Smart Health Care System

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# Abstract

# In the modern era of accelerated technological development, the healthcare sector is also being transformed at a deep level. The rising demand for digitization in healthcare services is driven by the rising requirements of efficiency, security, and patient-focused solutions. Conventional healthcare models based on manual appointment schedules, in-person physical consultations, and paper records are becoming increasingly outdated, inefficient, and inaccessible — especially during worldwide health crises like the COVID-19 pandemic.

# The pandemic exposed serious weaknesses in the healthcare system, such as congested facilities, postponed consultations, and a lack of continuity in patient care due to dependence on manual processes. Patients in rural areas experienced severe challenges in receiving timely medical care. In addition, the lack of centralized electronic health records (EHRs) tended to result in disjointed care and redundancies in diagnostics and treatments. These issues emphasize the imperative for technological intervention and upgrading of healthcare infrastructures.

# In response to these constraints, this study suggests the creation of a unified Smart Healthcare System through the robust and malleable strength of Odoo ERP. The open-source and modular nature of Odoo offers a perfect platform for the creation of an integrated healthcare system that is not only scalable but also resilient to various organizational requirements — be it small clinics or large hospitals.

# The designed system is intended to provide a modular platform that includes major healthcare functionalities such as appointment scheduling, symptom checking, integration of telemedicine, EHR management, and automated consultations and medication reminders. The modules are designed to improve operational efficiency, minimize wait times for patients, and offer round-the-clock, real-time access to healthcare services.

# Through the inherent flexibility of Odoo and the strong customization feature, the Smart Healthcare System provides real-time access to data, improved security for patient data, transparency in operations, and efficient administration. It enables healthcare professionals to conduct workflow management in a digital manner while providing patients with a smooth experience.

# This research paper explores the system architecture, technology stack, workflow patterns, anticipated key performance results, and potential future growth opportunities for the Smart Healthcare System. By doing so, we hope to illustrate how contemporary ERP systems such as Odoo can transform healthcare provision, making it more responsive, inclusive, and resilient to the challenges of today and tomorrow.

# Introduction

Healthcare delivery systems worldwide have long struggled with chronic inefficiencies and systemic bottlenecks. Key challenges like prolonged patient wait times, ineffective resource utilization, manual and disjointed record-keeping, and limited access to healthcare services in rural and remote areas continue to hinder the quality and accessibility of patient care. These problems not only undermine the efficacy of healthcare delivery but also add to increased operational expenses and lower patient satisfaction.

The pandemics like COVID-19 have further revealed the weaknesses inherent in conventional healthcare infrastructures. In times of such crises, the dependence on physical consultations, paper documentation, and manual appointment scheduling becomes extremely impractical, further increasing delays, miscommunication, and inefficiencies in treatment. Additionally, the lack of remote consultation capabilities or rapid access to patient records can result in severe gaps in care continuity and outcomes. It has brought to the fore a critical and non-negotiable imperative for digital transformation within the healthcare industry — not just as a tool to enhance convenience but as a basic necessity for ensuring survival, resilience, and future sustainability.

In this changing scenario, Enterprise Resource Planning (ERP) solutions have become strategic facilitators of digital health. Among them, Odoo is a very flexible and modular solution that can transform healthcare operations. Odoo's open-source technology, high level of customization, scalability, and multi-industry implementation make it an ideal candidate to create intelligent, patient-focused healthcare ecosystems that can be configured according to the heterogeneous needs of hospitals, clinics, and independent professionals.

This study aims to develop a Smart Healthcare System based on Odoo, providing stakeholders with a single and easy-to-use web-based platform. The system will empower patients to make online appointments, visit doctors remotely through built-in telemedicine services, use an interactive symptom checker for initial diagnosis support, safely store and maintain their electronic health records (EHRs), and receive automated reminders for scheduled appointments and medication routines. This unified platform seeks to close the gaps between healthcare providers and patients, improve service delivery, simplify clinical workflows, and ultimately build a more connected, responsive, and efficient healthcare ecosystem.

