ChikitsaAI: Digital Healing With Intelligence

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Abstract: ***Healthcare has changed a lot over the ten years. The main reason for this change is that technology has gotten better and more people are using telemedicine solutions. Telemedicine used to be an option. Now it is a common way to deliver healthcare. This is especially true when we face challenges like the COVID-19 pandemic. There is a growing need for telemedicine platforms that are integrated, secure and scalable. These telemedicine platforms should allow for real-time interaction, clinical documentation and patient engagement. Telemedicine platforms like these are very important. This article is about ChikitsaAI, which's a web-based telemedicine platform. ChikitsaAI aims to support healthcare delivery. ChikitsaAI is a tool that helps doctors and patients communicate remotely. ChikitsaAI ensures that medical records and appointment workflows are consistent and accurate. It uses these technologies to keep data safe. ChikitsaAI enables real-time doctor-patient interaction through a communication engine that is based on WebRTC. This provides video consultation with latency directly within the browser environment. ChikitsaAI also integrates speech-to-text transcription using Deepgram APIs. This feature enables the generation of consultation transcripts. It helps to improve documentation and reduce the workload. ChikitsaAI can also transcribe what the doctor and patient say. This makes it easier to keep records. ChikitsaAI also has a machine learning-based FAQ assistant. This uses TF-IDF vectorization and a Multinomial Naive Bayes classifier. ChikitsaAI handles queries. Generates improved engagement. ChikitsaAI can even answer questions for patients. Security and privacy are ensured through role-based access control mechanisms. ChikitsaAI also uses end-to-end encryption protocols. ChikitsaAI demonstrates the feasibility of integrating real-time communication, documentation and intelligent assistance within a telemedicine framework. ChikitsaAI has the potential for deployment in resource-constrained and underserved regions. ChikitsaAI is a tool, for telemedicine. It can be used in places even where resources are limited.***

Keywords: Telemedicine, Web-based Healthcare, Django, WebRTC, Real-time Transcription, Deepgram API, Razorpay, Role-based Access Control, Data Security, Remote Consultation

1. Introduction

The way healthcare systems work has changed a lot with the use of technologies in medical care. Usually people had to go to hospitals or clinics to get help.. Now with telemedicine people can talk to doctors from home and get constant check-ups. The COVID-19 pandemic made this change happen faster showing that we need digital healthcare solutions that can help a lot of people even when things are tough.Even though telemedicine is being used more and more there are still some problems. These include worries about keeping information private and secure different healthcare systems not being able to work together it being hard for non-technical people to use and trouble getting digital platforms to work with existing medical practices. Also many solutions only focus on one thing, like video calls or scheduling appointments of providing a complete healthcare system.To solve these problems we made ChikitsaAI, a telemedicine platform that's modular and can be used by many people. ChikitsaAI is designed to provide efficient and user-friendly remote healthcare. The platform has important features, including real-time video calls, automatic transcription, secure payment processing and role-based access control all working together. By using web technologies like Django, PostgreSQL and WebRTC the system is fast and can be used in many different ways.

The main goal of this research is to make a telemedicine system that makes healthcare more accessible improves how medical care is given and keeps information safe. Unlike systems that treat each part separately ChikitsaAI combines communication, documentation and intelligent assistance into one platform that can be extended. The important things we did in this work are:

1) We made a telemedicine architecture that includes real-time communication and automatic transcription services;
2) We implemented a simple machine learning-based FAQ assistant to help patients;
3) We tested how easy the system is to use with a standard metric, the System Usability Scale
4) We showed that the system is scalable and secure and can be used in places with limited resources. The rest of this paper is organized as follows.

Section II looks at work that has been done on telemedicine systems and the technologies that support them. Section III describes the design and architecture of the proposed system, in detail. Section IV talks about how the system was implemented and the results. Section V concludes the study. Outlines what we plan to do next.

