you want to delete the user, If clicked yes, then it will be deleted. If clicked Cancel. It will not be deleted.

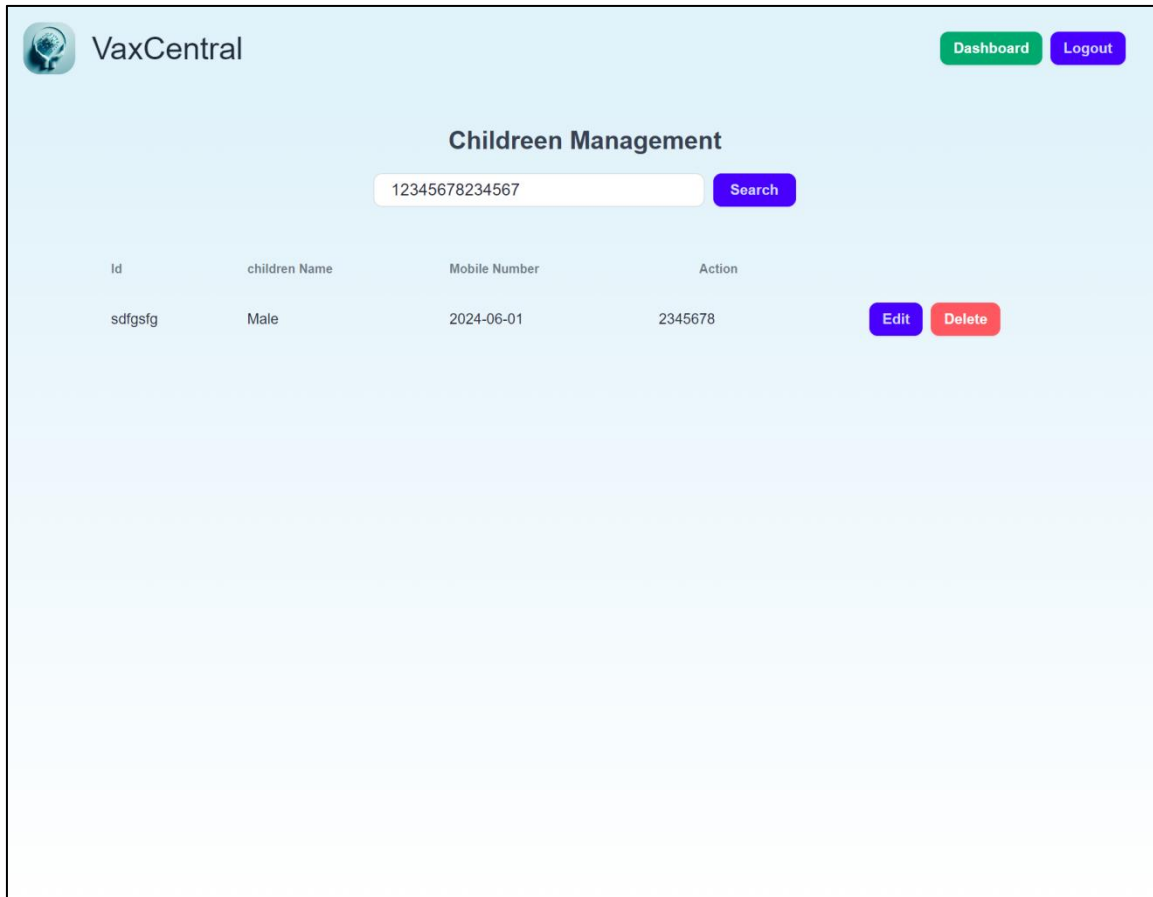


Figure 5.2.11 : Children Management page

In the children management, Admin can search any children using their parents NID number and edit and delete. By clicking edit admin can change the childrens data and by clicking delete admin can delete a child.

