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Virtual Healthcare with AI

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***Abstract*— Regular hospital visits can be expensive for people, particularly in rural areas, due to long-distance traveling to hospitals or travel costs. People usually go to hospitals for medical checkups and treatments. Visiting hospitals or clinics and making doctor appointments often involves exhausting waits in long hospital queues. Instead of visiting hospitals, people can take virtual healthcare through mobile devices or laptops. Virtual Healthcare with Artificial Intelligence allows video or chat functionality for real-time communication between patients and doctors to address their daily health issues without going to a clinic. Automatic Speech Recognition technology converts the doctor's spoken words into text, aiding in the creation of prescriptions. A medication reminder system sends SMS messages to patients to ensure they take their medications at the prescribed times. A secure database stores and manages patient medical histories, including prescriptions, treatments, and other relevant health information.**

***Index Terms*—Virtual Healthcare, Artificial Intelligence, Video Calling, Speech-to-Text, Medication Reminder.**

I. INTRODUCTION

Virtual healthcare is an innovative platform that facilitates remote consultations between patients and doctors using video, audio, and chat communication. By enabling patients to book appointments online, the system provides easy access to medical care without the need for in-person visits. This platform is especially beneficial for individuals who feel uncomfortable discussing sensitive health issues, as it allows patients to communicate privately via text or audio. Artificial Intelligence (AI) enhances the functionality of virtual healthcare by automating key processes. Using Natural Language Processing (NLP), the system converts doctors' spoken words into text, automatically generating prescriptions. This not only reduces the manual effort involved but also ensures accuracy in documentation and improves the overall efficiency of consultations. The system further supports patient adherence to prescribed treatments through its medication reminder feature. By sending timely SMS reminders, the platform helps ensure that patients take their medications as prescribed, ultimately improving treatment outcomes.

Additionally, an appointment scheduler keeps patients informed of their upcoming consultations, reducing the likelihood of missed appointments. A secure database underpins the platform, storing patient data such as medical histories, prescriptions, and consultation records.

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This ensures that doctors have easy access to accurate and up-to-date information while maintaining patient confidentiality. By integrating AI and secure data storage, the virtual healthcare system offers a convenient and effective solution to healthcare accessibility, especially for individuals in underserved or rural areas.

II. Literature Survey

The integration of AI in healthcare has seen significant advancements in recent years, focusing on improving patient access, diagnosis accuracy, and treatment efficiency. One such system is Morshedul Bari Antor's web-based telemedicine platform, which facilitates remote consultations via video calls and text messages. This system allows healthcare professionals to access and store patients' health information, thus enhancing healthcare access, particularly in rural regions. The integration of telemedicine platforms in remote areas has proven to be an effective solution for addressing challenges related to healthcare accessibility [1].

In the domain of disease diagnosis, Sharvari Patil's virtual assistant leverages AI for predicting diseases based on patient symptoms. By incorporating speech-to-text technology, the assistant helps patients interact with the system and schedule daily medication reminders. This technology helps automate patient engagement by providing necessary health information and scheduling routines for medication, which parallels the prescription generation and reminder system proposed in our study[2]. The work of Shyam Singha further advances virtual healthcare by developing a system capable of recognizing human emotions through speech. This AI-powered virtual assistant not only diagnoses diseases but also assists in appointment scheduling and email notifications for appointments. It incorporates machine learning algorithms to process symptoms and recommend possible treatments, similar to how our system leverages AI to transcribe doctor-patient consultations into accurate text-based prescriptions [3]. This study analyzes COVID-19's spread in India using real-time ICMR data and predictive models like SEIR and ARIMA to forecast cases, deaths, and recoveries. It predicts confirmed cases exceeding 473,000 with a peak by June 30, 2020. The research evaluates lockdown effectiveness, public sentiment, and the pandemic's socio-political impact, aiming to reduce risks and support informed decision-making through predictive modeling and preventive measures need a virtual based health care system [8].