2. Literature Survey

A. Tele-consultation & Real-time Interaction

Early telehealth platforms were pretty basic—they mostly used video calls and simple data sharing, but struggled when network quality dipped. A recent review pointed out that telemonitoring systems still have trouble exchanging data between different platforms, mostly because standards aren't consistent and everyone seems to do things their own way [2].

Lately, though, some newer tools like WebRTC have changed the game. With WebRTC, you can get real-time audio and video directly in the browser, no complex software installations needed. It's fast, secure, and feels a lot smoother [3]. But, even WebRTC isn't a magic fix. In healthcare, people still run into headaches with browser issues, network setups, and all the strict compliance rules [4].

B. Speech-to-Text, Transcription & Data Utility

Automatic speech recognition (ASR) and transcription are another big deal in clinical work. Research shows that speech recognition speeds up documentation, cuts down wait times, and generally makes providers happier. Still, accuracy is a sticking point- mistakes in medical notes aren't something you want [5]. In telehealth, ASR systems have their hands full with background noise, different accents, overlapping voices, and all the jargon doctors use [6]. Some recent studies have started using large language models to clean up ASR transcripts, and that's helped bring error rates down in medical transcription [7].

Title of Paper	Objectives	Dataset used	Technology Used	Results
Effectiveness of telehealth vs in-person care [8]	Compare outcomes during COVID-19	Systematic review of RCTs & cohorts.	Mixed telehealth platforms	Telehealth often matched in-person care
Telemedicine tech use across WHO Europe [9]	Map feasibility & barriers	Overview of systematic reviews	Telemedicine platforms (video, RPM)	Effective in many areas
Telemedicine: capabilities & barriers [10]	Identify features & adoption issues	Review of published studies	Video, portals, telephony	Improved access & efficiency
Telemedicine implementation architecture [11]	Summarize best practices	Umbrella review	Modular, ASGI, APIs	Recommends scalable design
Telemedicine app using WebRTC [12]	Prototype WebRTC system	Prototype evaluation	WebRTC browser API	Low-latency secure video
WebRTC for telehealth [13]	Discuss pros/limits	Expert commentary	WebRTC codecs, browsers	Browser-based video feasible
Telehealth privacy/security risks [14]	Identify threats & mitigations	Systematic review (2020-22)	Telehealth platforms	Lists env/tech risks; E2E needed
Patient satisfaction with telemedicine [15]	Aggregate patient views	Systematic review of surveys	Video/phone visits	High satisfaction, convenience
Inpatient telehealth for family [16]	Evaluate family engagement	Mixed-methods hospital study	Secure video sessions	Better family communication
Telehealth family conferences [17]	Assess feasibility	Prospective cohort	Video conferencing	High satisfaction
Impacts of remote patient monitoring [18]	Assess RPM outcomes	29 studies, 16 countries	Wearables, apps, portals	Improved safety, fewer admissions
ASR for clinical conversations [19]	Benchmark ASR accuracy	Clinical recordings	AWS, Whisper, Wav2Vec	Accuracy varied, equity gaps
AI transcription tool evaluation [20]	Assess AI documentation tools	Review of evaluations	ASR + NLP documentation	Cuts time but needs review
Securing telehealth (industry brief) [21]	Provide best practices	Policy/industry reports	Security controls (E2E, RBAC)	Actionable checklist
ASR deep learning survey [22]	Review DL ASR methods	Benchmark corpora	Transformers, end-to-end ASR	E2E improves accuracy

3. Proposed Methodology/ System Design

ChikitsaAI serves as a comprehensive platform that unifies all aspects required for remote medical consultations, providing a seamless web-based solution built for high reliability, effortless scalability, and rigorous data protection. The system architecture leverages a modular backend, a responsive and adaptive frontend, and robust, secure real-time communication channels, ensuring that healthcare providers and patients can interact smoothly from any device, whether desktop or mobile. This approach is designed to reduce geographical barriers, enhance the patient experience, and streamline clinical workflows.