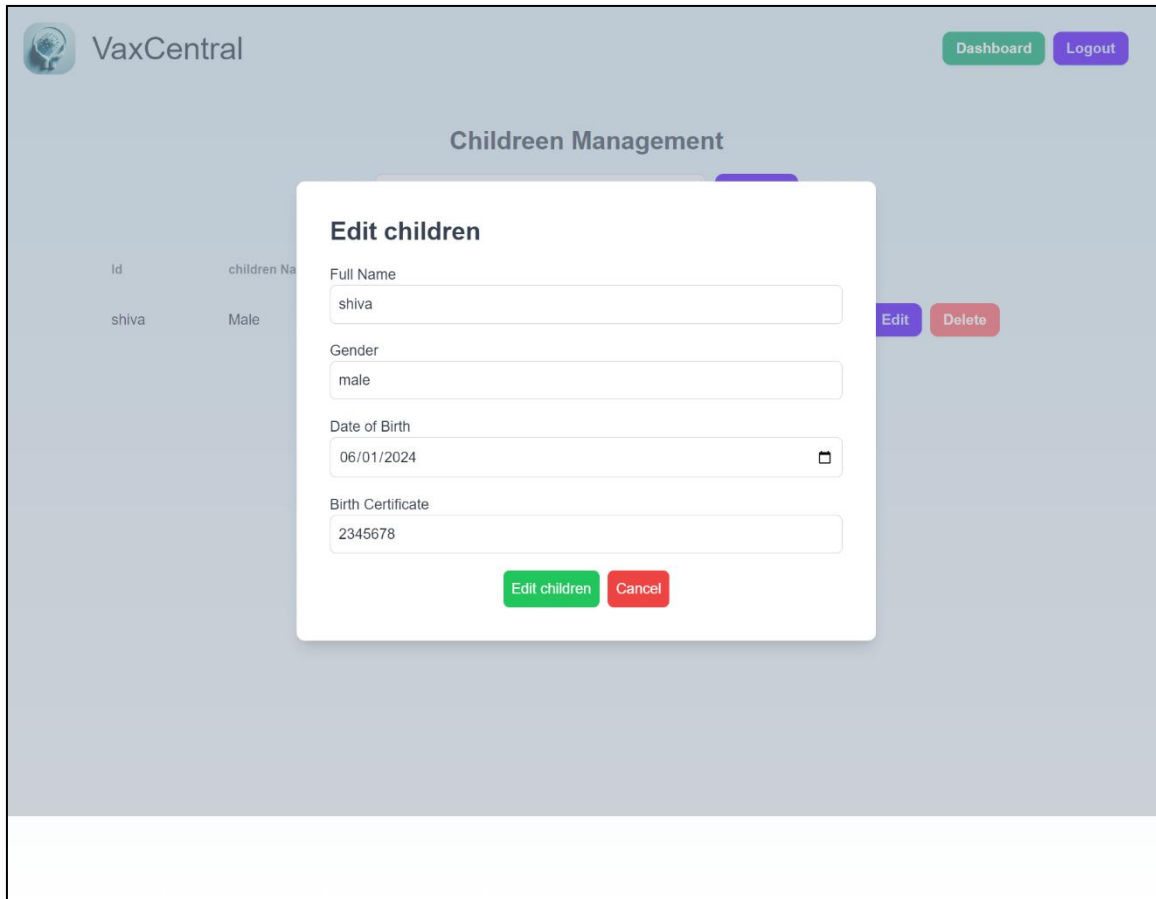


Figure 5.2.12 : Edit Children

Admin can edit children info by clicking the edit button. Admin has to change what he wants to, then clicks edit children. it will change the children's information. it will pop up every info about a child.

