INTEL UNNATI INDUSTRIAL TRAINING

PROBLEM STATEMENT - 6

Product Category Creation for Healthcare Kiosks in India

Submitted by

Team: *The Brainy Bunch*

1) Macharouthu Sathya Abhiram Verma

2) Mrigank Shekhar

3) Chinmayee Chintapanti

4) Shreya Kondur

5) Vemulapalli Shodhan

ABSTRACT

In a country like India, where healthcare infrastructure often struggles to meet the needs of its vast and diverse population, technology-driven solutions like healthcare kiosks offer a scalable, accessible, and affordable means to deliver basic healthcare services. This project aims to design and prototype a smart Healthcare Kiosk equipped with modern features to streamline patient registration, vital signs monitoring, and appointment booking processes, especially for underserved areas.

The proposed system integrates a user-friendly interface, biometric authentication via face recognition, and a patient report generation module. The kiosk workflow accommodates both new and registered users, with provisions for Ayushman Bharat Health Account (ABHA) ID integration to align with the Ayushman Bharat Digital Mission (ABDM). Patients without an ABHA ID are encouraged to register for one, promoting interoperability of digital health records.

Although some planned features like voice command integration, vitals monitoring sensor modules, and teleconsultation support are part of the extended roadmap, this prototype lays a strong foundation by demonstrating secure check-in, patient data management, and report generation capabilities.

The documentation also outlines hardware requirements, market analysis, cost estimates, and prospects like federated learning-based personalized healthcare plans. The proposed system supports India's vision for digital healthcare accessibility, especially in remote and rural settings, while offering a scalable model for integration with national digital health infrastructure.

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1. Introduction

1.1 Background

India's public healthcare system caters to over a billion people across urban and rural regions, yet continues to face significant challenges in delivering efficient, timely, and accessible medical services. Long patient queues, manual record-keeping, inconsistent health data management, and inadequate resource allocation at Primary Health Centers (PHCs) and Urban Primary Health Centers (UPHCs) have highlighted the urgent need for digitization and automation in healthcare delivery.

To address these challenges, the Government of India launched the Ayushman Bharat Digital Mission (ABDM), aiming to create a unified digital health ecosystem by promoting the use of Ayushman Bharat Health Accounts (ABHA) and interoperable digital health records accessible to patients and healthcare providers nationwide.

At the same time, self-service healthcare kiosks have emerged globally as an innovative solution to streamline patient registration, vital signs monitoring, and appointment booking — reducing the burden on frontline healthcare staff and improving patient experience. The integration of technologies like biometric authentication, face ID recognition, AI-based health analytics, and teleconsultation support has further enhanced the scope of such kiosks.

This project focuses on developing a smart Healthcare Kiosk prototype designed to simplify patient management workflows, support basic diagnostic services, and align with India's digital health infrastructure, especially targeting deployment in government PHCs, UPHCs, and community clinics.

1.2 Problem Statements

The following problem statements were selected from the list provided as part of the Intel Unnati Project, focusing on enhancing patient registration efficiency and immediate vitals monitoring through a smart Healthcare Kiosk:

Problem Statement 1:

"Can technologies like face ID recognition be brought in with advanced authorization from the patient, as seen in Digi Yatri Kiosks, to fasten the registration and check-in process?"

Problem Statement 2:

"Can the Healthcare Kiosk serve as a federated learning platform?"

Additional System Integrations:

In addition to addressing the above, the proposed system incorporates:

- A prompt for Ayushman Bharat Health Account (ABHA) ID during patient registration to encourage participation in the Ayushman Bharat Digital Mission (ABDM). Patients without an ABHA ID are recommended to register for one if eligible.
- A unique patient ID generation feature at the kiosk level for smooth patient data retrieval on repeat visits.
- Multiple authentication options including biometric verification (assumed Aadhaar-based integration), face ID recognition, PIN, or OTP-based login for registered users.

1.3 Why These Problem Statements Were Chosen

The selected problem statements address some of the most pressing challenges faced by public healthcare delivery systems in India, particularly at Primary Health Centers (PHCs), Urban PHCs (UPHCs), and small community healthcare facilities. The following reasons guided the selection of these problem statements for the proposed Healthcare Kiosk prototype:

- **Gap in Existing Kiosk Systems:**
  While several healthcare kiosks exist in India, most lack contactless, biometric-based patient check-in options such as face ID recognition, which can significantly reduce queue times and improve hygiene, especially in post-pandemic healthcare settings. The successful implementation of such systems at airports through initiatives like Digi Yatri demonstrates the viability of integrating similar systems within public healthcare environments.
- **Lack of Immediate, Automated Vitals Reporting:**
  Existing kiosks typically offer only limited services like BMI calculation or manual vitals entry. A system that can immediately monitor a patient's vitals (temperature, blood pressure, SpO_2, BMI, etc.) and generate a health summary report in PDF or printed form can empower both patients and doctors with timely, structured information — improving diagnostic efficiency and reducing consultation delays.

- **Alignment with National Digital Health Initiatives:**
  By integrating an Ayushman Bharat Health Account (ABHA) ID prompt into patient registration, the kiosk actively supports the Ayushman Bharat Digital Mission (ABDM) by promoting digital health record interoperability. This aligns the project with ongoing national healthcare digitization priorities.

- **Prototype Feasibility with Future Expansion Possibilities:**
  These problem statements were chosen because they offer a manageable scope for initial prototype development, while leaving room for future enhancements like teleconsultation support, voice command integration, AI-based diagnosis, and federated learning-based personalized health plans.

- **High Public Benefit Potential:**
  These features directly contribute to reducing patient waiting times, streamlining healthcare workflows, improving record-keeping accuracy, and enhancing healthcare accessibility in underserved and remote regions.

- **Assumed Existing Appointment Booking Usage:**
  It has been assumed that existing healthcare kiosks are primarily being used for patient appointment booking services at PHCs and public hospitals. Based on this, the proposed system builds upon this functionality by integrating patient vitals monitoring and digital report generation within the same kiosk workflow, thereby extending its utility and reducing the need for multiple patient touchpoints during outpatient visits.

- **Need for Privacy-Preserving, AI-Driven Healthcare Insights:**
  While machine learning models have shown promise in recommending medications and identifying at-risk patients, deploying them in healthcare environments requires careful handling of sensitive data. By integrating **Federated Learning (FL)** into the kiosk system, patient data remains local to the kiosk while model improvements are aggregated at a central server — preserving privacy without compromising on AI-driven insights. This enables decentralized, continuously improving health predictions (like vitals-based medication recommendations) without transmitting raw patient data. The inclusion of FL prepares the system for scalable, privacy-aware health analytics across multiple PHCs and rural clinics.

2. Objectives

The primary objective of this project is to design and prototype a smart Healthcare Kiosk that simplifies patient registration, automates vital signs monitoring, and integrates with India's evolving digital health ecosystem. The system aims to enhance patient experience, reduce operational delays, and promote the adoption of interoperable digital health records through the Ayushman Bharat Digital Mission (ABDM).

The specific objectives of the proposed system are as follows:

2.1 Features Implemented in the Prototype

- **User-Friendly Interface:**
  Design of an intuitive kiosk UI for both new and registered users with a simple navigation flow.
- **New Patient Registration Module:**
  Registration process involving generation of a unique kiosk ID and collection of patient demographic details.
- **ABHA ID Integration Prompt:**
  Prompt patients during registration to enter their Ayushman Bharat Health Account (ABHA) ID or encourage them to register for one if not available.
- **Biometric & Face ID Authentication:**
  Provision for patient login via face recognition, biometric verification (assumed Aadhaar-based integration), PIN, or OTP authentication for registered users.
- **Vitals Check Module:**
  System-guided process for recording vitals such as temperature, blood pressure, SpO_2, weight, height, and calculating BMI.
- **Digital Report Generation:**
  Immediate generation of patient health summary reports in PDF format, with options for printing, SMS, and email delivery.
- **Appointment Booking Module:**
  Enable patients to book doctor appointments based on available time slots, either locally or via integrated APIs (planned).

2.2 Planned Features for Future Implementation

- **Voice Command Integration:**
  Hands-free, voice-based interaction options for patient services and navigation, improving accessibility for elderly or differently-abled users.
- **Vitals Sensor Hardware Integration:**
  Integration of real-time medical devices and sensors for automated vital signs measurement directly from the kiosk interface.
- **Teleconsultation Support:**
  Facilities for remote virtual consultations with doctors via kiosk-integrated video conferencing modules.
- **Federated Learning-Based Personalized Healthcare:**
  Implementation of federated learning systems to create privacy-preserving, personalized health plans based on patient data trends.

2.3 Alignment with ABDM and India Stack

- Encourage adoption of ABHA IDs during patient registration to promote interoperable health record management under the Ayushman Bharat Digital Mission (ABDM).
- Ensure future compliance and integration capabilities with the India Stack public digital infrastructure, including Aadhaar-based authentication and Digital Locker integration for health records.