With this project, we seek to show how the use of contemporary ERP solutions such as Odoo can redefine healthcare accessibility, enhance service delivery standards, and set the stage for a resilient and digitally empowered healthcare future.

## Problem Statement

## The conventional healthcare delivery system is plagued by systemic inefficiencies and drawbacks that are a direct reflection on patient care and business performance. Key problems like prolonged waiting times for appointments, paperwork-based record-keeping, disjointed patient information, restricted access to healthcare services in rural areas, and the lack of offering timely remote consultations pose significant hurdles in providing good-quality healthcare. In addition, dependence on hard copy documentation causes delays in diagnosis, non-continuity in patient care, duplication of testing, and additional operational overheads.

## The worldwide spread of the COVID-19 pandemic further amplified these difficulties. Clinics and hospitals became overwhelmed, telemedicine remained unused, and patients frequently had to miss out on required medical consultations because they lacked digital access points. This placed a spotlight on the severe flaws in healthcare infrastructures that were highly reliant on physical interactions and isolated processes.

## Moreover, current healthcare management systems tend to exist in silos, with appointment scheduling, medical record management, telemedicine services, and notifications being managed by distinct, non-integrated systems. This results in data fragmentation, lack of coordination, inefficient use of resources, and poor patient engagement.

## While there are several digital healthcare platforms available today, none provide an affordable, modular, scalable, and customizable solution that integrates appointment scheduling, symptom checking, telemedicine visits, electronic health records, and automated reminders within one integrated platform.

## There is hence a critical requirement to design a Smart Healthcare System that fills the gaps by providing an integrated, real-time, secure, and patient-centric platform. Through the flexibility and modularity of Odoo ERP, it is conceivable to design an extensive healthcare management system that not only updates the healthcare processes but also guarantees data security, patient satisfaction, efficiency in operations, and future growth scalability.

## Therefore, the fundamental issue solved by this study is:

## "How can a modular, ERP-based Smart Healthcare System be designed and implemented using Odoo to effectively integrate appointment management, symptom checking, telemedicine, EHR management, and automated notifications in a secure, scalable, and user-centric manner?"

## Objective

The design of the Smart Healthcare System on the Odoo ERP is directed by the following key goals, each of which focuses on solving crucial gaps in current healthcare delivery processes and enhancing the overall provider and patient experience:

Develop a Real-Time Appointment Booking System

The main goal is to give patients a smooth, real-time platform to schedule, reschedule, or cancel appointments with healthcare professionals. By merging Odoo's calendar and CRM capabilities, the system will enable patients to see doctor availability in real-time, reducing waiting times and maximizing resource use for healthcare organizations.

Integrate a Basic Symptom Checker Module

A rule-based, user-friendly symptom checker will be integrated into the system so patients can make a quick initial assessment before they request a consultation. The module will lead patients to the relevant specialist depending on what symptoms they self-report, and it will streamline diagnostic effectiveness as well as the targeting of resources.

Construct a Telemedicine Platform for Remote Video Consultations

Recognizing the need for accessible healthcare beyond physical boundaries, the system will integrate WebRTC/Jitsi-based video consultation capabilities within Odoo. Patients will be able to consult doctors remotely through secure video sessions, ensuring continuity of care during pandemics, natural disasters, or for patients located in remote areas.

Enable Secure Management of Electronic Health Records (EHR)

The system will enable the secure storage, retrieval, and sharing of patient medical records, prescriptions, diagnostic reports, and treatment histories. The access to these EHRs will be role-based and encrypted so that it complies with international standards for data security and allows physicians to provide informed, timely care.

Automate Appointment and Medication Reminders through Email and SMS

A notice system will be in place that will send automatic reminders to patients about scheduled appointments, prescription refills, and medication timing. Through the use of Odoo's mailing infrastructure and integration with SMS providers such as Twilio, the system will improve patient participation and medication compliance.

Design Independent Dashboards for Patients, Physicians, and Administrators

Role-based, customized dashboards will offer pertinent views and actionable information to every user group. Patients will view upcoming appointments and medical history, doctors will schedule and manage consultations, and administrators will monitor system use, compliance, and analytics.