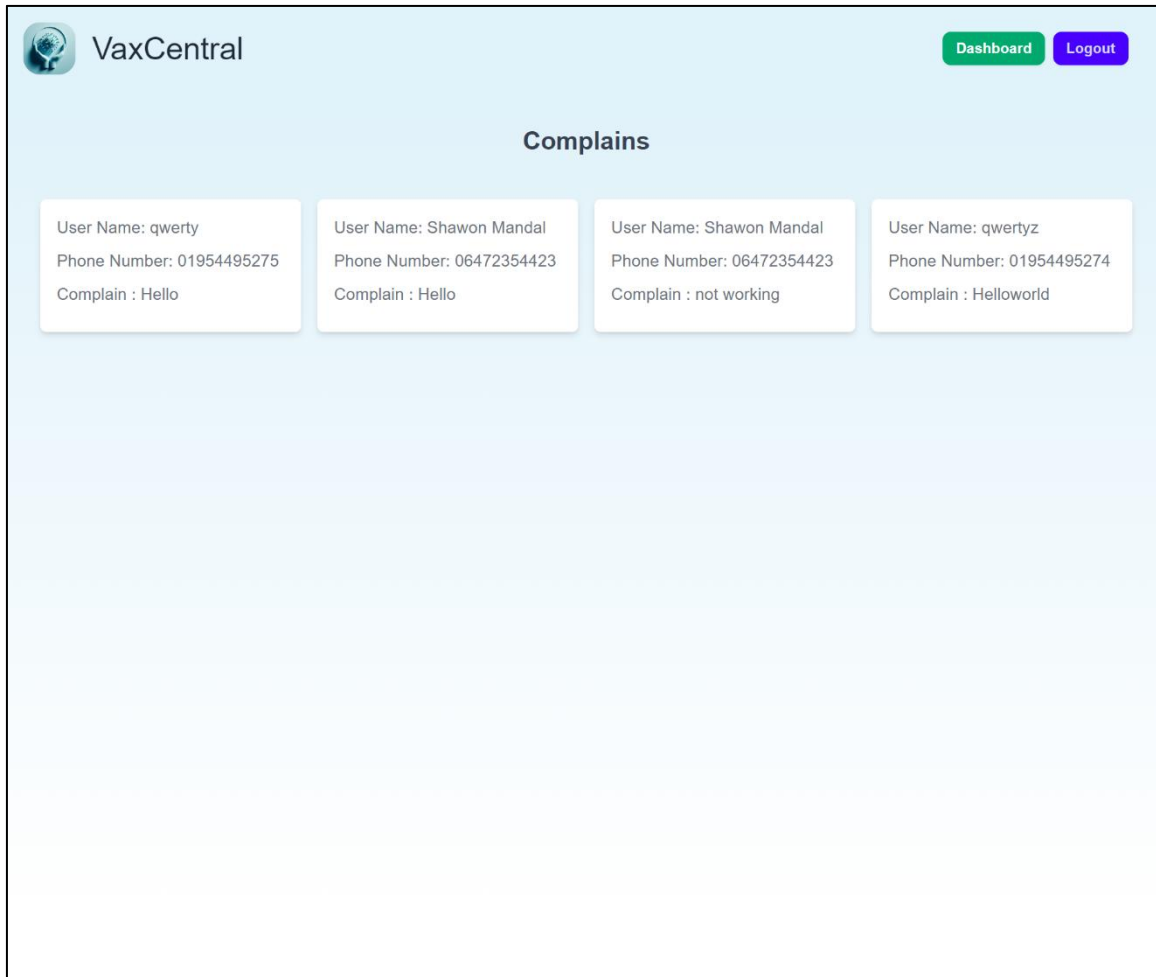


Figure 5.2.13 : Complain page

Complains or advice will be added here for admins to see. If anyone finds any bug they can report using the contact page and the complain of them or the advice of them will be shown here and required steps will be taken by the admin and authority. That will help to develop the website better.

The screenshot shows a web interface with a grey header. On the left is a hamburger menu icon. On the right, the text 'Hillol roy' and 'Id No: 12' is displayed. The main heading is 'Children Registered'. Below it is a white modal form with a close button (X) in the top right corner. The form contains four input fields: 'Full Name' (text), 'Gender' (dropdown menu with 'Male' selected), 'Date of Birth' (calendar icon and placeholder 'mm/dd/yyyy'), and 'Birth Certificate Number (If available)' (text). A blue 'Add Child' button is at the bottom center of the form.

Figure 5.2.14 : Add Child page

After going to the children page the user will see an add child. After clicking add child, the user will see a form. User has to enter the full name of the child, the gender, and the date of birth. And if the child has birth certificate, then user can give this information too and then by clicking add child button user can add his/her child.

 VaxCentral

Dashboard

Logout

12

Search

SL	Vaccine Name	No of Dose	Select
1	COVID-19	0	Register

Child Name	Vaccine Name	No of Dose	Select
shakti	Diphtheria, Tetanus, Pertussis	0	Register

Figure 5.2.15 : Employee Dashboard

This is the employee dashboard. Employees can search by user ID. If the user has any ongoing vaccine or if the user's child has any ongoing vaccine, then the Employee will see it by searching by the ID. And he can update a vaccine dose by clicking the register button.