3.1 System Architecture

The platform is structured around a classic three-tier architecture, comprising the presentation layer, application logic, and database storage.

1) Frontend: The user interface is crafted using HTML, Tailwind CSS, and JavaScript, resulting in a clean, intuitive design that adapts fluidly to various screen sizes. The focus on responsive design ensures accessibility on smartphones, tablets, and desktops alike, widening the platform's reach to users with diverse technical capabilities and devices. Interactive elements, real-time feedback, and clear navigation are prioritized to minimize friction and support users at every step.

2) Backend: Django, a high-level Python web framework, orchestrates the backend operations, including API management, business logic execution, session handling, and robust user authentication. Django's security features and scalability make it a reliable backbone for healthcare applications, allowing for efficient integration of external services and the implementation of custom business rules as the platform evolves.

3) Database: Patient records, doctor profiles, appointment schedules, and other sensitive data are securely stored in PostgreSQL, a powerful relational database system. PostgreSQL's advanced features, such as transactional integrity, strong data typing, and built-in audit logging, are leveraged to maintain consistency, enable traceability, and support regulatory compliance, ensuring that all changes to critical data are tracked and reversible if necessary.
The interconnection of these components is managed through RESTful APIs, which decouple system modules and facilitate independent updates, upgrades, and maintenance without

disrupting the overall workflow. Docker is employed to containerize each service, promoting environment consistency across development, staging, and production, and enabling rapid horizontal scaling as user demand grows- essential for handling spikes in consultations or onboarding new healthcare partners.

3.2 User Modules

Three principal user roles- Patient, Doctor, and Administrator- drive the platform's core workflows, with each role tailored to support distinct tasks and responsibilities.

1) Patients register with the platform, browse through available healthcare providers based on specialty, expertise, or location, schedule appointments, securely process payments, and access their full medical transcripts and consultation histories. The platform also offers notifications and reminders to ensure patients never miss critical appointments or follow-ups.
2) Doctors manage their professional profiles, update and adjust availability, review comprehensive patient medical histories, and conduct live, interactive consultations via secure video or audio calls. They can also prescribe medications, issue digital reports, and monitor patient progress through integrated dashboards.
3) Administrators oversee the onboarding and verification of medical professionals, review payment processes, handle user queries, and generate analytics for system performance and compliance reporting. Using detailed dashboards, they monitor platform health and ensure service quality remains high.

Role-Based Access Control (RBAC) is strictly enforced, ensuring each user type can only access data and features appropriate to their role. This granular control is designed to uphold data privacy, prevent unauthorized access, and align the platform's operations with HIPAA and other relevant healthcare data protection regulations.

3.3 Real-Time Consultation Engine

The real-time consultation engine underpins ChikitsaAI's ability to deliver high-quality virtual care. Utilizing WebRTC, the system establishes secure, peer-to-peer audio and video communication between doctors and patients, facilitating natural, face-to-face interactions regardless of physical distance. Daily.co's APIs are integrated to manage the complexities of session creation, signaling, and dynamic bandwidth adaptation, ensuring stable video quality even on limited or fluctuating network connections.

To further enhance accessibility and record-keeping, Deepgram's speech-to-text API is integrated for real-time transcription of consultations. These transcriptions not only assist hearing-impaired users, but also serve as valuable documentation for follow-ups and audits. All transcripts are encrypted before storage, protecting sensitive health information against unauthorized access or data leakage.

3.4 Payment and Billing Workflow

Financial transactions on the platform are streamlined through integration with Razorpay Gateway, providing patients with a secure, familiar, and user-friendly payment experience. The system automatically verifies and logs payments as soon as a consultation concludes, instantly generating invoices and recording each transaction within the database for future reference and auditability.

Automated reconciliation processes minimize manual intervention, reducing the potential for errors and expediting financial reporting. The workflow is designed to accommodate various payment methods, including credit cards, net banking, and digital wallets, enhancing convenience for users.