3. Literature Survey

3.1 Existing Healthcare Kiosk Systems

Healthcare kiosks have emerged as self-service systems that assist in improving patient flow management, reducing administrative workloads, and providing basic diagnostic services in public and private healthcare facilities. These systems are typically installed in hospitals, clinics, airports, and public spaces to perform tasks such as patient registration, appointment scheduling, and basic health screenings.

Some notable existing healthcare kiosk solutions and relevant systems include:

- **Apollo TeleHealth Kiosks:**
  Installed in select locations across India, these kiosks provide teleconsultation services and basic health check-ups. However, most kiosks rely on manual patient ID entry and do not offer advanced biometric-based authentication or face recognition capabilities.
- **Existing Public Hospital Kiosks:**
  Many government-run hospitals have basic kiosks used for appointment booking and OPD token generation. However, these lack integration with digital health records (ABHA IDs) and have no built-in vitals monitoring or AI-assisted reporting capabilities.
- **Digi Yatri Airport Kiosks:**
  Although not healthcare-specific, the Digi Yatri initiative successfully implements contactless face ID-based check-ins at several major Indian airports. This demonstrates the practical viability, public acceptability, and operational success of biometric face recognition systems in government-managed, high-footfall public environments. It serves as a proven example that similar systems can be safely adapted to healthcare kiosks for patient registration and check-in processes.

3.2 Limitations in Current Solutions

While healthcare kiosks and self-service systems have seen gradual adoption in India, especially in private healthcare and urban environments, several limitations remain in existing solutions. These gaps restrict their scalability, accessibility, and effectiveness in

public healthcare settings like government-run PHCs, UPHCs, and district hospitals. The key limitations are as follows:

- **Lack of ABHA ID and Digital Health Record Integration:**
  Most existing kiosks in government and private hospitals operate as standalone systems without integration into the Ayushman Bharat Digital Mission (ABDM) ecosystem. This prevents seamless, interoperable health record management for patients across healthcare facilities.
- **Absence of Biometric and Face Recognition Authentication:**
  Current hospital kiosks rely on manual entry of patient IDs, phone numbers, or tokens for authentication. There are no provisions for face ID recognition or biometric verification (like fingerprint scan via Aadhaar authentication), which can enhance security, speed, and hygiene, especially in crowded outpatient departments.
- **No Automated Vitals Monitoring:**
  Existing public kiosks lack integration with vitals monitoring devices like temperature sensors, BP monitors, SpO_2 readers, and digital scales. As a result, patients must visit multiple counters or nursing stations for these checks, increasing wait times and reducing operational efficiency.
- **Limited-Service Offerings:**
  Most government kiosks are restricted to appointment booking and token generation, without offering end-to-end services like vitals check, report generation, or teleconsultation booking in a single workflow.
- **Absence of AI-Assisted Reporting and Diagnosis:**
  Current systems do not leverage AI or large language models (LLMs) to generate preliminary diagnoses, personalized health insights, or automated case summaries, which could aid doctors in faster decision-making.
- **No Voice-Based Interface for Accessibility:**
  Existing kiosks lack voice command-based interfaces, which would enhance usability for elderly, differently abled, or digitally less literate patients in rural settings.
- **No Remote Teleconsultation Support:**
  While telemedicine services exist, there are no publicly deployed kiosks that allow patients to book or attend live remote consultations via integrated video conferencing directly from a healthcare kiosk, especially in rural PHCs or small clinics.

4. Proposed System

The proposed system is a smart, self-service Healthcare Kiosk prototype designed to streamline outpatient department (OPD) workflows, improve patient experience, and support India's Ayushman Bharat Digital Mission (ABDM). It offers touchless registration, biometric authentication, automated vitals monitoring, and appointment booking functionalities, with provisions for future AI-based healthcare recommendations and teleconsultation support.

4.1 System Overview

The Healthcare Kiosk is envisioned as an integrated, modular system installed in hospitals, PHCs, UPHCs, and public healthcare facilities. The kiosk enables patients to:

- Register using a unique kiosk-generated ID and optionally link their ABHA Health ID.
- Authenticate securely using face ID, biometric (assumed Aadhaar-linked), PIN, or OTP-based login.
- Check their vitals through system-guided sensors for parameters like temperature, blood pressure, SpO_2, height, weight, and BMI.
- Generate a health summary report instantly in PDF format, with options to print, email, or SMS the report.
- Book doctor appointments based on local availability or future API integration with government health services.

The kiosk workflow is structured to reduce human intervention, shorten waiting times, and provide immediate access to vital health data, while maintaining patient data security and consent-based access.

4.2 System Flow

The detailed workflow of the proposed Healthcare Kiosk is represented in the following diagrams. The system is designed to offer a clear, step-by-step navigation experience for patients, starting from the home screen and proceeding through patient services.

