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CliniNet: An Online Platform for all Healthcare Services

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Abstract: ***The COVID-19 pandemic has accelerated the adoption of digital healthcare solutions, prompting a shift from traditional manual procedures to digitally-enabled medical assistance. In response to the challenges faced during the pandemic, such as inadequate medical facilities, shortages of surgical instruments and medications, and unreliable lab results, this research presents "CliniNet: An online portal for all healthcare services," an innovative Android application. CliniNet serves as a comprehensive online platform for various healthcare services, offering features such as appointment scheduling, purchasing medicines and medical insurance, setting medication reminders, checking symptoms, and seeking diet-related advice. This paper explores the existing literature on healthcare applications, outlines CliniNet's architecture and features, discusses the implementation process, presents experimental data on performance and user satisfaction, and concludes with potential directions for future development. The CliniNet application addresses the necessity for improved access to healthcare services, catering to the evolving digital landscape.***

Keywords: Android application, healthcare services, online portal, scheduling appointments, medical records, medical advice.

I. INTRODUCTION

Healthcare applications have emerged as powerful tools in the modern healthcare landscape, offering convenience, accessibility, and improved healthcare outcomes for individuals. The increasing adoption of mobile devices, advancements in technology, and the demand for personalized healthcare experiences have fuelled the development of healthcare applications. These applications leverage mobile platforms, web-based systems, and data-driven technologies to provide a range of services, including appointment scheduling, remote consultations, medication management, health monitoring, and access to medical information. Healthcare applications have the potential to address various challenges in healthcare delivery. They allow users to access healthcare services anytime and anywhere, reducing the need for physical visits to healthcare facilities. These applications empower individuals to take control of their health by providing tools for self-management, such as tracking symptoms, monitoring vital signs, and managing medication adherence.

Moreover, healthcare applications contribute to improving healthcare outcomes and patient engagement. They enable seamless communication and collaboration between healthcare providers and patients, facilitating timely access to medical advice, test results, and personalized treatment plans. These applications also support preventive healthcare by promoting healthy behaviors, providing health education resources, and facilitating early detection of diseases through symptom monitoring and risk assessment. Healthcare applications have the potential to revolutionize the way healthcare services are delivered and accessed. By leveraging technology, these applications offer opportunities to improve efficiency, enhance patient experiences, and contribute to better healthcare outcomes. Continuous advancements in technology and a growing emphasis on digital health solutions are expected to drive further innovation in the field of healthcare applications.

Aligned with the progress in healthcare applications, we introduce CliniNet, an innovative Android application developed using Kotlin. CliniNet serves as a comprehensive online platform, offering a wide range of healthcare services. Its primary objective is to enhance access to healthcare and improve the overall healthcare experience for users. CliniNet provides various features to cater to the diverse needs of individuals seeking healthcare services. Some of the features provided by this application are as follows:

*Scheduling Appointment for Consultation, Surgeries and Lab Tests
* Booking Instant Video Consultation
*Buying Medicine and Medical Insurance
*Setting medication reminder for Medication Management
*Seeking a general diet plan according to the calculated Body Mass Index (BMI)
*Detecting disease through Symptom Checker

By offering these comprehensive features, CliniNet aims to bridge the gap between healthcare providers and patients, making healthcare services more accessible, convenient, and efficient. Through its intuitive design and user-friendly interface, CliniNet strives to enhance the healthcare experience for individuals, empowering them to take control of their health and well-being.