Ahmed Al Kuwaiti's work highlights the broad application of AI in healthcare, particularly in areas like medical imaging, virtual care, and patient engagement. Our system builds on this foundation by emphasizing AI's role in automating workflows, such as prescription generation and medication adherence, ensuring that patients receive personalized care without requiring physical visits [4]. The integration of advanced AI technologies, including natural language processing (NLP) and computer vision, can significantly enhance telemedicine kiosks by addressing inefficiencies like delays, misdiagnoses, and poor communication.

AI improves symptom recognition, data management, and real-time communication, leading to more accurate diagnoses and reduced wait times. Preliminary results show that AI-driven kiosks enhance healthcare accessibility, especially in remote areas, streamline the telemedicine process, and improve patient outcomes, marking a transformative step in healthcare delivery[6].

Moreover, Ayesha Amjad's research underscores the growing impact of AI in telehealth, specifically in improving diagnostic accuracy and virtual assistant functionalities. By analyzing AI's role in remote monitoring and diagnosis, this study provides insights into how AI can be used to automate healthcare processes, which aligns with the automation of key tasks like prescription creation and medication reminders in our system[5].

III. Detailed Explanation of the Proposed System

The proposed system is a web-based application developed using HTML, CSS3, Flask, Bootstrap, and PHP. It facilitates real-time interaction between patients and doctors through video calls and integrates several functionalities for seamless operation. The concept revolves around creating a unified platform where users can perform all essential healthcare activities remotely.

System Architecture

Frontend: Developed with HTML, CSS3, and Bootstrap for a responsive and user-friendly interface.

Backend: Powered by Flask and PHP to handle application logic and data management.

Database: MySQL is used for secure and scalable storage of medical records, appointment schedules, and user details.

A. Block Diagram

The figure below illustrates the block diagram of the proposed web application, which facilitates remote consultations with doctors for treatment.

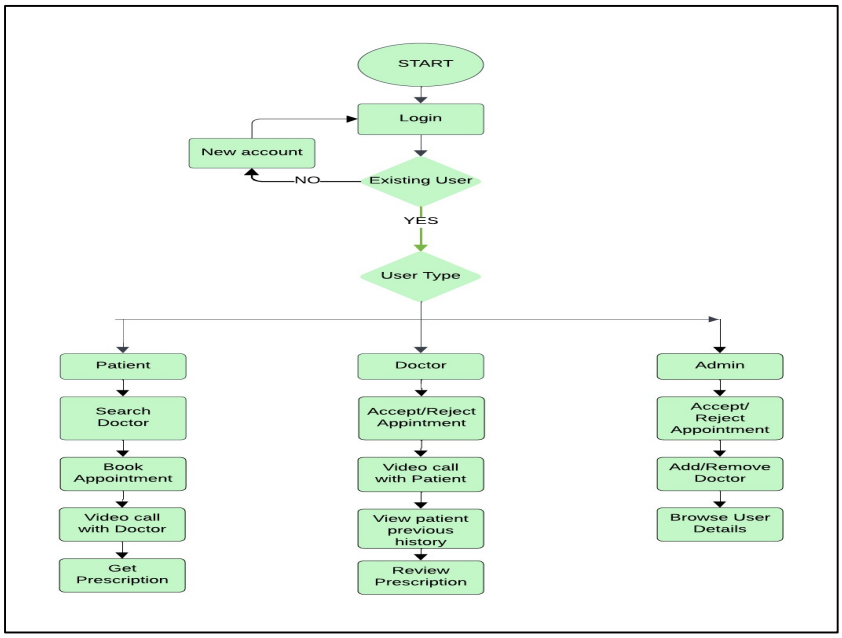

Figure 1. Block Diagram of Virtual Healthcare System

Users can access the web application by logging into the website. If already registered, they can log in directly. Otherwise, they need to register first. Users can sign in as a patient, doctor, or admin.