4.2.1 Home Screen Navigation Flow

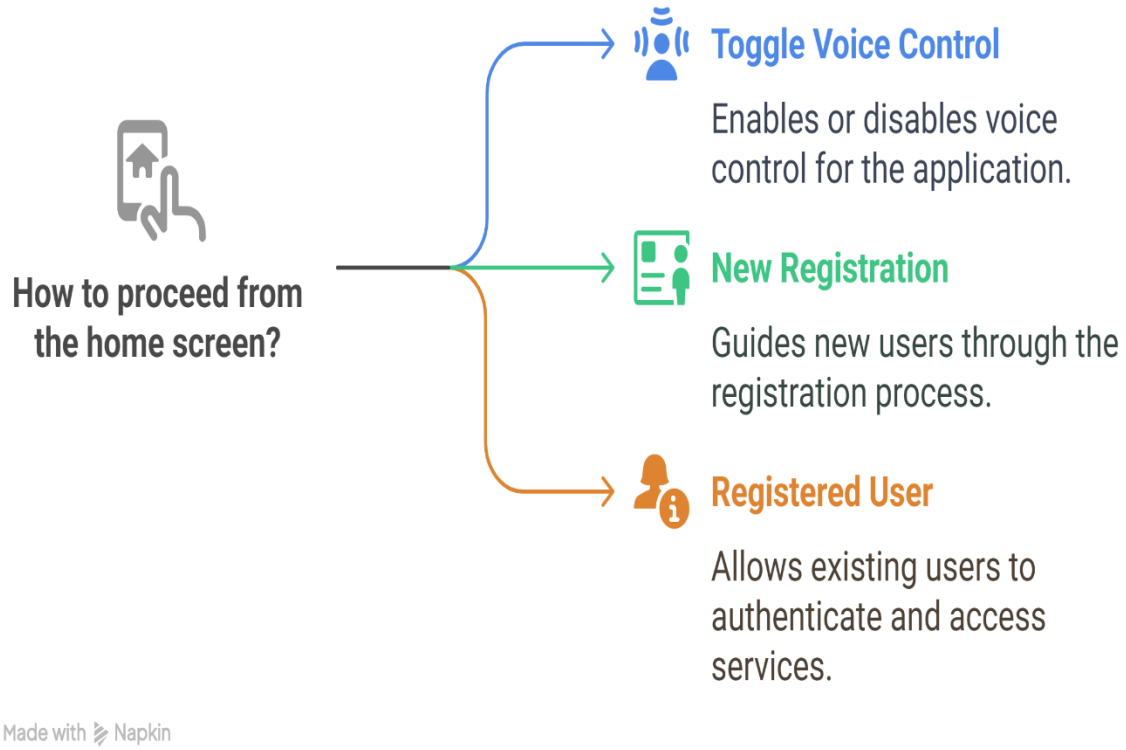

Figure 4.2.1: *Home Screen Navigation Flow Diagram*

4.2.2 Patient Services Module Flow

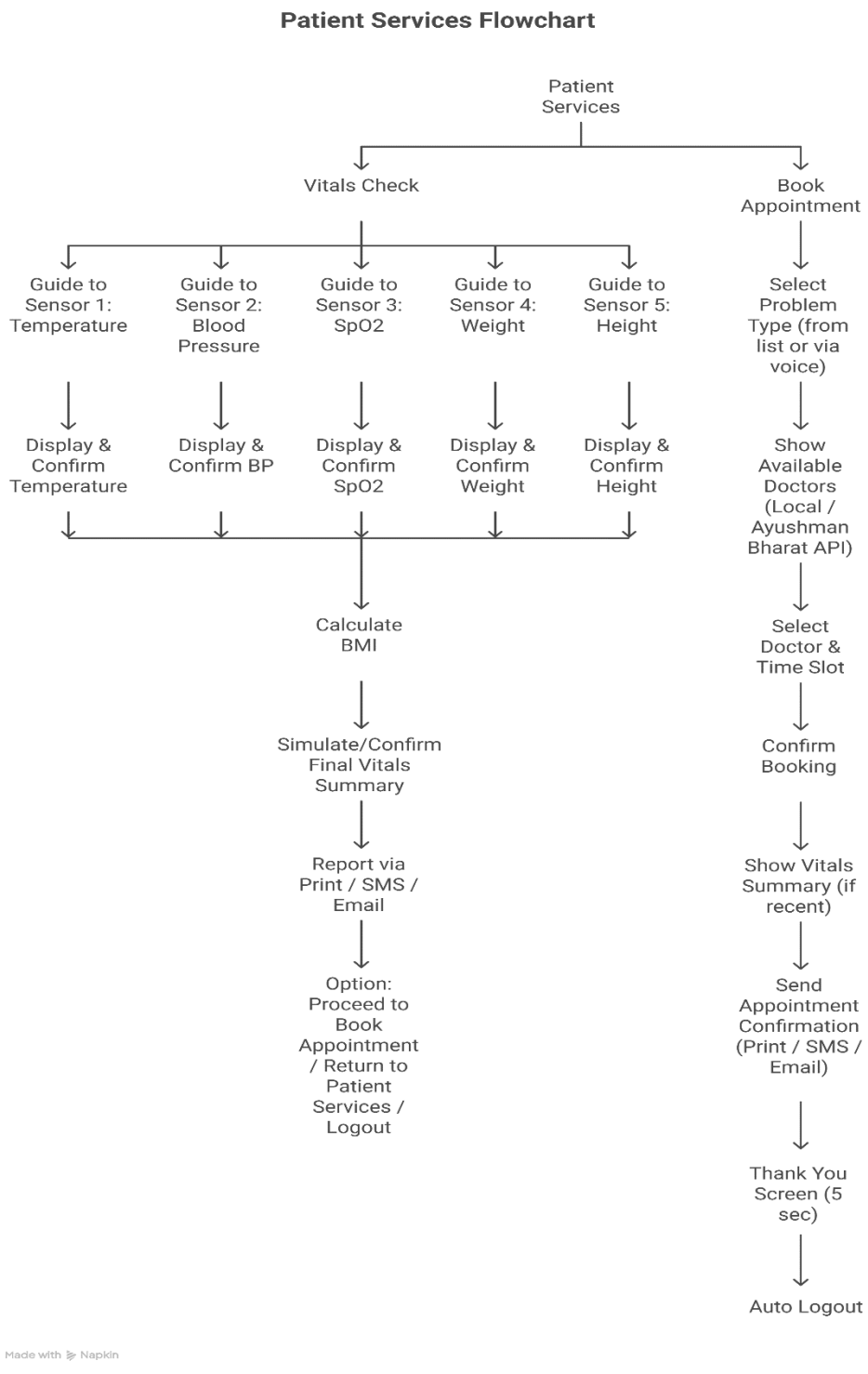

Figure 4.2.2: *Patient Services Module Flow Diagram*

4.3 Module Descriptions

The proposed Healthcare Kiosk system is designed with multiple functional modules, each handling a specific workflow in patient registration, authentication, health monitoring, reporting, and appointment booking. The details of each module are as follows:

The Home Screen of the Healthcare Kiosk displays primary options for users, including New Patient Registration, Registered User login, and a Voice Control Toggle. This intuitive interface ensures easy navigation for both new and returning patients while supporting contactless operation via the voice control feature.

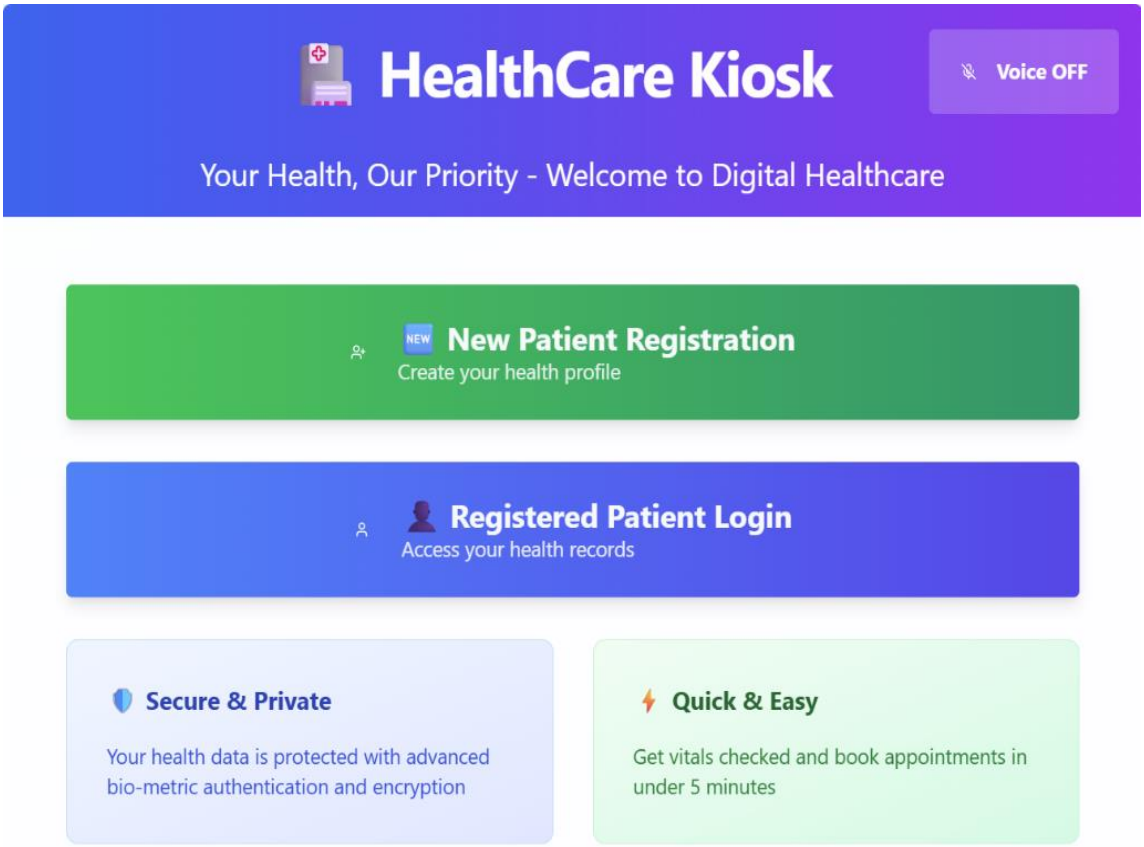

Figure 4.3.1: *Home Screen Interface of the Healthcare Kiosk*

4.3.1 New Patient Registration Module

This module facilitates the registration of new patients at the kiosk. The system generates a unique kiosk ID for every new user and captures essential personal and contact details as follows:

- Full Name
- Date of Birth (DOB)
- Gender
- Mobile Number
- Email ID
- Address
- Aadhaar Number
- Ayushman Bharat Health Account (ABHA) ID *(optional — entered if available; otherwise, patient is recommended to apply for one if eligible)*

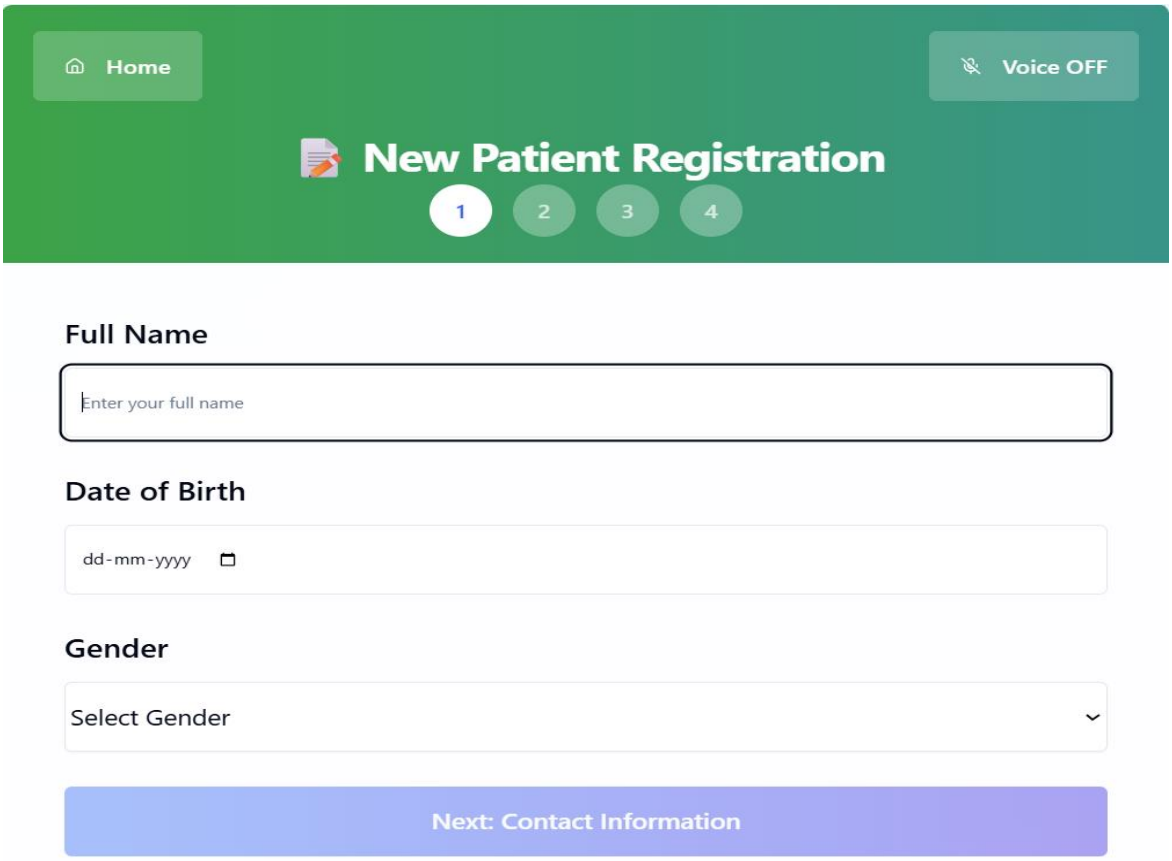

Figure 4.3.2: *New Patient Registration Screen*

4.3.2 Authentication Module

Registered patients can log in to access services using any of the following:

- Health ID / Phone number / Kiosk-generated ID
- Face ID Recognition
- Biometric Verification (fingerprint) (assumed for production)
- PIN / OTP sent to their registered mobile

This module ensures fast, secure, and contactless access to the kiosk services.

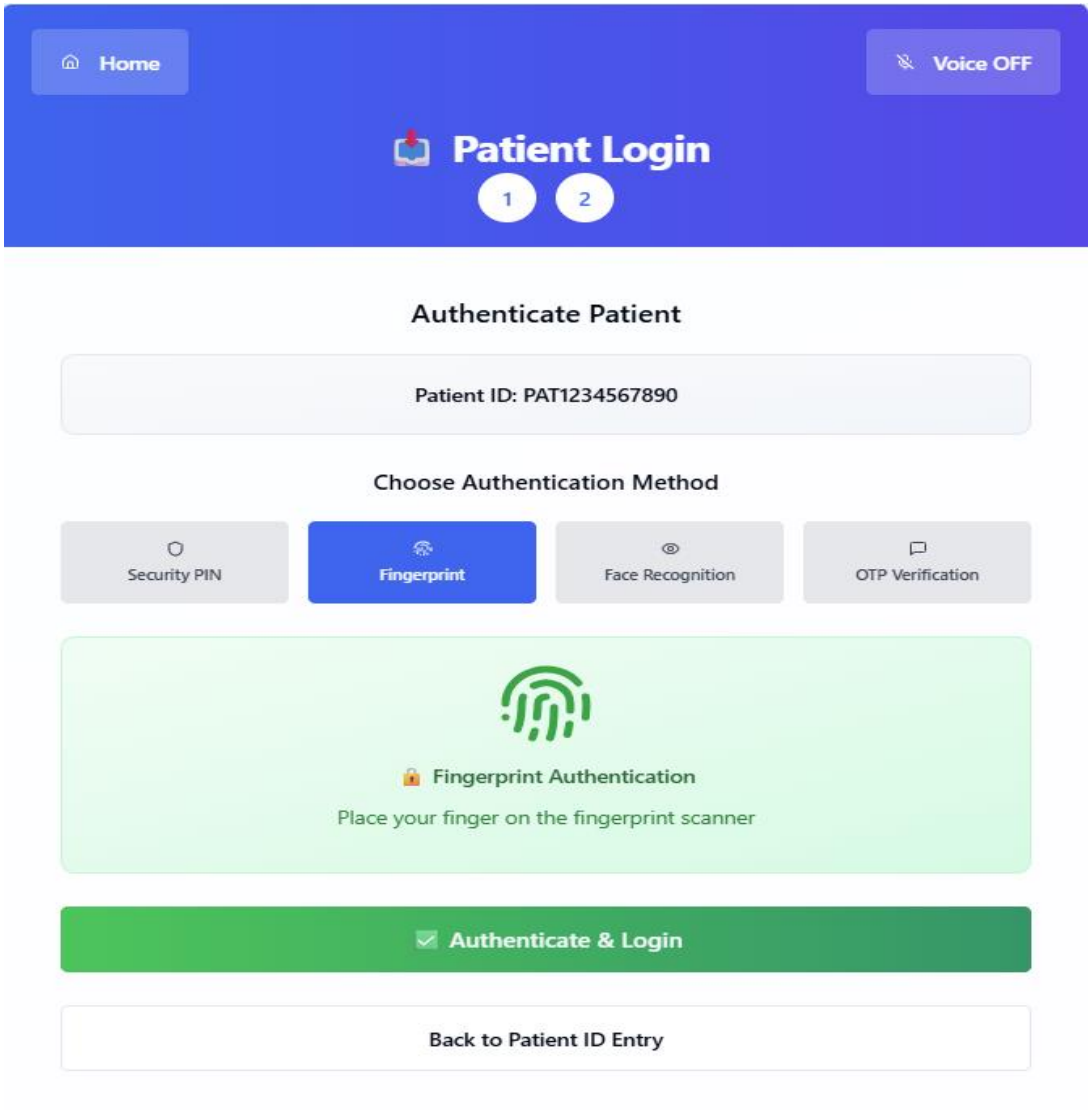

Figure 4.3.3: *Registered User Login Screen*

4.3.3 Vitals Check Module

This module guides patients to check their vitals through integrated sensors and displays readings sequentially:

- Temperature
- Blood Pressure
- SpO_2
- Height & Weight
- BMI Calculation

Patients are guided through each check via on-screen prompts. The collected data is summarized and confirmed before generating the final health report.

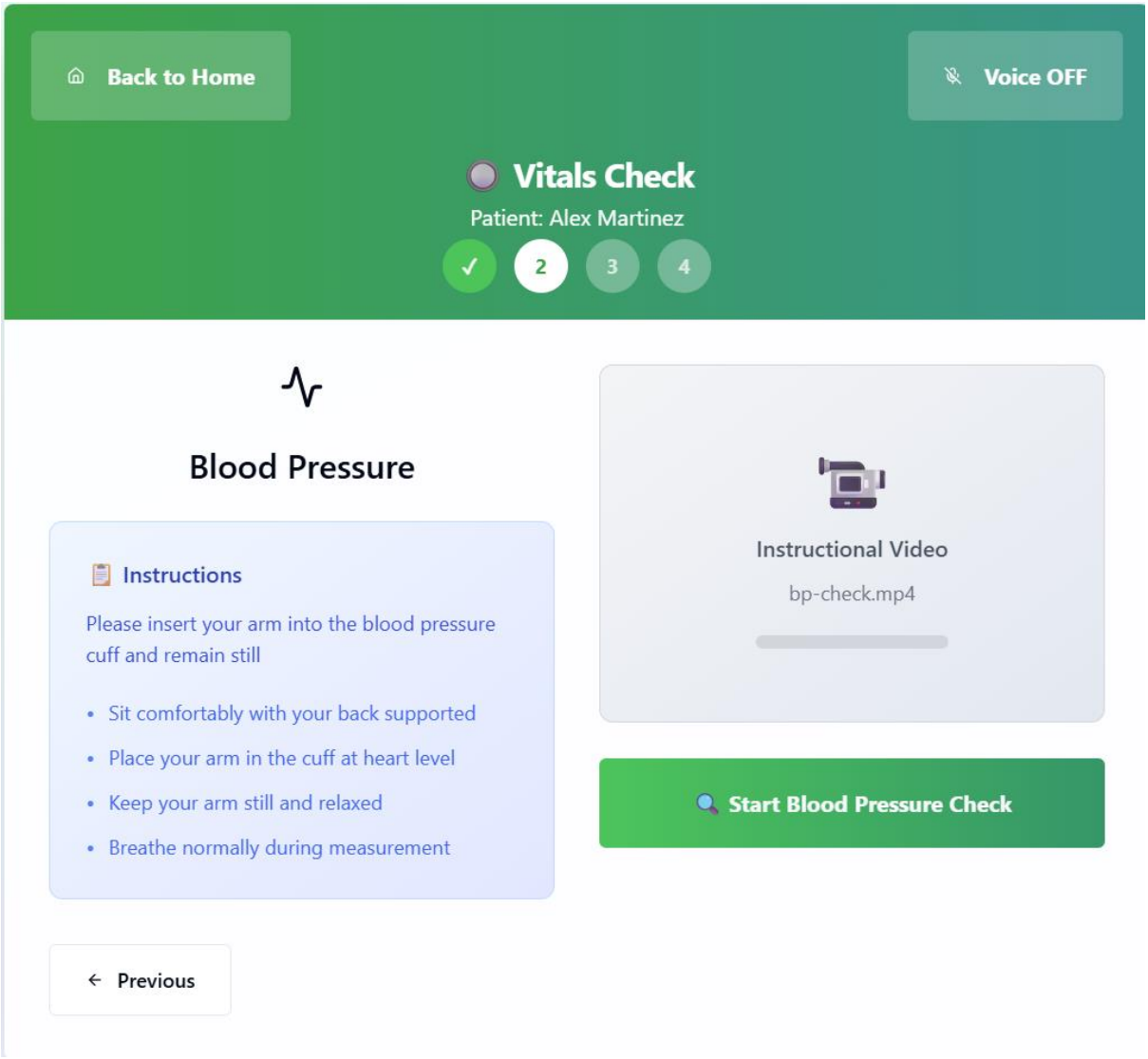

Figure 4.3.4: *Vitals Check Module Screen*

4.3.4 Report Generation Module

Once vitals are recorded, this module generates a health summary report containing:

- Patient details
- Recorded vitals
- Calculated BMI
- Timestamp

Reports can be delivered via:

- On-screen display
- SMS link
- Email
- Print (if printer is connected)

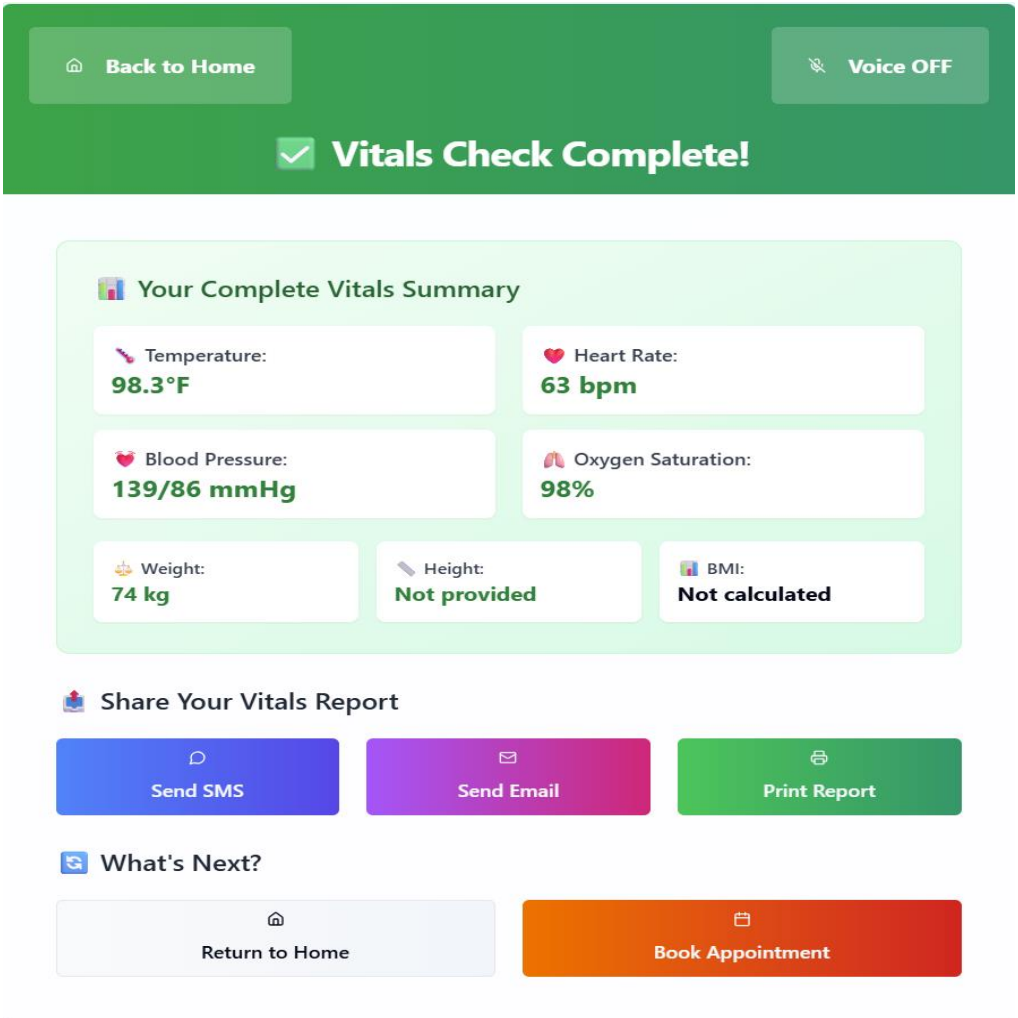

Figure 4.3.5: *Vitals Summary Report Screen*

4.3.5 Appointment Booking Module

Patients can book appointments with available doctors based on:

- Issue type (selected from a dropdown or via voice in future updates)
- Doctor availability (local or via future integrated API)

Once booked, confirmation is displayed and optionally sent via SMS or email.

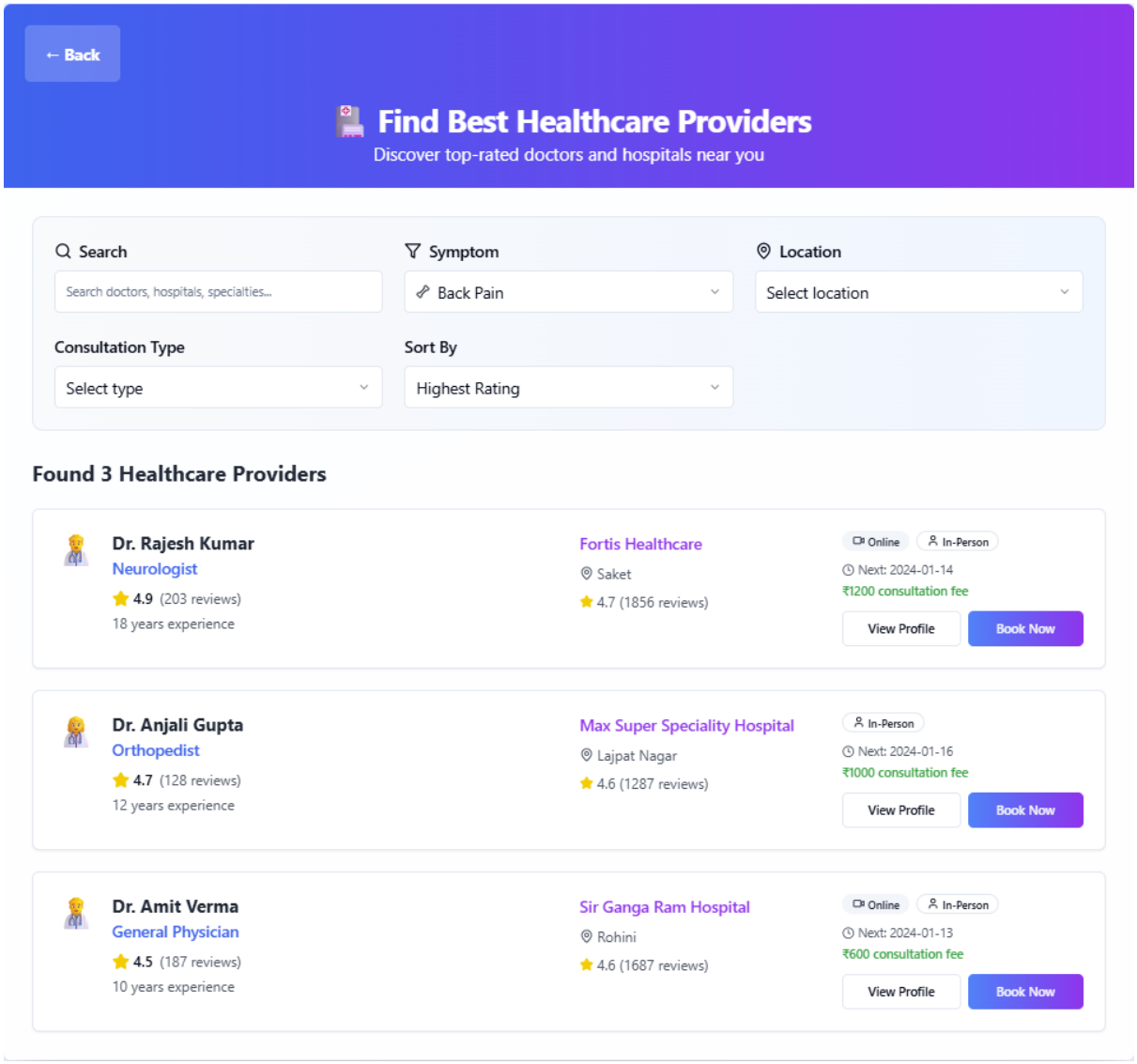

Figure 4.3.6: *Appointment Booking Screen*

4.3.6 Voice Integration Toggle Button

To improve kiosk accessibility and hygiene in public health setups, a voice control toggle button was added to the UI:

Features:

- A toggle button on the home screen enables/disables voice command mode.
- The UI colour theme changes based on the toggle state for clear visual feedback:
  - **Voice Enabled**: Highlighted theme
  - **Voice Disabled**: Default theme
- Voice commands integration for kiosk navigation and patient services planned for the next prototype version.