Figure 5.2.16 : Children Dashboard page

After adding a child User can go to the Child's dashboard. He can see what vaccine his/her child can take. If he/she thinks of any vaccine he/she wants to register , then he/she will click vaccine registration and it will go to the registered vaccine.



Figure 5.2.17 : User Dashboard page

This is the user dashboard user can see if he has any ongoing vaccination. And if he completed any vaccine it will show on the completed vaccine table. Suggested vaccine will show the available vaccine according to users age. If he has any ongoing vaccine it will be shown on the ongoing section.

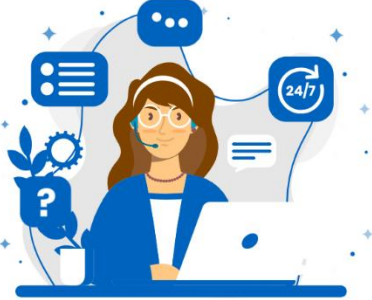
 VaxCentral

[Home](#) [Contact](#) [Eligibility Check](#) [FAQ](#) [Dashboard](#)

Hillol roy

Contact

Contact



QUICK LINKS

[Home](#)
[Contacts](#)
[Eligibility Check](#)
[FAQ](#)

LEGAL

[Privacy Policy](#)
[Terms of Services](#)

SOCIAL



Figure 5.2.18 : Contact page

Contact page actually is a form. Here we can see 5 Fields name, email, phone number subject and message. If anyone wants to complain, then he can come to this page and fill the blanks and press the contact button. So That admin can know it and solve the problem.


VaxCentral

[Home](#)
[Contact](#)
[Eligibility Check](#)
[FAQ](#)
[Dashboard](#)

Hillol roy

Check Eligibility

Date of Birth

SL	Vaccine Name	Total No of Dose
1	Diphtheria, Tetanus, Pertussis	5
2	Measles, Mumps, Rubella	2
3	COVID-19	2
4	Hepatitis A	2
5	Chickenpox	2

Figure 5.2.19 : Check Eligibility page

Anyone can access this page and if they want to check if they are Eligible for any vaccines, they have to enter the date of birth and then click the search button. After clicking the search button, a table will appear containing the vaccine name which the checker is eligible.