- Patient User Interface: Patients can log in and view a list of doctors on the website. They can also search for doctors and book appointments. At the scheduled appointment time, a patient can get remote treatment by interacting with specialized doctors to discuss their health issues. After the consultation, patients can view the prescriptions provided by the doctors.
- Doctor User Interface: Doctors have access to a website where they can log in to manage their appointments, accepting or rejecting them as necessary. They can engage with patients, recommend medications, and create prescriptions. Doctors also can review and update prescriptions, as well as access patients' medical histories stored in the database.
- Admin User Interface: Admins can log in to the website to accept or reject patient appointments. They can add or remove doctors as necessary. Admins can also browse patient details and view patients' medical histories.

B. Voice Prescription

The prescription generation system leverages advanced Speech Recognition and Natural Language Processing (NLP) technologies to streamline the process of creating accurate and professional medical prescriptions. This system enables doctors to dictate prescriptions during consultations, reducing the need for manual documentation and ensuring efficiency.

The process begins with capturing audio input during live consultations or through pre-recorded files. Using PyAudio, a Python library, the system facilitates seamless interaction with the inbuilt microphone to record the doctor's spoken words. The recorded audio is then processed using NLP tools like spaCy or Google Speech-to-Text API, which transcribe the spoken content into structured text. This transcription prioritizes accuracy, especially for medical terms, to maintain the integrity of the prescription.

Once the transcription is complete, the system employs NLP techniques to analyze the text and extract key details such as the patient's name, medication names, dosages, and instructions. These extracted entities are formatted into a clear and standardized prescription layout using tools like Pydocx. The prescription is then reviewed and verified by the doctor before being converted into a secure PDF format and sent to the patient via email using SMTP protocols. This approach ensures fast, error-free delivery and enhances the overall efficiency of the virtual healthcare system.

The prescription is generated from the input audio file recorded by the doctor. The process includes the following steps

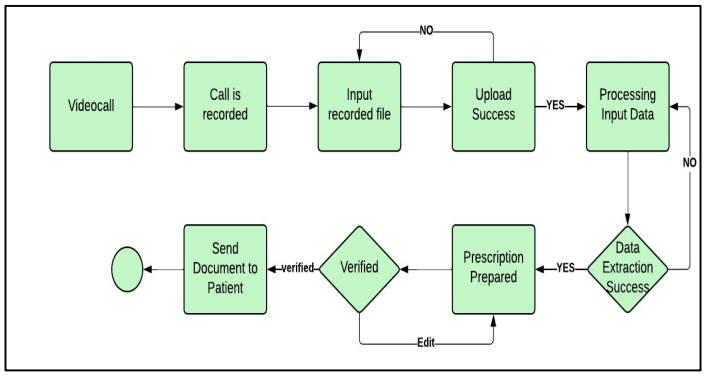

Figure 2. Prescription Process

- Input Recorded Audio File or Live Recording

The input is provided either as a pre-recorded file or through live recording using an inbuilt microphone, facilitated by a speech recognition module that utilizes PyAudio for microphone interaction.

- Converting the Audio File into Text

The recorded audio input is converted into text format, which is essential for further processing.

- Extracting the Details from The Text File

Key information such as patient name, age, drug name, dosage, etc., is extracted from the text using natural language processing libraries like NLTK and spaCy, which utilize built-in functionalities to identify the required entities.

- Preparing the Prescription

The extracted entities are used to prepare the prescription. This step can be accomplished using the Pydox module, and the generated prescription is displayed to the doctor for verification

- Verifying the Prescription

The doctor verifies the prescription format and details before finalizing it.

- Converting and Previewing the Document

The prescription is converted from a DOCX format to a PDF format using the Docs2Pdf tool.

- Sending Verified Prescriptions to Patients

The final step involves sending the verified prescription to the patient via email, which can be achieved using the smtplib module.