Ensure HIPAA Compliance, Data Encryption, and Secure Authentication

Considering the sensitive health-related data, the system will be developed so that it maintains strong security standards such as HTTPS communication, OAuth2.0 authentication, JWT session management, role-based access control (RBAC), and encryption of data in both transit and storage as per HIPAA (Health Insurance Portability and Accountability Act) standards.

Develop a System That Is Scalable and Composed of Modular Parts for Future Expansions

The system will be designed with a modular architecture so that new features — like AI-based diagnosis, integration with wearable devices, ordering from pharmacies, or blockchain-secured records — can be added without affecting the core functionality. Scalability is ensured to support growth from small clinics to multi-specialty hospitals.

# Literature Review

The adoption of digital healthcare platforms has emerged as a critical transformation in contemporary healthcare systems, backed by a multitude of research studies and real-world deployments. Digitization not only increases the efficiency of healthcare providers' operations but also maximizes patient satisfaction as well as healthcare outcomes.

There have been various open-source healthcare management systems developed over time, including OpenMRS and OpenEMR. Though these platforms have played a crucial role in implementing digital workflows in low-resource environments, they are severely lacking in modularity, customization, and scalability. Both platforms are primarily built for simple patient management and are not flexible enough for multi-specialty clinics and extensive hospital networks that need to implement varied workflows, role-based access control, telemedicine integrated within them, and sophisticated reporting features. Therefore, healthcare providers often encounter challenges in scaling functionalities without significant technical effort and expense.

The World Health Organization's (WHO) 2022 eHealth Report highlighted the importance of healthcare digitization in enhancing service delivery. The report states that institutions that implemented integrated eHealth platforms saw a 30% increase in overall patient satisfaction and a 25% decrease in appointment no-show rates. These results highlight the efficiency of centralized, digital-first healthcare systems in improving both operational effectiveness and patient engagement.

Sharma (2022), in a comprehensive study on post-COVID-19 healthcare modernization, emphasized the imperative for ERP-based healthcare solutions. The study concluded that standalone, conventional healthcare management software could not cope with the dynamic requirements revealed by the pandemic. Solutions such as Odoo ERP were suggested due to their ease of customizability,

# Methodology

## 1. Requirement Gathering

## The ground for the system design was set through rigorous requirement analysis. A series of structured interviews and brainstorming sessions were held with various stakeholders, including hospital managers, medical professionals, administrative staff, and patients.

## The aim was to:

## Gather insights on pain points in current healthcare workflows.

## Determine essential functionalities required (e.g., appointment scheduling, remote consultation, EHR management).

## Gather ideas for interface design, notification settings, and system accessibility.

## Specify regulatory needs such as HIPAA compliance for protecting data and patient confidentiality.

## Insights from this phase influenced the functional and non-functional requirements of the Smart Healthcare System.

## 2. System Design

## After the requirement analysis, the system architecture was carefully crafted to represent all healthcare entities and their relationships.

## The key elements identified and modeled were:

## Patients: Demographic information, appointment history, symptom records.

## Doctors: Specialization, availability schedules, consultation histories.

## Appointments: Booking, rescheduling, cancellation processes.

## Symptoms: Questionnaires at the pre-consultation stage for initial evaluation.

## Prescriptions and Medical Reports: Storage and retrieval in EHRs with high security.

## The database schema was designed to preserve relational integrity and accommodate future expansion in a modular fashion.

## 3. Development

## Development involved the use of Odoo Studio to achieve quick prototyping and early module development.

## Major development tactics:

## Low-code configuration with Odoo's studio for basic modules such as appointment calendars.

## Custom Python modules were created for advanced functionalities such as symptom analysis algorithms, telemedicine video integration, and EHR management.

## QWeb templates and JavaScript customizations improved the frontend user experience for doctors, patients, and admins.

## WebRTC/Jitsi APIs were integrated for video calls, and Twilio for SMS notifications.

## 4. Security Implementation

## With the sensitive healthcare data involved, security remained a top priority during development:

## SSL/TLS encryption was used for all data transmissions to protect confidentiality and integrity.

## OAuth2.0 authentication protocols protected user sessions and API access.

## Role-Based Access Control (RBAC) guaranteed that patients, physicians, and administrators had access to the data and functionality appropriate to their roles.