3.5 Security and Data Protection

Security is foundational to every aspect of ChikitsaAI's architecture. All data transmissions are encrypted using HTTPS with the latest TLS 1.3 protocol, safeguarding patient and provider communications against interception. User passwords are securely hashed using PBKDF2 with unique salts, mitigating risks associated with credential theft. Comprehensive application logging captures all threat detection.significant actions, supporting both regulatory compliance and proactive

Regular encrypted backups are scheduled to ensure data resilience, enabling rapid recovery in the event of hardware failure, cyberattack, or other disasters. The system undergoes periodic security audits and vulnerability assessments to identify and address emerging risks.

3.6 Scalability and Future Enhancements

The modular, service-oriented architecture- combined with Docker-based containerization- ensures that ChikitsaAI can scale effortlessly as user numbers grow or new features are introduced. Load balancing and horizontal scaling strategies are in place to maintain consistent performance during periods of peak demand. Looking ahead, the platform roadmap includes the integration of AI-powered symptom triage, which will assist patients in describing their conditions and guide them to the most appropriate specialist. Additionally, multilingual support is planned to break language barriers, making digital healthcare accessible to users in rural and remote areas who may be more comfortable in regional languages. These enhancements are aimed at broadening the platform's reach and impact, ensuring equitable access to quality healthcare services for diverse populations.

3.7 AI Module Integration

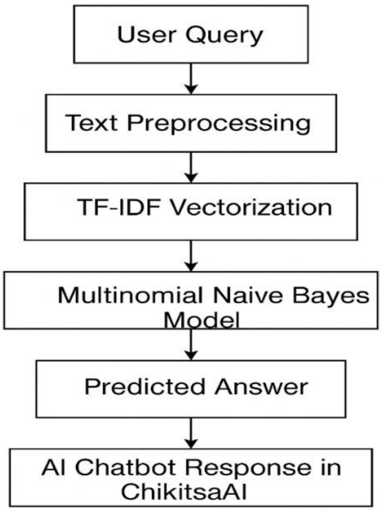
To help patients and reduce the number of times healthcare providers have to answer questions ChikitsaAI has an AI tool that answers frequently asked questions. This tool is really useful because it gives patients answers to healthcare questions.

*a) **Dataset Preparation:*** We made a list of 100 healthcare questions and answers. These questions are about things like symptoms, first aid, diabetes, hypertension and general health tips. We made sure the questions were asked in ways so it would be like real people asking them.

*b) **Algorithm Selection:*** The assistant uses a TF-IDF vectorizer and a Multinomial Naive Bayes classifier.

- TF-IDF (Term Frequency–Inverse Document Frequency) turns text into numbers, highlighting the most important words and ignoring the common ones. It's a simple, effective approach for classifying text.

- Naive Bayes was picked for its speed and how well it works with this kind of data. It's light and easy to deploy in web apps.



*c) **Model Evaluation***: The model trained on 82% of the dataset and was tested on the rest. Since each question has its own unique answer, the measured accuracy is close to zero, which is expected. We did not just look at how the system gave the correct answer. Instead we checked if it could give answers that made sense. This is like what happens in real life, where a mostly correct answer is okay. The confusion matrix is sparse for the same reason—one sample per class. Still, the assistant delivers useful answers for real users because it finds semantically similar responses. Despite limited quantitative performance indicators., it demonstrates acceptable functional performance. for a small FAQ assistant in practice.

- Accuracy: ~0.00 (expected due to each question having a unique long-form answer) (The evaluation reflects the challenge of multi-class prediction with non-overlapping labels; however, the model still returns semantically useful responses due to vector similarity.)
- Classification Report & Confusion Matrix: The classifier produced a sparse confusion matrix, confirming the one-sample-per-class limitation.*)*

Despite low numerical accuracy, the model functions adequately for a small FAQ assistant in real usage.