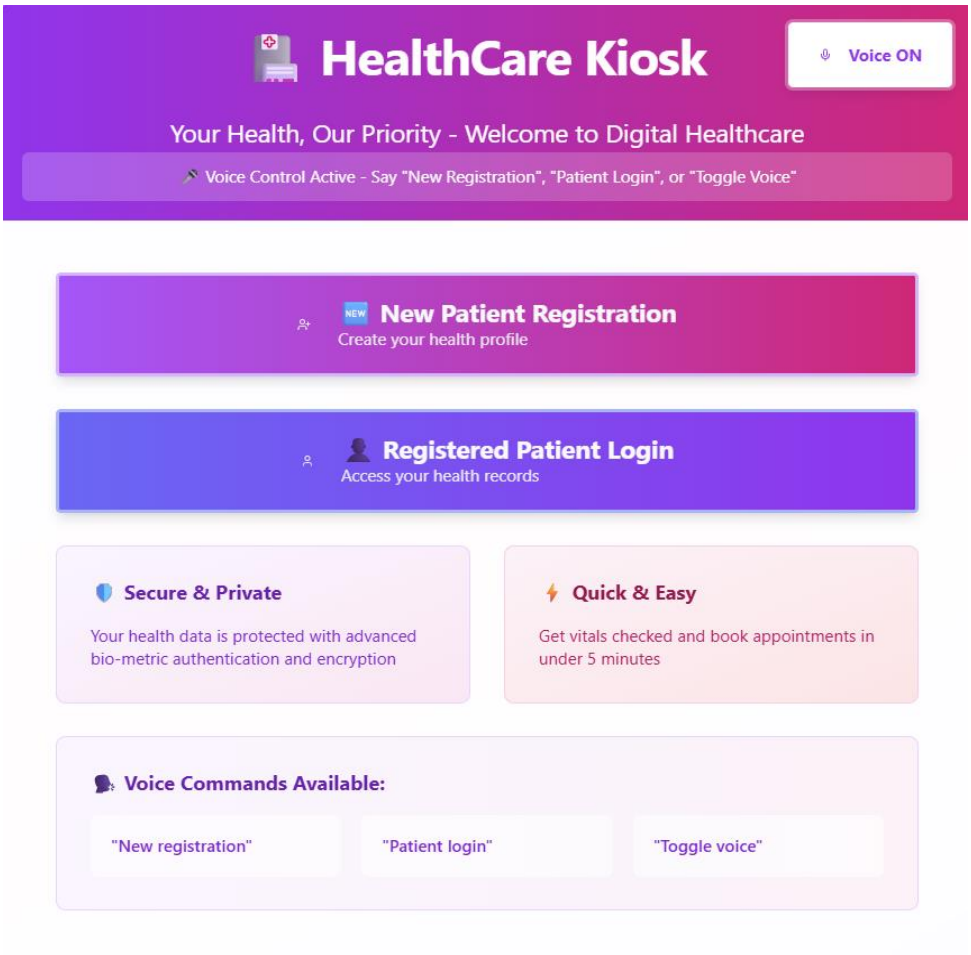

Figure 4.3.7: *Voice Control Toggle with Theme Change*

4.3.7 Medication Prediction & Federated Learning Module (Prototype Deployment)

Medical Prediction Module uses a supervised machine learning model trained on synthetic patient vitals to predict medications. It serves as a local, fast prediction engine within each kiosk, enabling instant recommendations even without federated training.

Model: RandomForestClassifier trained on vitals data (med_model.pkl)

Integrated into the vitals entry workflow for real-time medication suggestions

Sample Test Data

Example vitals are prepared to simulate:

- High blood pressure → Amlodipine
- High fever → Paracetamol
- High blood sugar → Insulin
- Normal readings → Multivitamins

Federated Learning Module implements a privacy-preserving federated learning system for healthcare kiosks. It enables multiple decentralized kiosks to collaboratively train a machine learning model on local patient vitals without sharing raw data.

Features

- Decentralized model training using the Flower framework.
- Medication prediction model (med_model.pkl) trained on synthetic vitals data.
- Real-time metrics logging to Supabase (training_logs table).
- Dynamic training dashboard visualizing accuracy, loss, and kiosk-wise performance.
- Critical condition detection during vitals entry with immediate alerts.

Workflow

- server.py: Manages federated training rounds and aggregates client updates.
- client.py: Simulates kiosks that train on local data and send updates.
- Training logs: Stored in Supabase and visualized via Streamlit dashboard.
- Vitals prediction: Predicts medications based on vitals using a trained ML model.

Future Scope

- Model versioning and drift detection
- Real-time kiosk status alerts
- Deployment with Supabase Auth security