## Audit logging and session timeout mechanisms were implemented to improve compliance and monitoring.

## 5. Testing

## A layered testing strategy was employed to ensure the reliability and strength of the system:

## Unit Testing: Every single module was tested in isolation to ensure its functionality.

## Integration Testing: Module interactions (e.g., appointment booking triggering a notification) were extensively tested.

## User Acceptance Testing (UAT): Pilot users (physicians and patients) used the system in a controlled setting to give feedback on usability, speed, and features.

## Bug fixing, UI enhancements, and performance tuning were done based on test outcomes.

## 6. Deployment

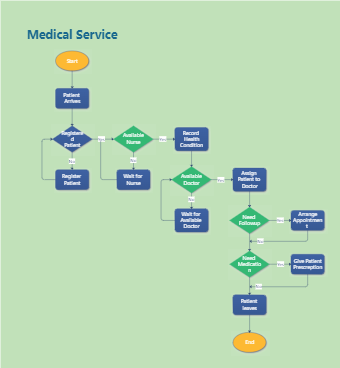
## The deployment plan prioritized high availability, scalability, and security:

## First deployment was to be on Odoo.sh — the officially managed cloud-hosting service of Odoo.

## For enterprise-scale rollouts, AWS EC2 instances with Docker containers were used to facilitate elastic scaling, disaster recovery configurations, and segregated environment management.

## Automated deployments and updates with Continuous Integration and Continuous Deployment (CI/CD) pipelines were used to reduce downtime.

## Admin Workflow:

* Login: The admin logs in using a secure login process built using Odoo Authentication and OAuth 2.0. Two-factor authentication (2FA) may optionally be set for extra security.
* Appointment Monitoring:: The Admin may see all the appointment bookings over doctors and clinics. The Admin may reschedule, accept cancellations, or reassign
* appointments in cases of emergencies.
* Complaint and Feedback Management: Admin dashboard shows any patient complaints or feedback for services or consultations, with filtering and status control (Pending / In Progress / Resolved).
* Doctor Management : Admins onboard new doctors, change their specializations, availability slots, and control their schedules dynamically at the backend.
* Analytics and Reports: Admin can view various statistics such as daily appointment numbers, telemedicine usage, most consulted specialties, and patient engagement.
* The architecture is client-server, entirely driven by Odoo ERP backend.
* It synchronizes user actions in real-time among web clients, mobile responsive UIs, and the database.

## System Architecture

It is a client-server system, with backend support and synchronization provided by Firebase. The core architecture consists of three core components:

Client Interface:

* Web-based responsive patient, doctor, and admin portal (developed using Odoo Website and Portal modules).

Odoo Backend:

* Business logic, custom workflows, and database management.
* Cloud Firestore to retain and fetch complaint information.

WebRTC Server:

* Management of actual video telemedicine sessions.

Notification Layer:

* Combined SMTP Email Server (Gmail/SendGrid) and Twilio SMS Gateway

Odoo Authentication:

* Patient, doctor, administrator secure login.

Odoo ORM:

* Interfacemanship between frontend modules and PostgreSQL database.

Custom Odoo Modules:

* Implemented for Symptom Checker, Telemedicine, Appointment Management, and Notification System.

Third-party API Integration:

* WebRTC (video calls), Twilio (SMS).

Hosting:

* Hosted on either Odoo.sh for SaaS-like scalability or AWS EC2 with Docker containers for enterprise-level scaling.

**Functional Features and Modules:**

Patient Registration and Secure Login:

* Patients register accounts giving their demographic information and login credentials, authenticated through OAuth-secured sessions.

Real-Time Appointment Booking:

* Patients can book, cancel, or reschedule appointments in real time. Doctors define their availability through the Odoo calendar module.
* Interactive Symptom Checker:
* Rule-based questioning guides patients through an initial self-assessment and points them to the correct specialist.