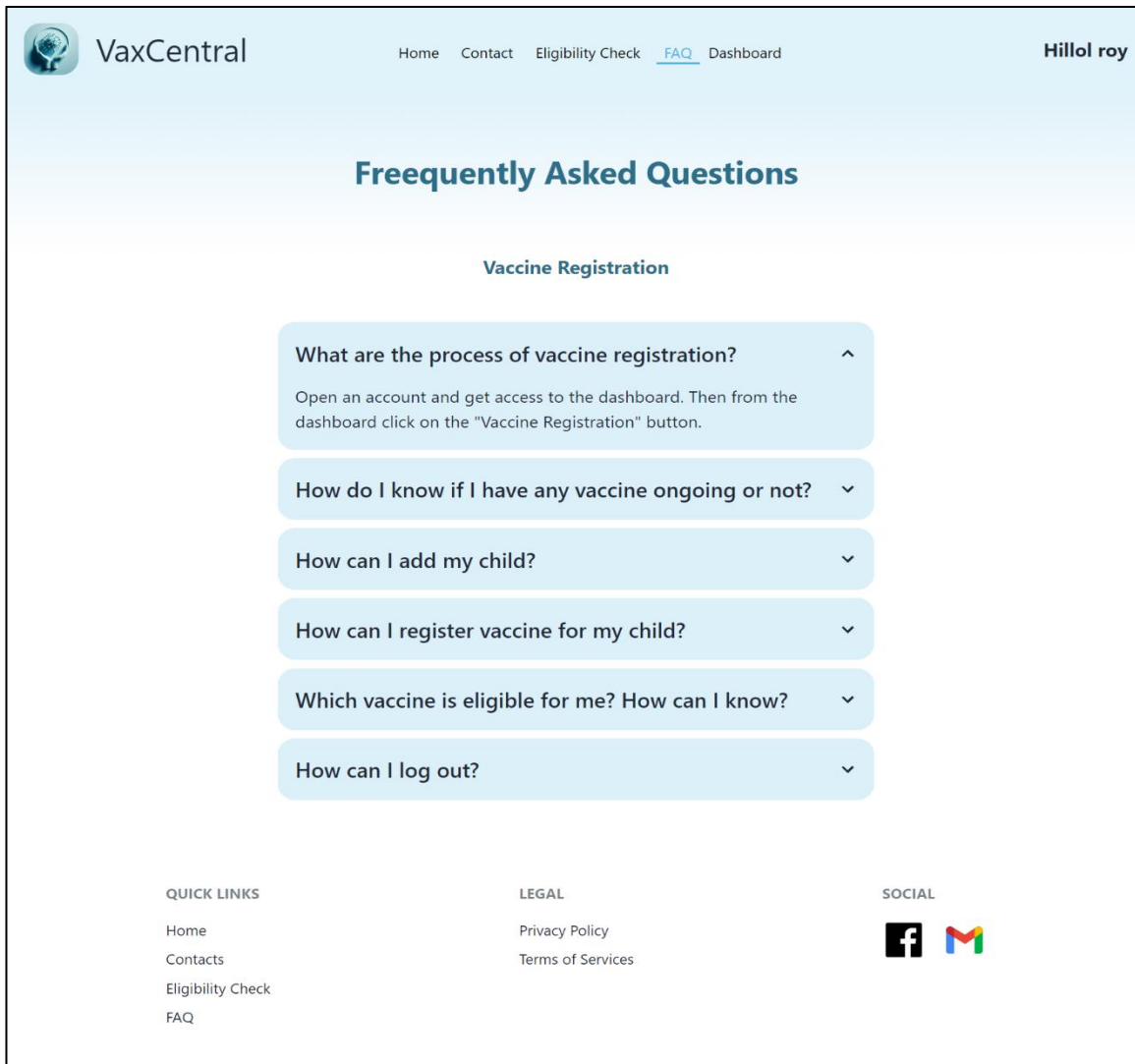


Figure 5.2.20 : FAQ Page

From this page a guest can know the frequently asked questions and the answers. Before using the contact page they can check the faq once if it solves their problem.

5.3 Performance

Our integrated vaccination website is designed for high performance to meet the needs of a large user base. It ensures smoothness, The backend infrastructure uses efficient database management for rapid data processing and retrieval.

The front-end is optimized for quick loading and smooth interactions on various devices, ensuring accessibility and usability. Advanced caching techniques further enhance speed and reduce server load. Regular performance testing and monitoring help maintain reliability and responsiveness.

Overall, our performance strategy prioritizes speed, reliability, and scalability to provide an efficient user experience.

5.4 Summary

From the result and the analysis, we can clearly see that VaxCentral makes a significant positive impact on vaccination management and user satisfaction. It is also under monitoring and kept updating based on the feedback of the users. This continuous improvement approach ensures that VaxCentral remains responsive to the evolving needs of its users, enhancing its effectiveness and reliability. Additionally, the proactive monitoring helps in quickly identifying and addressing any issues, further solidifying the platform's role as a crucial tool in promoting public health and facilitating efficient immunization processes.

CHAPTER 6

Impact on Society, Environment and Sustainability

6.1 Impact on Life

As an integrated vaccination system VaxCentral has revolutionary impact in vaccination and healthcare. It digitalized and smoothing the way of vaccination system by registration process, appointment scheduling, vaccination tracking. As it easier the life of people and management system in the way of vaccination so the application has significant impact on public health. VaxCental has enhanced the public health outcomes by improving vaccination rates. As it provides a user-friendly platform and ensures that everyone take doses in right time and also give information about vaccination, it encourages the users to take the vaccine by acknowledge them about the importance of vaccination. Again, as it is increasing the rate of vaccination and give body immunity so it decreased or minimizing the vaccine prevented diseases. VaxCentral empowered individual by giving assess to vaccine information so that they can easily make decisions about them and their families also. The platform provides a personal dashboard so that the user can track their vaccination history, it helps them manage personalized health. By the platform user can make appointments, it helps them by saving their time. If we, do it by traditional pen and paper method it can take hours to complete the process. We can clearly see the impact of the platform as it proficiently handles all the process of vaccination, it plays a vital role in the vaccination process also safeguarding the public health.