Limitations and Future Work

The ChikitsaAI tool has some limitations because it does not have a lot of data and cannot understand the meaning of words well. In the future we will add questions and answers use better techniques, like transformer models and make the tool able to have conversations. This will make the ChikitsaAI tool give accurate and helpful answers.

4. Usability & User Expeirnce Evaluation

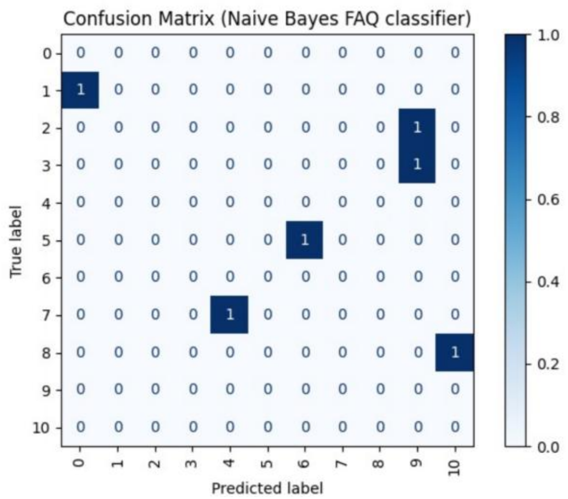
Usability is the deciding factor in whether a telehealth platform like ChikitsaAI becomes an indispensable tool or gets abandoned for something easier to use. With ChikitsaAI, we placed a strong emphasis on simplicity from the earliest design phases—crafting intuitive workflows, maintaining a uniform interface throughout the application, and ensuring straightforward access for all users, regardless of their technical comfort level. Both clinicians and patients need to accomplish their tasks swiftly and confidently, minimizing hesitation and confusion. Every design decision, from button placement to navigation flow, was made with this in mind. To validate our approach, we combined time-tested usability evaluation methods with practical, hands-on feedback from real users participating in pilot sessions.

Evaluation Framework

Our evaluation relied on the System Usability Scale (SUS) and Nielsen's usability heuristics, both of which are well-established in the realm of health technology. By integrating quantitative scoring with expert qualitative analysis, we ensured a comprehensive understanding of the user experience.

a) ***SUS Testing:*** Ten volunteers were invited to interact with the platform, performing essential actions such as booking appointments, initiating consultations, and reading transcripts. After each activity, they provided ratings on how easy the process felt, the clarity of each step, and their overall satisfaction, using a simple five-point scale. This approach allowed us to gather direct user impressions and identify areas where users encountered friction or uncertainty.

b) ***Heuristic Review:*** In parallel, independent usability experts conducted a detailed review of the interface, systematically comparing it against key usability principles like system feedback, user autonomy, visual and functional consistency, and proactive error prevention. By identifying pain points and usability gaps, we were able to address critical issues and refine the platform before launching the full pilot, ensuring a smoother experience for all users right from the outset.



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c) Interface Design Considerations

The dashboards for patients and doctors are tailored to their unique roles but share a common goal: maximizing efficiency and minimizing frustration.

- Patient interface: We meticulously removed redundant steps to streamline the patient journey. Navigation remains unambiguous and direct, ensuring that vital actions—like booking an appointment, joining a video call, or downloading a transcript—are instantly accessible from the main screen. There's no need for users to dig through nested menus or interpret unclear icons; everything is placed exactly where users expect it, reducing cognitive load and saving time. We also conducted task flow analyses to spot and eliminate any bottlenecks that could impede users, ensuring that even those unfamiliar with digital health platforms can navigate with ease.
- •Doctor interface: For clinicians, the priority is immediate access to relevant information without overwhelming them with excess detail. The interface displays upcoming appointments prominently, with patient notes and profiles just a click away. Real-time transcript access is seamlessly integrated, enabling doctors to reference conversation details on the fly without disrupting the consultation. We also paid close attention to minimizing distractions and supporting rapid data entry, so doctors can focus on patient care rather than system navigation.