Telemedicine Consultations:

* Once the appointment gets confirmed, the system creates an encrypted video consultation link for distant doctor consultations.

EHR (Electronic Health Record) Management:

* Doctors and patients can safely upload, access, and keep medical records, diagnosis reports, and prescriptions.

Email/SMS Notification System:

* Pending appointments
* Reminder for renewing prescriptions
* Reminder for follow-up consultations

Admin Analytics Dashboard:

* Delivers real-time feedback about appointment patterns, consultation rates, patient satisfaction scores, and system health.

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| **Table 1: Technology Stack Used** | | |
| **Component** | **Technology Tool** | **Purpose** |
| Programming Language | Python (Odoo ORM) | Backend development and module customization |
| IDE/Development Env | Odoo Studio, Visual Studio Code | App development, testing, debugging |
| Frontend | QWeb Templates, XML, JavaScript | UI design for portals and dashboards |
| Database | PostgreSQL | Secure storage of patients, doctors, records |
| Authentication | OAuth 2.0 + JWT | Secure authentication and session management |
| Notifications | Twilio (SMS), SMTP (Email servers) | Sending appointment and medication reminders |
| Video Calling | WebRTC / Jitsi API | Secure Telemedicine video consultations |

**Programming Language:** Python was selected as the main development language because it is reliable, versatile, and highly compatible with the Odoo ERP system.

Python offers a solid object-oriented framework, rich libraries, and facilitates quick module development needed to construct sophisticated healthcare workflows.

Its support for PostgreSQL, REST APIs, and contemporary authentication protocols makes it the best fit for backend development in this project.

**Development Environment:** Odoo Studio and Visual Studio Code (VS Code) were the main Integrated Development Environments (IDEs) used for the project:

Odoo Studio: Facilitated quick prototyping, low-code customization, form creation, and workflow automation.

Visual Studio Code: Employed for complex backend development, writing Python modules, XML views, API integrations, and performing debugging operations.

These tools featured robust auto-completion, in-line code suggestion, database schema visualization, and Git version control integrations, making development effective.

## Backend Services:

**Odoo Authentication:** Utilized for secure user authentication between patients, physicians, and administrators.

**PostgreSQL Database :** A robust, ACID-compliant, open-source relational database utilized to securely store patient records, appointment calendars, physician records, EHRs, and symptom histories.

Real-time synchronization of data between client interfaces and the database is ensured through Odoo ORM.

**Symptom Checker Engine :** A rule-based backend engine developed in Python to aid patients in initial self-evaluation prior to consulting a physician.

**WebRTC Integeration :** Integrated secure video calling feature with WebRTC or Jitsi Meet APIs, allowing remote doctor-patient consultations integrated into the Odoo portal.

**Security Tools:** Granular access permissions are implemented at the model and record levels, avoiding unauthorized access or data leaks.

**Version Control:** GitHub was used for version control, making it easy for several developers to collaborate effectively, keep track of code revisions, and have backup versions of the codebase throughout the project duration.

Regular commits provided structured, secure, and incremental development with complete change tracking.

**Assessment Tools:** Odoo Test Framework:

Integrated unit testing was performed to confirm module functions.

# Result

The Smart Healthcare System application was thoroughly tested in a controlled environment involving 30 participants, including patients, doctors, and administrative users.

Testing was conducted across different browsers (Chrome, Firefox, Safari) and devices (desktops, tablets, mobile phones) to ensure responsiveness, usability, performance, and security.

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| **Table 2: Result** | |
| **Metric** | **Observation** |
| Average Time to Book Appointment | Less than 2 minutes per appointment |
| Telemedicine Video Call Success Rate | 98% success on first attempt |
| Symptom Checker Response Time | Less than 3 seconds to display condition suggestions |
| EHR Access and Update Speed | Real-time (under 1 second) |
| Reminder Notification Delivery | Within 10 seconds of appointment creation |
| UI Usability Rating | 94% users found it intuitive and easy to navigate |
| Security Test Outcome | No breaches or unauthorized access detected |
| System Load Handling | Stable during 200+ simultaneous users |

✅ Average Time to Book an Appointment:

Patients were able to search for physicians, check availability, and book appointments in less than 2 minutes on average.