C. Work Flow

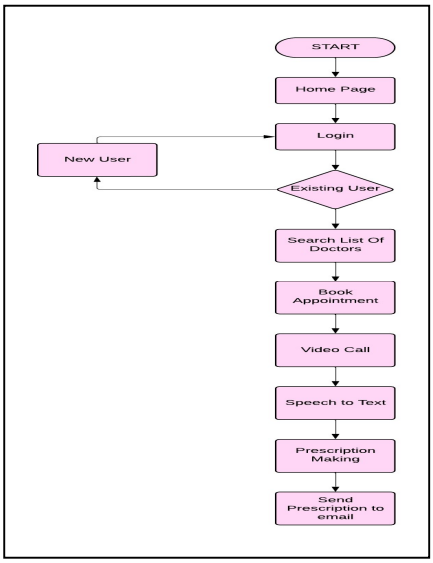

Figure 3. Work Flow of Model

The workflow for a virtual healthcare system begins with the homepage. New users can register by providing essential information such as their name, email, and password. After registration, users can log in directly. Once logged in, they can search for doctors by medical specialty, select a doctor from the search results, and choose a convenient date and time for their appointment. Users confirm the booking details to finalize the appointment.
During the scheduled appointment time, users interact with their doctors via video call to discuss medical issues. Doctors provide advice and suggest medications during the call. The audio from the video call is recorded and converted into text. Keywords such as medication names, dosages, and duration are extracted to create a prescription. The doctor can review and edit the transcribed text or create a new prescription. The prescription includes specific dosage and usage instructions for each medication. After review, the system sends the prescription to the patient via email in text format.
Users can purchase medications through the web application by searching for their names, adding them to the cart, and completing the purchase. The medications are then delivered to the specified address. Additionally, users can set up medication reminders by entering the medication name, dosage, and duration to receive timely SMS reminders, ensuring they adhere to their medication schedule.

D. Video Calling Setup

The video calling module in the virtual healthcare system was implemented using Agora.io API, which provides high-quality, real-time audio and video communication capabilities. The integration process involved the following steps:
Agora SDK Integration: The Agora Web SDK was integrated into the front end, which was developed using HTML, CSS, and Bootstrap. This enabled embedding a secure video calling feature directly within the web interface.

- Authentication and Session Management: Unique tokens generated by the Agora server API ensure secure participant communication. Patients and doctors are assigned session-specific tokens upon appointment confirmation, allowing them to join the call securely at the scheduled time.
- Video and Audio Optimization: Agora's adaptive bitrate streaming and echo cancellation features ensure seamless communication, even in low-bandwidth conditions. Additional controls like camera toggling, screen sharing, and muting were added for a user-friendly experience.
- Testing and Deployment: The module underwent extensive testing to handle various scenarios, such as network interruptions and multi-device support, ensuring reliability during consultations.

IV. RESULTS AND DISCUSSIONS

A. Registration page

Users can gain access to the web application by registering on the website. The registration process is the same for doctors, patients, and administrators. Users must enter their correct details and click the submit button. After completing the registration, they can log in to the website and access the web application directly.

B. Login Page

Users can utilize the telemedicine service via the application's user interface. If they input an incorrect username or password, the login attempt will be unsuccessful. The system includes a feature to reset a forgotten password, which requires users to provide specific information to confirm their registration. If the information is verified, they can update their password and access the user interface.

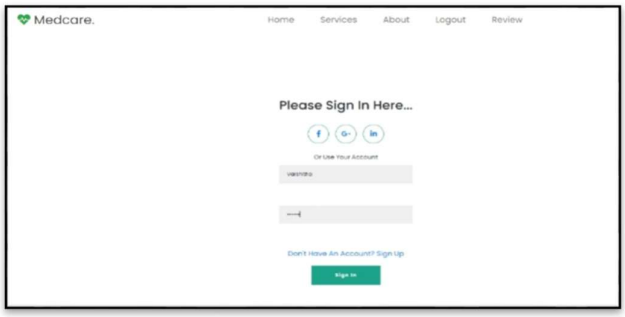

Figure 4. Login Page

C. Appointment Booking

Patients can interact with the doctors by booking an appointment. Patients can fill in their details and can search for doctors based on various criteria such as specialty. The platform displays available dates and times for each doctor. Patients can choose an available time slot that suits their schedule and can confirm the appointment by clicking on the desired time slot and providing any additional information or notes for the doctor. Once booked, the patient receives an appointment confirmation via email or SMS.