6.2 Impact on Society & Environment

Impact on Society:

- VaxCental plays an important role by giving education people about the importance of vaccination. The platform contains information about various vaccines like their benefits, side effects and other basic information. All these things help to increase the public health awareness.

- After increasing the vaccination rates, it improves the community's health and protects against vaccine-preventable diseases. As the diseases are prevented before they occur, it reduces healthcare costs. Overall, it improves community health.
- VaxCentral provides a user-friendly interface that makes it easier to use for users, especially those who are in remote areas. This platform ensures that more people have access to essential health services which promote equality in health care. It helps to enhance health care access.
- As healthcare management also uses the platform, it helps to reduce the workload on healthcare employees. Moreover, it can lead to more efficient and effective healthcare delivery and strengthen healthcare infrastructure.

Impact on Environment:

- VaxCentral provides a digital solution of the vaccination process. As it digitizes vaccination records and appointment scheduling, it significantly reduces the use of pen and paper for documentation. It helps the environment to be clean and pollution-free as we know how much tree is cut down just for made paper.
- As all the work here is done through online, not only it saves time but also it decreases the carbon footprint.
- VaxCentral provides a real-time database that allows management to distribute and use efficiently, which reduces the wastage of vaccines and ensures minimizing the environmental impact of medical waste.
- The platform centralizes the vaccination management and reduces the physical storage of records, which reduces energy consumption.

6.3 Ethical Aspects

- VaxCentral provides privacy and data protection to the user. This platform uses robust APIs to ensure the data storage and transmission are secure. The platform provides users the power of having control over their personal data. Users can view, update, and delete their own information.
- This platform is designed in a very user-friendly way so that it can be accessible to all kinds of people.

- VaxCentral keep transparency in its functionality, it provides users a clear communication about how the platform is working. Also, the platform maintain accountability by having the option feedback to the users.
- VaxCentral maintain ethical aspects while using technology, it never uses any bias method. It is designed to enhance user experience without degrading the ethical standards or user trust.
- We maintain honesty in the representation of VaxCental as it only focusses on honesty and accuracy. It avoids the vulnerabilities in its marketing methods.

6.4 Sustainability plan

- For long term effectiveness implementing subscription plans for user to get premium features. Raising fund from the government will be another secure funding. Moreover, partnership and collaboration can help VaxCentral to become sustainable.
- By optimizing technological resources, we can reduce cost without compromising the performance and also have to design the platform that will allow increasing user number efficiently.
- The improvement should be continuous. Regularly gather user feedback and improve the functionalities according to the feedback. Beside that have to innovate new features and updates that will help user to become more comfortable with the platform.
- Ethical practices can also make the VaxCental sustainable. By maintaining the data privacy standards and working with transparency can earn user trust and make the platform more sustainable.
- As more as we educate people the need of the platform will increase. By doing awareness camping the platform will be more engage with users and also can add community leaders to promote such a novel work.
- Make inclusive design so that the user can easily access VaxCental and make the platform affordable to all class of peoples.

- The digitizing to the platform is another strength of VaxCentral. Paperless work and remote access make this platform online so that one does not have to come physically in the location just to make an appointment or schedule.
- By reducing the electronic waste and resources will make the platform to become more sustainable.

6.5 Summary

This chapter represents the impact of VaxCentral on individual life, social life, society, and the environment. There is no doubt that VaxCentral has a significant impact on everything. This platform maintains high ethical values, which will help VaxCentral become more sustainable. Additionally, VaxCentral is designed to make people's lives easier and raise awareness among everyone. By promoting vaccination adherence and streamlining the immunization process, it contributes to better health outcomes and fosters a healthier community. The platform's commitment to environmental sustainability further enhances its positive impact, ensuring that its operations align with eco-friendly practices.