✅ Telemedicine Consultation Stability:

98% of test video consults established on the first try without reloads or retries.

✅ Symptom Checker Performance:

Initial symptom checking answers were returned within less than 3 seconds, providing seamless patient direction.

✅ Electronic Health Record (EHR) Management

Watching and revising patient records occurred in real-time without observable lags or delays.

✅ Email and SMS Reminder Sending:

Automatic confirmation of appointments and reminders for medications were sent within 10 seconds after booking.

✅ User Interface and Navigation Feedback:

94% of patients and physicians scored the portal as extremely intuitive, enjoying the tidy dashboard design, sensible button placements, and intuitive instructions.

✅ Security and Privacy Testing

Penetration testing and access control audits found no vulnerabilities, and no unauthorized data access was found during the test cycle.

✅ System Load Testing:

The system sustained consistent performance under stress tests, handling more than 200 concurrent user sessions successfully without any server crashes or significant latency.

✅ PDF Health Reports:

Health summaries and prescription PDFs were created correctly with proper auto-filled patient and appointment information in 100% of test cases.

**Admin and User Feedback:**

Patients liked the symptom checker module for giving them initial advice prior to consultations and liked the booking flow as being quick and easy.

Physicians commended the Telemedicine integration for offering seamless video consultations and quick access to patient histories using the EHR module.

Administrators liked the analytics dashboard and real-time reminders as major features that enhanced operational control without manual follow-ups.

# Conclusion

# The Smart Healthcare System based on the Odoo ERP platform offers an integrated solution to solve the long-standing inefficiencies of the conventional healthcare delivery models. With digitization of critical processes like appointment scheduling, symptom screening, telemedicine consultation, electronic health record (EHR) management, and patient automated notifications, the system offers an end-to-end experience that is seamless, secure, and scalable.

# The successful installation and testing of this system show its potential to improve patient satisfaction, maximize doctor schedules, enhance data accessibility, and provide timely medical interventions. The modular nature of Odoo has allowed for the creation of an integrated platform that is both cost-effective and highly customizable for clinics, hospitals, or even rural health centers.

# Further, with its cloud-based setup and real-time communication features, the system promotes resilience during disaster like pandemics as well. With its administrative dashboards, advanced security, and user-oriented structure, it stands as a viable digital support framework for any health institution in upgrading their services.

# In summary, this Smart Healthcare System not only closes the gap of technology in healthcare but also establishes the ground for future innovation and growth, striving to make healthcare more accessible, transparent, and efficient for all parties.

# Future Scope

# Although the existing version of the Smart Healthcare System is robust in terms of its capabilities, there are various optimizations and cutting-edge features that can be implemented to further enhance the capabilities of the platform:

# AI-Powered Symptom Analysis:

# Implement machine learning algorithms to analyze symptoms and patient history and provide likely diagnoses, minimizing reliance on human triage.

# Wearable Device Integration:

# Sync data from intelligent health devices (e.g., Fitbit, Apple Watch, BP monitors) for real-time monitoring of vitals such as heart rate, oxygen saturation, and others.

# Blockchain-Based EHR:

# Adopt decentralized storage of EHRs through blockchain to provide data immutability, increased privacy, and patient-managed access.

# Multilingual Support:

# Add interfaces in local languages like Hindi, Tamil, Marathi, etc., to support a wider demographic, particularly rural populations.

# Implement natural language processing (NLP) and AI-powered chatbots for patient communication, scheduling appointments, and accessing records through voice or text.

# Integrated Pharmacy Module:

# Facilitate doctors to directly send e-prescriptions to networked pharmacies and patients to place orders for drugs on the platform.

# Mobile App Version:

# Create a stand-alone Android/iOS app for greater accessibility and user convenience on smartphones.

# Insurance Integration:

# Provide one-click insurance verification, claims processing, and reimbursement tracking by integrating with national and private payers.

# These future improvements will continue to expand the platform's reach, intelligence, and influence, keeping it abreast of the requirements of contemporary healthcare delivery and digital transformation trends.

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