

NeoVax: Smart Child Vaccination and Monitoring Platform

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Abstract

Child vaccination plays a crucial role in preventing life-threatening diseases and ensuring long-term public health. Despite the availability of structured immunization programs, many children miss scheduled vaccinations due to lack of awareness, busy lifestyles of parents and absence of effective reminder systems. This research paper presents NeoVax, a smart and user-friendly child vaccination reminder and management system designed to address these challenges using digital technology. NeoVax is an Application that enables parents to register their child's vaccination details and receive timely reminders through multiple communication channels such as SMS, WhatsApp and Email. In addition to reminders, the system provides personalized diet recommendations to support the child's immunity, allows flexible rescheduling of missed vaccinations. The system also integrates basic Machine Learning techniques to predict missed vaccinations and optimize reminder timing. The proposed system aims to improve vaccination compliance, reduce missed doses and enhance parental awareness. By combining automation, personalization and intelligent prediction, NeoVax contributes to improving child healthcare management in both urban and rural settings. One of the most important features of NeoVax is the child vaccination profile. This profile keeps a complete record of every vaccination related to the child. It clearly shows which vaccinations have been done, which ones are still pending, and which ones were missed. Along with this, it also shows the exact dates for each vaccination. Parents can check this information anytime through the system, so they always know the current health status of their child. If a parent misses a vaccination appointment, the system does not simply ignore it. Instead, it automatically reschedules that missed vaccination and updates all future reminders accordingly. This way, no vaccination is permanently skipped, and the child's immunization continues without any break. NeoVax also includes a AI Assistant that works like a helpful assistant for parents. Parents can ask questions about vaccines, side effects, or any general health concerns related to their child. The AI Assistant gives instant and reliable answers, so parents do not have to wait or visit a doctor for basic information. Along with answering questions, the AI Assistant also suggests a proper diet plan based on the child's age. For example, soft food suggestions for toddlers, and balanced meal plans for older children. This helps parents take better care of their child's nutrition alongside vaccination. Overall, NeoVax is built to make child vaccination easy, organized, and stress-free for every parent, whether they live in a city or a rural area.

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INTRODUCTION

Vaccination is one of the most effective methods of preventing infectious diseases and reducing child mortality rates worldwide. Diseases such as polio, measles, hepatitis, and tetanus can be prevented through timely immunization. According to global health reports, millions of

lives are saved each year due to vaccination programs. However, despite these advancements, many children still fail to complete their vaccination schedules, especially in developing countries like India [1].

One of the major reasons for missed vaccinations is the lack of awareness and proper tracking systems. Parents often rely on paper-based vaccination cards, which can be easily lost or forgotten. In many cases, parents are unaware of upcoming vaccination dates or do not receive timely reminders.

Busy schedules, work commitments, and limited access to healthcare information further contribute to this issue.

Another challenge is the lack of integrated systems that combine vaccination tracking with additional child healthcare support. Parents are often unaware of the nutritional needs of their children during vaccination periods, which can impact the effectiveness of vaccines. Moreover, in situations where parents travel or relocate, it becomes difficult to track vaccination records and find nearby healthcare facilities [2].

To address these challenges, there is a strong need for a smart, digital and user-friendly system that not only reminds parents about vaccination schedules but also provides additional support such as diet recommendations, rescheduling options and location-based services. NeoVax is designed to fulfill this need by offering a comprehensive vaccination management solution enhanced with intelligent features [3].

OBJECTIVES

The primary objectives of the NeoVax system are as follows:

- To develop a simple and accessible digital platform for managing child vaccination schedules
- To provide automated multi-channel reminders through SMS, WhatsApp and Email
- To reduce missed vaccinations by ensuring timely notifications
- To enable easy rescheduling of missed or delayed vaccination appointments
- To provide personalized diet recommendations based on the child's age and health need through AI Assistant
- To maintain a secure and complete digital record of vaccination history
- To integrate Machine Learning techniques for prediction and personalization
- To improve overall awareness and participation in child immunization programs

LITERATURE REVIEW

Several digital solutions have been developed to improve vaccination tracking and reminder systems. Government initiatives such as immunization programs have attempted to digitize vaccination records; however, these systems are primarily designed for healthcare professionals and lack user-friendly access for parents.

Existing mobile applications allow users to manually enter vaccination data and set reminders. While these applications provide basic functionality, they heavily depend on user input and do not offer automation or intelligent features. In many cases, users forget to update data, leading to inaccurate schedules [4].

Research studies have shown that SMS-based reminder systems can significantly improve vaccination rates, especially in rural areas. However, most of these systems are limited to a single communication channel and do not provide a comprehensive solution.