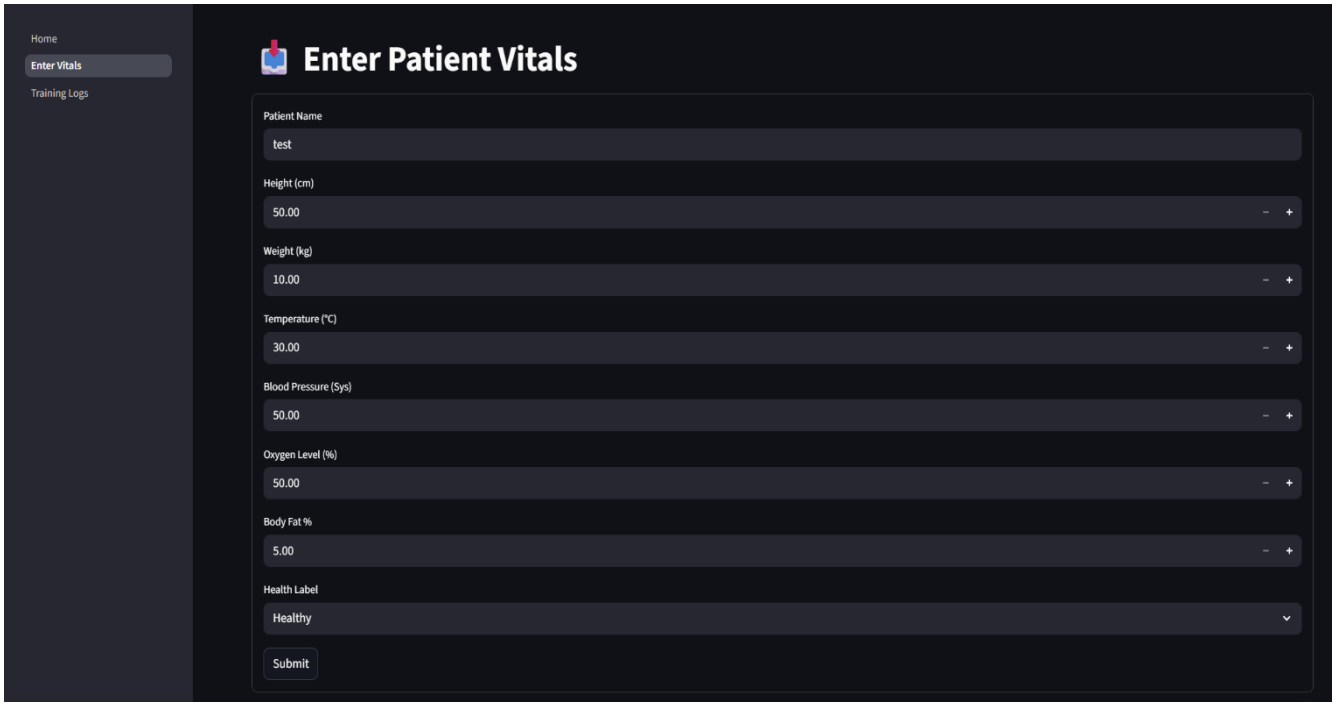

Figure 4.3.8: *Entering patient vitals for making predictions*

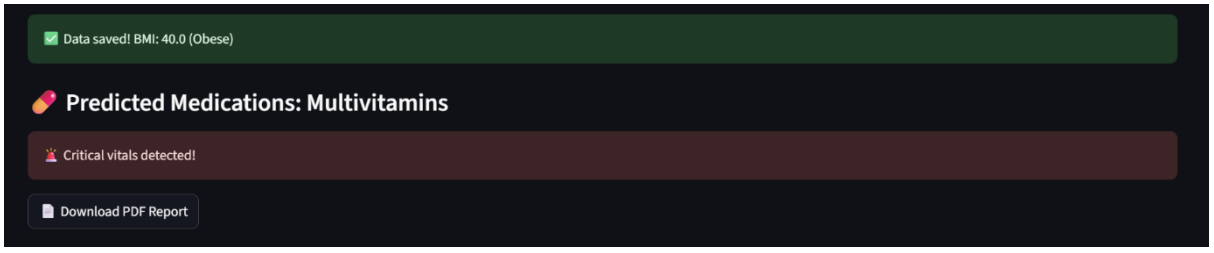

Figure 4.3.9: *Predicted medications for the given patient vitals*

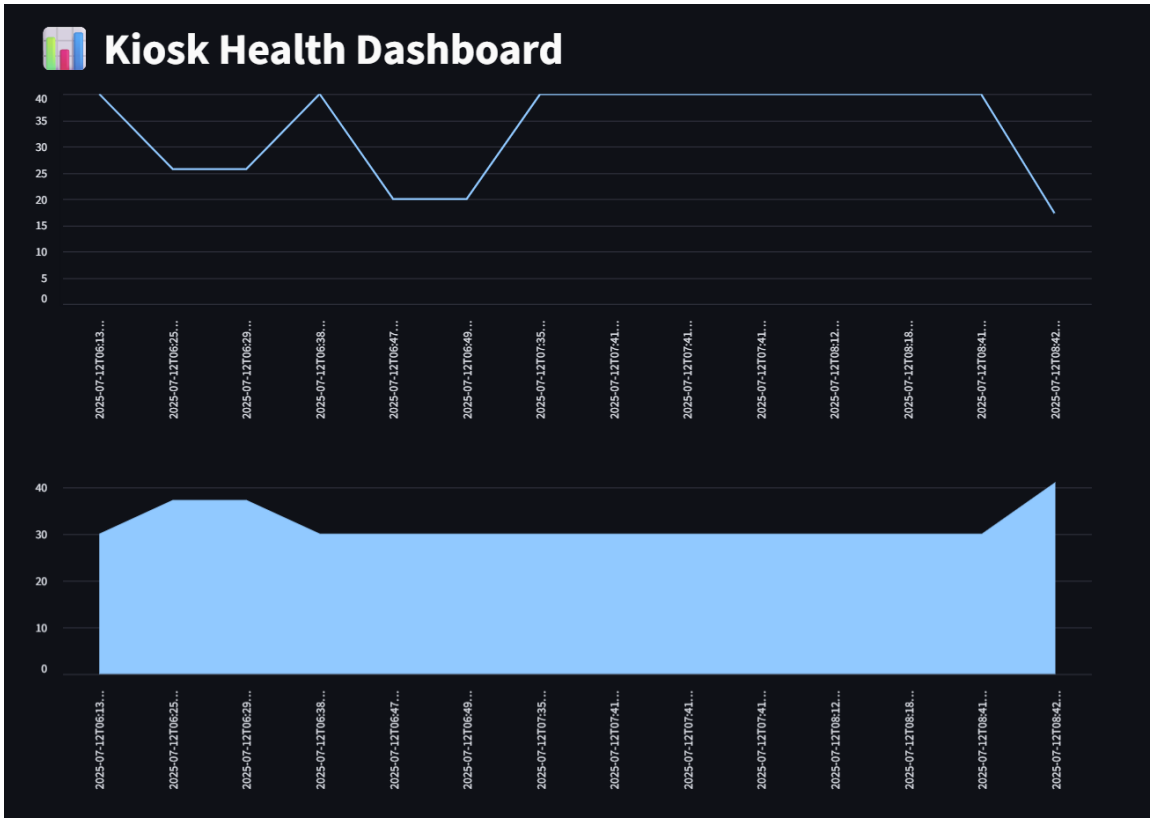

Figure 4.3.10: *Machine Learning model which predicts basic medication*

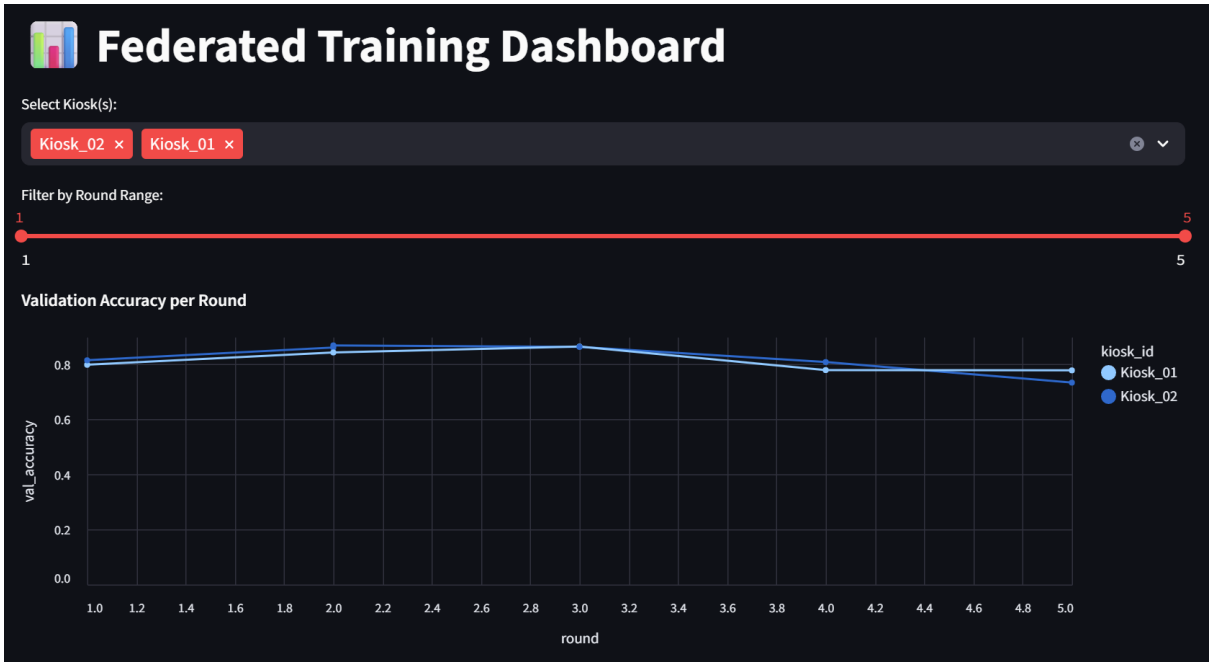

Figure 4.3.11: *Federated Training Dashboard*

5. Sensor Details and Source Information

This section lists the detailed specifications, price range, and reliable Indian sources for procuring each sensor module and vital monitoring component used in the kiosk prototype.

Parameter	Sensor/Module	Approx. Price (INR)	Source(s)
Weight Measurement	Single Point Platform Load Cell + HX711	₹1,200 – ₹2,500 (Load Cell) ₹100 (HX711)	Monad Electronics, Robu.in
Height Measurement	HC-SR04 / JSN-SR04T (waterproof)	₹90 – ₹200	Robokits India, Robu.in
Body Temperature	MLX90614 IR Sensor / Omron IR modules	₹700 – ₹1,500 (MLX90614) ₹2,000 – ₹4,000 (Omron)	Robokits, Olelectronics, IndiaMART
Pulse Rate / SpO_2	MAX30102 or MAX30100 Module	₹200 – ₹400 (MAX30102) ₹1,500 – ₹3,000 (Med-grade probe)	Robu.in, IndiaMART, Nonin distributors
Heartbeat	MAX30102 / MAX30100 (PPG Pulse Sensor)	₹250 – ₹400	Robu.in, Robokits India, Olelectronics
Blood Pressure	Certified Digital BP Module (OEM) MPX5050GP (prototype)	₹3,000 – ₹8,000 (OEM) ₹1,800 – ₹2,700 (MPX5050GP)	Mouser India, Element14, Omron India
Sugar Level	OEM Glucometer Module + Strips	₹2,000 – ₹4,000 (Reader) ₹600–₹1,200 (50 strips)	NetMeds, BeatO, Local Medical Distributors

6. Cost Analysis and Market Requirements

This section outlines the detailed cost estimates for building the kiosk prototype, projections for production-ready deployments, and highlights the current market demand for integrated healthcare kiosks in India.

6.1 Prototype Cost Estimation

The following table presents the estimated cost for developing a working prototype of the Healthcare Kiosk using student-accessible sensors, components, and basic enclosures:

Category	Approx. Cost (INR)
Touchscreen Display	₹12,000 – ₹18,000
Thermal Printer (optional)	₹7,500 – ₹9,500
Fingerprint Scanner	₹2,800 – ₹3,200
Web Camera	₹2,000 – ₹2,500
Sensors (Vitals Monitoring)	₹10,000 – ₹15,000
Casing, Stand, Wiring, Cables	₹5,000 – ₹8,000
Software Development (student prototype)	₹0

Total Prototype Cost: ₹35,000 – ₹55,000

Note: The above cost estimates are based on current rates from Robu.in, Robokits India, Mouser India, and IndiaMART as of July 2025. Prices may vary based on procurement quantities and sourcing.

6.2 Production-Grade Cost Estimate

For hospital and PHC deployment, the cost per kiosk would increase significantly due to:

- Use of industrial/commercial-grade medical sensors
- Aadhaar-compliant biometric scanners

- Secure, tamper-proof enclosures
- Embedded system-grade PCs with certified healthcare software stack

Estimated Production Cost per Kiosk: ₹1,20,000 – ₹1,80,000

This estimate factors in vendor pricing for medical-grade certified modules, ruggedized hardware, and additional security integrations.