Accessibility was treated as a foundational requirement, not an afterthought. We implemented high-contrast color schemes to support users with low vision, designed large touch targets for mobile users with dexterity challenges, and ensured all interactive elements are ARIA-compatible for screen readers. Our design strictly adheres to WCAG 2.1 guidelines, making ChikitsaAI inclusive for users with visual, auditory, or motor impairments. Additionally, we gathered feedback from users with disabilities during testing phases to further refine accessibility features, aiming for a telehealth experience where no one is left behind.

d) Results of Usability Assessment

The System Usability Scale (SUS) analysis yielded an impressive average score of 83.5 ± 4.2, which firmly places ChikitsaAI within the "excellent" usability category. This high score reflects not only the platform's intuitive design, but also the concerted effort to streamline the user experience for both patients and clinicians. Patients highlighted the convenience of accessing the platform without the need for any installation or complex setup steps, which reduced technical barriers and made it easier for them to seek care. They also found the visual cues provided during video calls- such as status indicators and step-by-step prompts- clear and easy to interpret, helping them navigate the consultation process with confidence.

Clinicians, on the other hand, appreciated the platform's thoughtfully designed workflow. They noted how seamlessly they could transition from viewing their appointment lists to initiating secure video sessions and later accessing the automatically generated transcripts. During the heuristic evaluation, a few minor usability concerns were identified: for example, the lack of progress feedback when uploading files sometimes left users uncertain if their actions were being processed, and some error messages- especially those related to network failures- were too vague to be useful. In response, the development team quickly implemented enhancements, introducing visible progress indicators during uploads and crafting more informative, context-aware error messages in subsequent software updates. These adjustments further refined the user experience and addressed early pain points.

e) Qualitative Feedback

Participants across both patient and clinician groups consistently remarked that the platform's clean, uncluttered design contributed to a calmer, more reassuring atmosphere during online consultations. In particular, patients felt less anxious about the technology itself, allowing them to focus on their health concerns. The presence of privacy indicators- such as prominent lock icons and explicit consent prompts- stood out to users, giving them reassurance that their personal information was being handled securely and transparently. Clinicians found significant value in the integrated, real-time transcripts, which not only reduced the amount of post-session documentation they had to complete but also improved the accuracy and thoroughness of their records.

While overall feedback was positive, users identified areas where enhancements could further improve accessibility and comfort. Several participants requested the addition of a dark mode option, which would reduce eye strain during extended use, especially in low-light environments. Others expressed a desire for the interface to support regional languages, making the platform more inclusive and easier to use for people from diverse linguistic backgrounds.

One unifying theme emerged from all this feedback: users' sense of trust in the system and their perceived level of control over their own data and experience were central to their overall satisfaction. This finding echoes trends reported in other studies of digital health technology usability, highlighting the importance of transparency, privacy, and user empowerment in fostering adoption and ongoing engagement.

5. Future Enhancements

The insights gained from early usability testing proved invaluable, enabling the team to make targeted improvements that increased user engagement and drove adoption right from the platform's launch. Looking to the future, several enhancements are planned for upcoming releases of ChikitsaAI to address user feedback and evolving needs:

1) The platform will introduce comprehensive multilingual UI support, allowing users to interact with the system in their preferred regional language. This is expected to broaden accessibility and foster inclusivity among diverse user groups.
2) An optional dark mode will be added, along with customizable font size settings, to improve visual comfort and accommodate users with different preferences or visual requirements.
3) Real-time troubleshooting tips will be embedded into the consultation workflow, providing immediate guidance to patients whenever they encounter connectivity issues or other technical challenges. This proactive support will help users resolve problems quickly and independently.
4) The team plans to initiate longitudinal studies to monitor how usability, trust, and user satisfaction evolve with repeated use over time, ensuring that the platform continues to meet user expectations and adapts to changing needs

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