Another limitation of existing systems is the absence of personalization. Most applications do not provide diet recommendations or health-related guidance, which are essential for improving the effectiveness of vaccinations [5].

Furthermore, very few systems utilize Machine Learning techniques to predict user behavior or improve system efficiency. The lack of predictive capabilities limits the effectiveness of reminder systems.

NeoVax addresses these gaps by integrating automation, personalization, multi-channel communication, and Machine Learning into a single platform, making it more effective and user-friendly.

PROPOSED SYSTEM/ SYSTEM ARCHITECTURE

The NeoVax system is designed as Application that operates through multiple interconnected modules.

The system follows a structured workflow to ensure efficient vaccination management.

Registration Module

The system begins with user registration, where parents provide basic details such as name, contact information and location. After registration, they can add their child's details, including date of birth and vaccination history. Based on this information, the system automatically generates a vaccination schedule.

Reminder System

NeoVax uses a multi-channel reminder system to notify parents about upcoming vaccinations.

Reminders are sent through SMS, WhatsApp, and Email at different intervals, such as one week before and one day before the vaccination date. This ensures maximum reach and reduces the chances of missed notifications.

AI Assistant Module Description

The proposed system also integrates an intelligent AI Assistant module to enhance user interaction and provide real-time assistance to parents. The AI Assistant is designed to offer comprehensive information related to child vaccination, general health guidance, and personalized dietary recommendations. It acts as a virtual assistant that responds to user queries regarding vaccination schedules, vaccine importance, side effects, and precautions. Additionally, the AI Assistant analyses the child's age and provides suitable diet suggestions to ensure proper growth and nutrition. For example, it can recommend breastfeeding practices for infants, balanced diets for toddlers, and nutrient-rich food plans for older children [6].

The AI Assistant improves accessibility by allowing parents to quickly obtain reliable health information without needing direct consultation. It also helps reduce the workload on healthcare staff by handling frequently asked questions. By combining automation with personalized recommendations, the AI Assistant enhances user experience, promotes awareness about timely vaccination and supports overall child health management within the system [7].

Rescheduling Module

If a vaccination appointment is missed, the system allows parents to reschedule easily. The system automatically updates the schedule and adjusts future reminders accordingly, ensuring continuity in the vaccination process [8].

System Workflow

1. Parent registers and adds child details
2. System generates vaccination schedule

3. Reminders are sent before due dates
4. Parent updates vaccination status
5. System reschedules if needed
6. Diet recommendations are provided

Database Design and Implementation

The Vaccine Care system utilizes a relational database management system (RDBMS), specifically MySQL to efficiently store, manage and retrieve vaccination-related data. The database is designed in a structured manner using multiple interrelated tables to ensure data integrity, consistency and scalability. The primary tables include Users, Children, Vaccines, Vaccination Records and Reminders. Each table is defined with appropriate attributes and constraints, such as primary keys for unique identification and foreign keys to maintain relationships between entities (Figure 1).

The Users table stores information about different system roles, including parents, ANMs (healthcare workers) and administrators, along with authentication details. The Children table maintains child-specific data such as name, date of birth and is linked to the parent through a foreign key. The Vaccines table contains predefined vaccine details and schedules, while the Vaccination Records table tracks the vaccination status of each child, including administered doses and dates. Additionally, the Reminders table is used to manage upcoming vaccination alerts and notification statuses (Table 1).

The database ensures data normalization to reduce redundancy and improve efficiency. It supports CRUD operations (Create, Read, Update, Delete) through the backend, enabling seamless interaction between the application and stored data. Security is maintained through authentication mechanisms and controlled access based on user roles. Overall, the database plays a crucial role in enabling real-time data updates, automated reminder generation and reliable storage of vaccination records, thereby enhancing the effectiveness and reliability of the system [9].

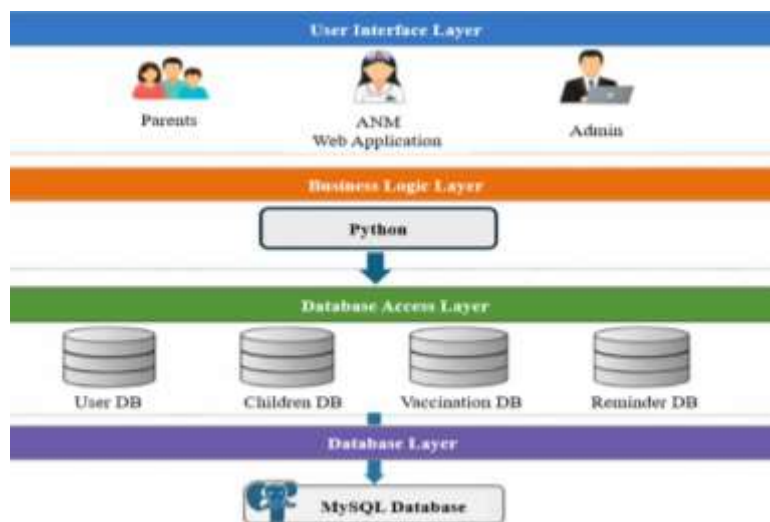


Figure 1. User interface layer

Table 1. Technology stack.