CHAPTER 7

Conclusion and Future Work

7.1 Conclusion

VaxCental is a digital, reliable and ethical solution for vaccination management. This platform is designed to enhance the vaccination system. This system will help the general people and the vaccination management authority to conduct the process easily. VaxCental is development is continuous, it continuously updates when it gives the user more premium user experience. As the platform is user friendly and also educate people at the same time about vaccination, it will create a positive impact in healthcare and vaccination.

7.2 Further Suggested Works

- Can add multiple language; at least include Bangla language so that all the people can understand and access easily.
- Integrating the platform with other health care platform including telemedicine or other health records.
- Mobile application development will be another way to enhance the platform which make people more comfortable with the system.
- Including AI for analysis the personalized data which will suggest the user for extra health care.
- Use advance analytics method for more clear data analysis that will help the authority to analyze the people health.
- Use advanced encryption techniques so that the privacy will be maintained properly.
- Apply blockchain technology to ensure that the system and the data are safe. That will make the system more transparent.

- Make advertise or educational camp for make people acknowledge about the importance of vaccination.
- Doing research for utilizing the hole process that will help to overcome the short comes.
- Collaborating with other application can make the platform more powerful where people can find solution of everything in one platform related to healthcare.

7.3 Limitations

- Not every user has the ability to operate with technology specially in remote area.
- There will be always cyber security risks despite the platform is concern about security measures but it is difficult to earn user trust and maintain ongoing challenges.
- Integration with other existing system can be complex because of the lack of infrastructure and standardized process till now.
- Use maybe resist to adopting new digital technology besides if user engagement regulatory maintenance can be challenging.
- There are external dependencies of this platform. If healthcare provides do not work actively the system can be collapse.

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Appendix A

Course Outcomes, Complex Engineering Problems (EP) and Complex Engineering Activities (EA) Addressing

Title: VaxCentral: Design and development of an integrated vaccination system.

Students ID: 201-15-14082 and 201-15-13754

CO Description for FYDP

CO	CO Descriptions	PO
Phase -I		
CO1	Integrate recently gained and previously acquired knowledge to identify a web based Vaccination management problem for the Final Year Design Project (FYDP)	P01
CO2	Analyze different aspects of the goals in designing a solution for this FYDP	P02
CO3	Explore diverse problem domains through a literature review, delineate the issues, and establish this goals for the FYDP	P04
CO4	Perform economic evaluation and cost estimation and employ suitable project management procedures throughout the development life cycle of the FYDP	P011
Phase -II		
CO5	Design and develop technical solutions and system components or processes that meet specified requirements, ensuring compliance with public health and safety standards, as well as considering cultural, socioeconomic, and environmental factors in this FYDP	P03
CO6	Choose and apply appropriate methodologies, resources, and contemporary engineering and IT technologies to address complex engineering processes, encompassing prediction and modeling, while adhering to relevant constraints in this FYDP	P05
CO7	Analyze societal, health, safety, legal, and cultural considerations, along with associated responsibilities, in the context of professional engineering practice and the resolution of this problem, employing logical reasoning	P06

	guided by contextual understanding.	
CO8	Comprehend and evaluate the enduring sustainability and impact of professional engineering endeavors in addressing intricate engineering challenges within social and environmental frameworks.	P07
CO9	Implement ethical principles and adhere to professional standards and norms in this FYDP	P08
CO10	Capable of operating proficiently both individually and as a team member or leader across diverse teams and interdisciplinary settings in this FYDP.	P09
CO11	Proficiently communicate with the engineering community and broader society regarding complex engineering endeavors, including the ability to comprehend and generate comprehensive reports and design documentation, as well as provide and receive clear instructions throughout this FYDP.	P010
CO12	Acknowledge the importance of self-directed and life-long learning within the evolving landscape of technology, and possess the readiness and capability to engage in lifelong learning endeavors.	P012

Addressing of COs, Knowledge Profile (K), and Attainment of Complex Engineering Problems (EP):

SN	EP Definition	Attainment	CO	Justification (with Knowledge Profile)	References
1	EP1: Depth of Knowledge required	Yes	CO1, CO2 and CO3	In our project, we use our engineering knowledge like programming languages and the use of databases, which covers k3 and depth in web design and development cover k4. For our project we use tailwind css and it demonstrates expertise in areas such as design optimization which covers k5 and K6 is adept at leveraging cutting-edge technologies, tools like	Page no: [16,17,18], Section: [3.4]