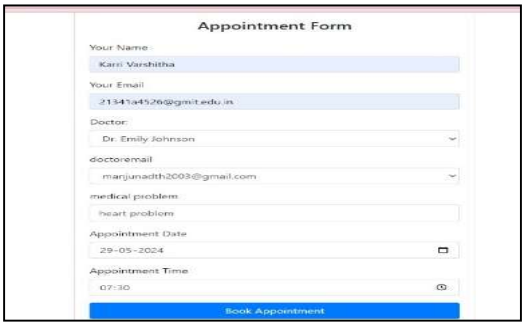

Figure 5. Appointment Form

D. Appointment Scheduler

Patients mostly forget about their appointments due to their busy schedules. The appointment scheduler reminds patients about their appointments. The scheduler sends automated reminders to both parties to reduce no-shows and supports easy rescheduling and cancellations.

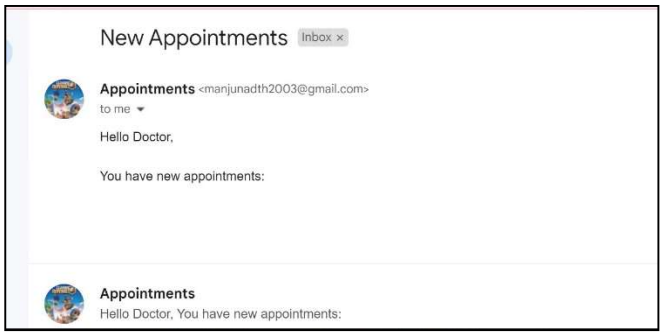

Figure 6. Appointment Scheduler

E. Video Calls

Patients can connect to the video calls at the appointed slot. Video calls in a telemedicine website facilitate remote consultations between patients and healthcare providers, offering a convenient and efficient way to deliver medical care. The video call feature typically includes high-quality audio and video capabilities, ensuring clear communication between the patient and the healthcare provider. During the consultation, patients can discuss their symptoms, receive medical advice, and even show physical symptoms or conditions to the doctor through the video feed.

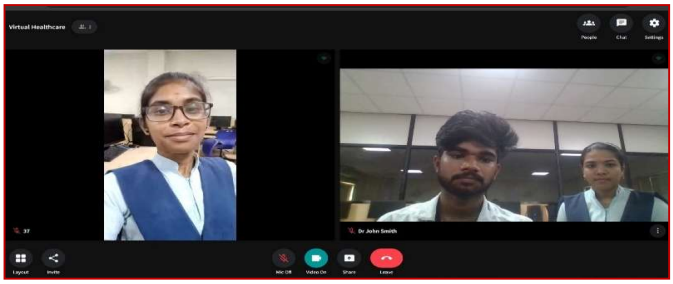

Figure 7. Video Call

F. Prescription

The proposed system offers a platform where doctors can orally dictate their prescriptions using speech recognition and natural language processing, eliminating the need for manual typing or writing. This approach saves time for both doctors and patients and significantly reduces the likelihood of human errors. Doctors send the verified prescription to the patient via email, which can be achieved using the smtplib module.