Layer	Technology
Frontend	React Native
Backend	Python, PHP
Database	MongoDB
Server & Tools	Python, VS Code

SYSTEM DESIGN

This diagram shows how a Child Vaccination System works in a very basic way. First, the parent uses the system. They register or log in and their child's details. All this information goes into the main system database called the Vaccine-Care DB (Figure 2).

Next, the ANM (Auxiliary Nurse Midwife), who is a healthcare worker, uses the system to manage vaccinations. After giving vaccines to children, they update the records in the database. So, they are responsible for keeping the vaccination data correct and up to date.

Then comes the admin. The admin manages the whole system. They add new ANMs and control how the system works. Basically, the admin ensures everything runs smoothly.

The database is the central part of the system. All information—like child details and vaccination records—is stored there and everyone (parent, ANM, admin) interacts with it (Figure 3).

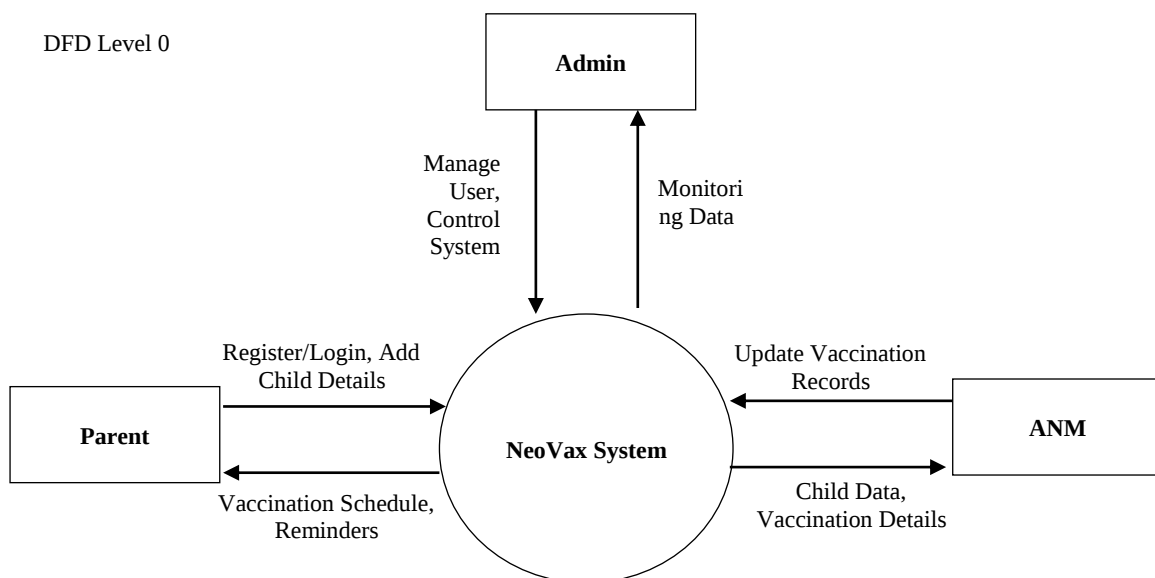


Figure 1. Data flow diagram level 0.