6.3 Market Demand and Need

There is a clear and growing demand for integrated healthcare kiosks in India, especially within the public healthcare infrastructure. The reasons include:

- High patient volumes in public hospitals and PHCs lead to long queues, delays, and inconsistent health record management.
- Lack of accessible vitals monitoring facilities in rural and semi-urban healthcare centers.
- The Ayushman Bharat Digital Mission (ABDM) encourages digital health record management via ABHA IDs, and these kiosks can act as touchpoints for linking patient health data to their ABHA accounts.
- No existing public kiosks currently offer a combination of:
    - Biometric/face recognition-based login
    - Automated vitals check
    - Instant health report generation
    - AI-assisted reporting (planned)
    - Appointment booking

      in a single workflow.
- Successful examples like Digi Yatri kiosks at airports validate public acceptance of touchless, biometric-based, and automated check-in systems.
- Post-pandemic public health strategies increasingly emphasize contactless, hygienic service delivery models in hospitals.

This makes a strong case for deploying such kiosks in government hospitals, district PHCs, railway stations, and rural health centers.

7. Technologies Used

The Healthcare Kiosk prototype integrates a combination of software tools, frameworks, hardware modules, and communication protocols to achieve seamless operation and user interaction. The technologies used are listed below:

7.1 Software Technologies

Technology/Tool	Purpose
Python 3.x	Core programming language for application logic
Streamlit	Interactive UI development for kiosk application
OpenCV	Face ID recognition module (for prototype)
ReportLab / FPDF / PyFPDF	PDF health report generation
SQLite / JSON Storage	Lightweight database/storage for patient records
Twilio API / SMTP Library	SMS or email-based report delivery
Tkinter (optional)	For standalone local desktop app interface (if required)

7.2 Hardware Components

Component	Purpose
Touchscreen Display	User interaction and navigation
Thermal Printer (optional)	Health report printing
Fingerprint Scanner	Biometric authentication
Web Camera	Face ID recognition
Vitals Monitoring Sensors	Body vitals capture (temperature, BP, SpO_2, etc.)

7.3 Sensor Modules

Sensor/Module	Function
MLX90614 IR Sensor	Body temperature measurement
MAX30102 Pulse Oximeter	SpO_2 and pulse rate measurement
Omron BP Monitor / MPX5050GP	Blood pressure monitoring
HC-SR04 / JSN-SR04T	Height measurement
Single Point Load Cell + HX711	Weight measurement
MAX30102 / PPG Pulse Sensor	Heartbeat monitoring
OEM Glucometer Module	Blood glucose testing (future integration)

7.4 Communication & Integration

Tool/Service	Purpose
ABHA Health ID APIs (planned)	Linking patient records to national digital health infrastructure
Aadhaar Authentication APIs (assumed for production)	Secure biometric-based login
Twilio / SMTP / Email APIs	Sending reports via SMS or email
Local SQLite / Cloud storage (future)	Patient records and appointment logs

8. Future Scope

The Healthcare Kiosk prototype opens avenues for several advanced features and enhancements to improve patient experience, healthcare accessibility, and integration with India's digital health ecosystem. The future scope of the system includes:

- **Certified Medical-Grade Sensors:**
  Upgrading to government-approved, industrial-grade, medically certified sensors for accurate and legally compliant vitals monitoring.
- **Integration with Ayushman Bharat Digital Mission (ABDM):**
  Official integration with ABHA Health ID APIs to directly link patient reports and appointments to the National Digital Health Record system.
- **Aadhaar-Based Biometric Authentication:**
  Enabling secure, Aadhaar-compliant biometric login for seamless, authenticated kiosk access in public healthcare settings.
- **Voice-Controlled Interface:**
  Adding a multilingual voice command feature for hands-free interaction, especially beneficial for elderly patients and differently abled users.
- **Teleconsultation Module:**
  Implementing a real-time video consultation module for remote doctor consultations, reducing travel and waiting times in rural and remote areas.
- **AI-Assisted Preliminary Diagnosis:**
  Integrating AI and Large Language Models (LLMs) to analyze vitals and patient data, suggest possible conditions, and propose preliminary care plans for doctor review.
- **Federated Learning for Personalized Healthcare Plans:**
  Implementing federated machine learning models where kiosks learn locally from patient inputs and vitals, while maintaining data privacy, to offer personalized health recommendations without centralized data storage.
- **Health Insurance Claim Support:**
  Linking kiosks with insurance claim APIs (Ayushman Bharat and private insurers) to help eligible patients claim free/subsidized treatments.
- **Mobile App Companion:**
  Developing a smartphone app for patients to access reports, book appointments, and receive follow-up health advice remotely.
- **Offline Mode Support:**
  Adding an offline data sync feature for rural setups with intermittent internet access, where data syncs with hospital servers once connectivity is restored.

9. Limitations

While the proposed Healthcare Kiosk prototype addresses several gaps in public healthcare delivery, certain limitations remain in its current implementation stage:

- **Prototype sensors are not medically certified:**
  The prototype uses developer-grade sensors, which are not calibrated for clinical diagnosis and may vary from standard hospital equipment.
- **No direct integration with ABHA Health ID APIs:**
  Due to API access restrictions and sandbox environment limitations, integration with official Ayushman Bharat Health Account (ABHA) APIs has been simulated but not implemented in real-time.
- **Biometric authentication is assumed for production:**
  While face recognition is demonstrated, full Aadhaar-compliant biometric verification has been assumed and not implemented due to regulatory and API access constraints.
- **Voice integration not fully functional:**
  Though planned, the prototype lacks integrated voice command support for hands-free kiosk operation, which will be implemented in future iterations.
- **Teleconsultation feature is not live:**
  The current system does not support remote video consultations; it has been listed as a future enhancement module.
- **Limited backend infrastructure:**
  The prototype uses local JSON/SQLite storage. A scalable, secure cloud or hospital-grade database system is required for real-world deployment.
- **Internet dependency for certain modules:**
  Features like email/SMS delivery and online appointment APIs rely on consistent internet connectivity, which may be unreliable in rural settings.
- **No AI-assisted diagnosis in current version:**
  The AI-based preliminary health analysis and recommendation system remains a planned feature for future upgrades.

10. Suggested Implementation Partners

While the current project is a student-developed prototype, deploying a production-ready Healthcare Kiosk would require integration with certified cloud infrastructure providers, medical hardware vendors, telehealth services, and deployment specialists. Based on available industry practices and similar deployments, the following partners and services are recommended:

10.1 Cloud Infrastructure and Data Management

For secure, scalable, and compliant patient data storage and health record management:

- **Google Cloud Healthcare API** – Currently used by **Apollo Tele Health Services** for patient data storage and FHIR-compliant health records.
- **Microsoft Azure for Health**
- **Amazon Web Services (AWS) Healthcare**

Additionally, health tech startups like **Cloud Solutions Healthcare Kiosk** are developing integrated cloud-based vitals monitoring kiosks and teleconsultation platforms for hospitals and PHCs — showing the viability of cloud-native kiosk deployments in India.

10.2 Teleconsultation and Networking Partners

- **Cisco Webex for Telehealth** – Partnered with Apollo for rural teleconsultation.
- **JioMeet Healthcare** – Secure doctor-patient video consultations, scalable for rural centers.

10.3 Certified Medical Hardware Vendors

- Omron Healthcare India
- BPL Medical Technologies

- Dr. Trust India
- Nonin Medical India
- Mantra Softech India

10.4 Deployment & Infrastructure Partner

- **Deloitte India** – As recommended by the problem statement for nationwide kiosk deployment and infrastructure management.

Note: While several health tech startups like **Cloud Solutions Healthcare Kiosk** and **Cloudphysician** are developing similar solutions, direct public data about large-scale public sector deployments remains limited as of July 2025.

Conclusion

The Healthcare Kiosk prototype developed under this project aims to address several key challenges in India's public healthcare system — including long waiting times, lack of accessible vitals monitoring, and fragmented patient health records. By integrating essential vitals sensors, biometric authentication, face recognition, and instant health report generation into a single interactive kiosk, this system demonstrates the potential to enhance patient care and streamline hospital workflows, especially in high-volume public hospitals and rural health centers.

Through this documentation, we've identified gaps in existing public hospital kiosks, proposed an improved workflow model with ABHA ID integration, and suggested partnerships with cloud service providers and telehealth networks for future deployment. The kiosk's modular structure allows for future upgrades such as voice-controlled interfaces, AI-assisted preliminary diagnosis, federated learning for personalized health plans, and secure teleconsultation services.

While the current prototype utilizes affordable, developer-grade sensors and simulated API integrations, it successfully validates the feasibility of a more comprehensive and digitally connected healthcare kiosk solution. With the support of certified medical hardware manufacturers, cloud infrastructure partners, and deployment firms like Deloitte India, this system holds significant potential to support India's Ayushman Bharat Digital Mission (ABDM) and bridge the healthcare accessibility gap in underserved regions.

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