				ReactJS, and ExpressJS.	
				This project applies various system modeling like system model, use case diagram, analyzing design requirements like API, security, reliability, use robust and user centric vaccination management system.	Page no: [9,10,11,12,13], Section: [3.2]
				In this project we reviewed possible competitors' websites, UI/UX designs, security protocols studies, feasibility analysis.	Page no: [6,7,19-24], Section: [2.2, 2.3, 4.2]
2	EP2: Range of Conflicting Requirements	Yes	CO2	The project tackles EP-2 by fulfill the user vaccination demand, overcoming the accuracy and safety issues, maintaining the quality of services, handle the volumes efficiency, shearing necessary data with public health authorities, service availability, suggesting personalized health care.	Page no: [26,27], Section: [4.3]
3	EP3: Depth of analysis required	Yes	CO2	This project fulfills the EP-3 by analyzing the user requirements or need of the project by doing feasibility analysis, by designing user-friendly interface, analyzing the challenges and come up with solutions, maintaining the scalability.	Page no: [14,15,16], Section: [3.3]
4	EP4: Familiarity of Issues	Yes	CO3	The project covers this EP-4 by mentioning the issues like public hesitancy or misinformation, vaccine supply problems, health center	Page no:

				employee issues, emergency response and general peoples' trust.	[2,7], Section: [1.3,2.4]
5	EP5: Extends of application codes	No	CO3	N/A	Page no:--N/A
6	EP6: Extends of stakeholders involved and conflicting requirements	No	CO3	N/A	Page no:-- N/A
7	EP7: Interdependence	Yes	CO4	The project meets CEP, EP-7 by addressing the potential interdependencies for VaxCental like supply chain management from reliable vendors timely and safely deliver the vaccines, health centers employee should be trained and data security.	Page no: [14], Section: [3.3]

Addressing CO11 with Complex Engineering Activities (EA) [Some or all of the following]:

SN	EA Definition	Attainment	CO	Justification	References
1.	EA1: Range of resources	Yes	CO11	VaxCentral ensures seamless and effective vaccination operations using a frontend hosted on Netlify, a backend on	Page no: [25,26,27],

				Vercel, and a user interface designed in Figma, supported by electronic health record systems, patient management software, communication platforms, and data analytics frameworks. We used postman and jmeter for load testing.	Section: [4.3]
2.	EA2: Level of interaction	No		N/A	N/A
3.	EA3: Innovation	No		N/A	N/A
4.	EA4: Consequences for society and the environment	Yes		This platforms operations have significant positive consequences for society and the environment. By ensuring widespread and efficient vaccination, VaxCental helps reduce the spread of infectious diseases, leading to improved public health and reduced healthcare costs. Enhanced community immunity levels contribute to fewer outbreaks and a healthier population.	Page no: [51,52,53], Section: [6.1, 6.2, 6.4]

5.	EA-5: Familiarity	Yes		VaxCental's familiarity with the complexities of vaccination programs is evident through its comprehensive approach to addressing common challenges. It understands the importance of a trained and motivated workforce, providing continuous training and support to healthcare professionals and administrative staff.	Page no: [7-10], Section: [2.1, 2.3]
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Addressing CO (4, 9, 10, and 12):

SN	COs	Attainment	Justification	References
1	CO4	Yes	The project captures CO4 by ensures efficient fund distribution, continuous expenditure monitoring, and identification of optimization opportunities, all while maintaining the highest standards of quality in vaccination services.	Page no: [3], Section: [1.5]
2	CO9	Yes	This platform offers user to control personal data. It uses standardized protocol to make the process more transparent and clearer to the users.	Page no: [52,53], Section: [6.3]
3	CO10	No	N/A	N/A
4	CO12	Yes	This commitment to lifelong learning allows VaxCental to stay at the forefront of technological advancements and best practices in vaccination services, ultimately enhancing the	Page no: [29,50], Section: [5.1, 5.4]

			quality and effectiveness of its programs.	
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