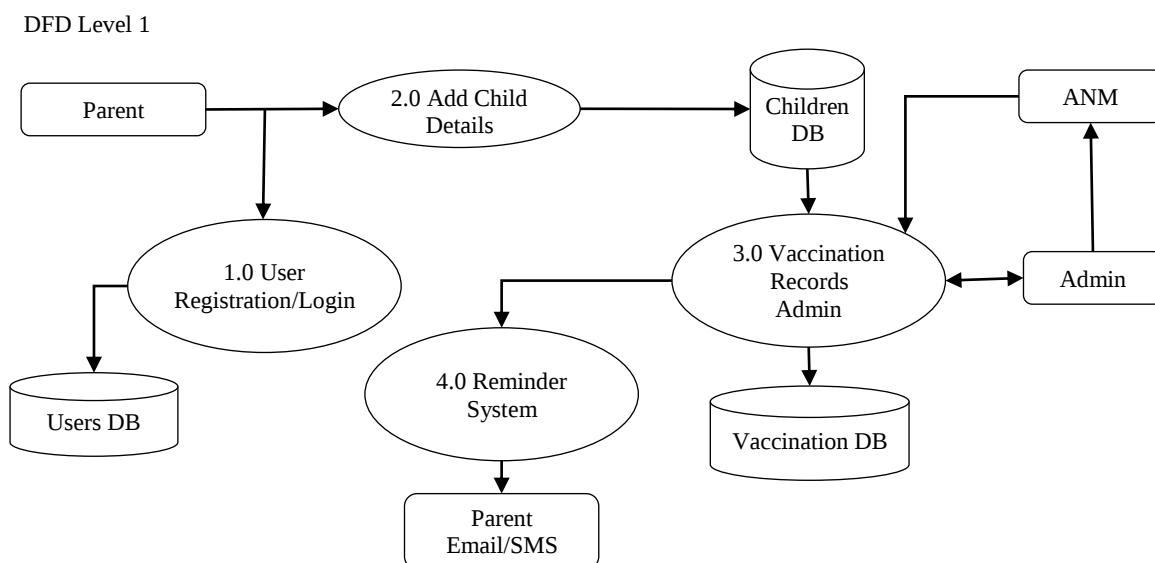


Figure 2. Data flow diagram level 1.

This Data Flow Diagram (DFD Level 1) represents the internal working of the NeoVax Child Vaccination System by breaking it into different processes and data stores. The process begins with the parent registering or logging into the system and the user details are stored in the Users database. After successful login, the parent adds child details, which are saved in the Children database. The ANM (healthcare worker) then updates the vaccination records of the child, and this information is stored in the Vaccination database while also using data from the Children database. The system then processes this information in the reminder module, which checks the vaccination schedule and sends timely reminders to the parent through email or SMS. Additionally, the admin monitors and manages the system and vaccination records to ensure proper functioning. Overall, the diagram shows how data flows between users, processes and databases to maintain accurate vaccination records and ensure timely notifications.

MACHINE LEARNING INTEGRATION

Machine Learning enhances the intelligence and effectiveness of the NeoVax system.

Logistic Regression

This algorithm is used to predict whether a child is likely to miss a vaccination. It analyzes factors such as past behavior, missed appointments, and location. Based on this prediction, the system can send additional reminders to high-risk users.

Decision Tree

The Decision Tree algorithm helps determine the best time to send reminders. It analyzes user response patterns and identifies the time when users are most likely to check messages, improving engagement.

K-Nearest Neighbours (KNN)

KNN is used for personalized diet recommendations. It compares a child's profile with similar profiles in the dataset and suggests suitable diet plans. This ensures relevant and customized recommendations.

These Machine Learning techniques improve system efficiency, personalization, and user engagement.

RESULTS AND DISCUSSION

Since NeoVax is a proposed system, the results are based on expected outcomes. The system is expected to significantly reduce missed vaccinations by providing timely and consistent reminders.

The use of multiple communication channels ensures that parents receive notifications even if one channel fails. The rescheduling feature helps recover missed appointments, ensuring that vaccinations are not skipped entirely [10].

Machine Learning integration enhances system performance by predicting user behavior and optimizing reminder delivery. Personalized diet recommendations improve child health and support better vaccine response.

Overall, NeoVax is expected to increase vaccination coverage, improve parental awareness, and contribute positively to public healthcare systems [11].

FUTURE SCOPE AND LIMITATIONS

Limitations

- Dependence on internet connectivity
- Accuracy depends on user-provided data

- No real-time verification of vaccination
- Limited accessibility for non-digital users
- Language limitations in current system

Future Scope

- Development of mobile application
- Integration with government healthcare systems
- Addition of multilingual support
- Implementation of advanced AI models
- Direct integration with hospitals and doctors
- Offline functionality for rural areas

CONCLUSION

NeoVax presents a smart and effective solution to one of the critical challenges in child healthcare — missed vaccinations. By combining automated reminders, personalized recommendations, and intelligent prediction, the system provides a comprehensive approach to vaccination management.

The platform is designed to be simple, accessible and efficient, making it suitable for a wide range of users. Its ability to integrate technology with healthcare needs makes it a valuable tool for improving immunization rates and ensuring better health outcomes for children.

With future enhancements and wider adoption, NeoVax has the potential to play a significant role in strengthening public healthcare systems and supporting the goal of complete child immunization.

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