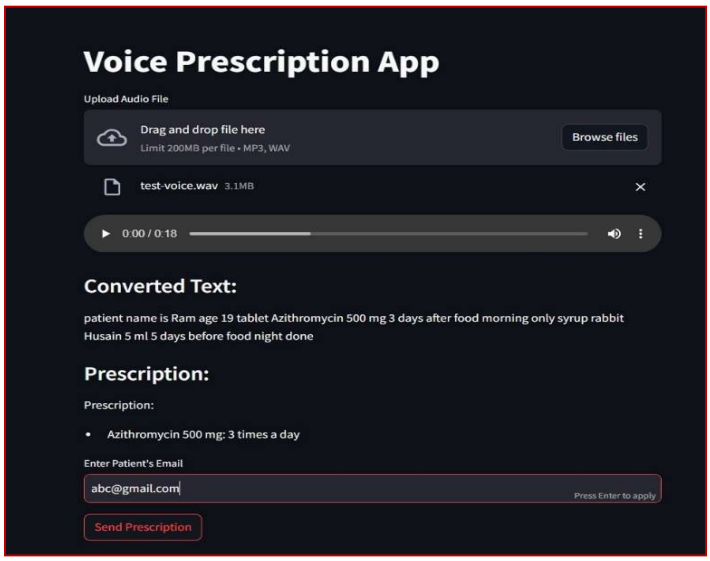

Figure 8. Prescription

G. Database

The web application connects to a database containing multiple tables for data storage and management. Registered users can view their activity history, essential for database maintenance. Doctors can access patients' medical histories. The database was developed using PHPMyAdmin and MySQL.

H. Buy Medicine

Users can purchase medicine through the web application. They can search for the medicines they need, add them to their cart, and complete the purchase. The application offers a variety of medicines, and the purchased items are delivered to the address provided by the user. This convenience eliminates the need to go out to buy products.

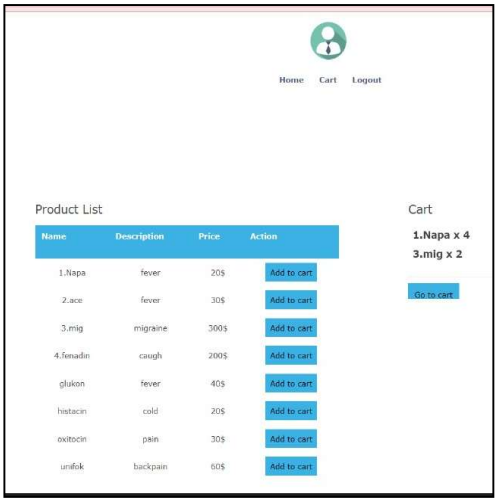

Figure 9. Products List

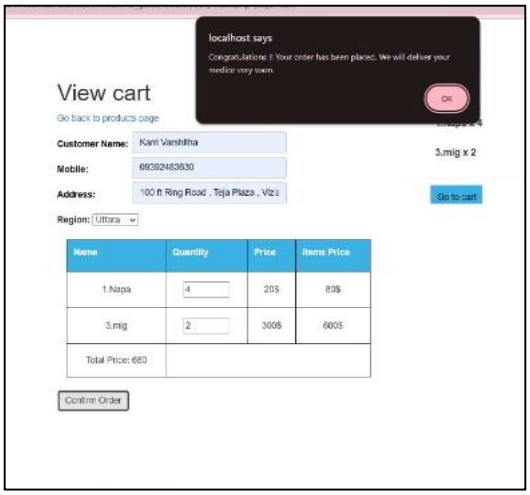

Figure 10. Product Cart

V. Conclusion

In this research, we developed a virtual healthcare system that bridges the gap between patients and doctors, offering a seamless platform for remote medical consultations. By enabling patients to book appointments and interact with doctors via video calls, the system addresses the need for accessible, convenient, and efficient healthcare services. The integration of Artificial Intelligence (AI) enhances the platform by automating essential processes, such as speech-to-text transcription for prescription generation and medication reminders, significantly improving the overall patient experience. The system's user-friendly interface ensures that patients can easily navigate the platform to access qualified healthcare professionals, receive timely prescriptions, and manage their medical routines. By securely storing patient information in a centralized database, the system not only maintains data confidentiality but also allows doctors to provide personalized care based on comprehensive medical histories. Furthermore, this virtual healthcare solution is particularly beneficial for underserved and rural areas, where access to quality healthcare is often limited. By reducing the need for physical visits, the platform minimizes travel costs and waiting times, making healthcare more inclusive and equitable. Future enhancements to the system could include the integration of advanced AI features, such as predictive analytics for early diagnosis, multilingual support for broader accessibility, and enhanced data analytics to track patient progress. With these improvements, the system has the potential to further transform the landscape of virtual healthcare, offering smarter, faster, and more reliable medical solutions for a diverse range of users.

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