II. LITERATURE REVIEW

1) .“A study and an implementation of online doctor consultation system” by Wang Jack Huan et al. [1]: The study focuses on the implementation of an online doctor consultation system using the Rapid Application Development (RAD) methodology. The system aims to provide advantages such as saving patients from waiting for registrations or appointments, reducing waiting time, and allowing users to book consultations online. By implementing this system, patients can conveniently schedule appointments from home and visit the hospital only at the scheduled time.
2) “Doctor Consultation through Mobile Applications in India: An Overview, Challenges and the Way Forward” by Neeraj Agarwal et al. [2]: This paper discusses the concept of mHealth (mobile health) and its applications in India. It highlights popular mobile applications such as Practo, Mfine, DocsApp, 1mg, Netmeds, Lybrate, MediBuddy, and Medlife that offer online doctor consultation and appointment booking services. The challenges faced in doctor consultation through mHealth in India include limited accessibility due to smartphone affordability, low health literacy, and inadequate healthcare infrastructure, particularly in rural areas. However, with the increasing penetration of mobile phones, mHealth platforms have the potential to provide accessible and cost-effective healthcare services, minimizing travel and time-related costs for both users and providers.
3) "Online Doctor Appointment System” by Venkatesh Rallapalli et al. [3]: This paper introduces an Online Doctor Appointment System that leverages technology to improve the quality and efficiency of healthcare services. The web-based system aims to bridge the gap between doctors and patients by providing fast and adequate medical services. The system offers online registration and appointment booking, allowing patients to easily view doctor details, timings, and specializations, and book appointments accordingly. By utilizing this online application, patients can save time and effort, while healthcare providers can streamline their operations and enhance service quality. The research highlights the significance of technology in facilitating convenient access to healthcare and addressing challenges such as long waiting times and the impact of the COVID-19 pandemic. The online doctor appointment system presented in this study offers a user-friendly and efficient solution for booking appointments, reducing the tediousness and time-consuming nature of the process.
4) "E-Buying of Medicines: Trends and Factors Influencing Online Pharmacy" by Sadiya Fatima et al. [4]: This study examines the e-buying behavior of medicines and aims to identify the factors influencing online pharmacy purchases. It investigates the crucial factors that play a role in influencing the e-buying of medicines, with a specific focus on understanding the differences in buying patterns between consumers in relation to generic and non-generic medicines. By gaining a deeper comprehension of the motivations driving consumer choices in acquiring prescribed medicines online, this research provides valuable insights into Indian consumer behavior and their perspectives on online pharmacies. Additionally, the paper presents a theoretical framework that elucidates the relationship between the influencing factors of online medicine buying among Indian consumers. Overall, this study contributes to the existing literature by shedding light on the trends and factors shaping e-buying behavior in the pharmaceutical industry, particularly within the Indian context.
5) “Systematic Review Usage of Mobile Applications or Mobile Health Technology to Improve Diet Quality in Adults” by Alan Scarry et al. [5]: This systematic review explores the impact of mobile applications on diet quality in adults. The review identifies ten studies that measured diet quality using different methods. It reveals that mobile applications can improve diet quality by helping individuals track their food intake, monitor exercise, and provide supplementary information and reminders. However, there are concerns about the potential negative impact on dietary habits and the overdependence on mobile applications for dietary advice.
6) “GoMed: Daily Medicine Reminder Application” by Afshaan Sarguroh et al. [6]: This paper present an android application, designed to address the issue of medical non-adherence by providing users with reminders for taking their medications at the appropriate time. The application offers a user-friendly experience, taking advantage of the widespread use of mobile phones. It includes features such as a reminder system that sends notifications for medication intake, the ability to search for nearby hospitals, doctors, and pharmacies, a notes feature for important appointment details, a Body Mass Index (BMI) calculator, health/first aid tips for emergencies, monthly report generation, and a caretaker function for emergency situations or medicine restocking. The GoMed app aims to enhance medication adherence and facilitate convenient access to healthcare resources for users.

7) "Self-Diagnosis through AI-enabled Chatbot-based Symptom Checkers: User Experiences and Design Considerations" by Chin Ling Chen et al. [7]: CSC apps, which employ chatbots to assess medical symptoms and provide diagnoses, have become increasingly prevalent. This study is the first to review the functionalities and user experiences of CSC apps. The findings highlight new challenges in the functional and conversational design of these apps from users' perspectives. The app selection process involved excluding apps without chatbot functionality, those targeting mental health, and those not focused on symptom checking. The analysis categorized the features mapped to the offline diagnostic process. CSC apps generally lack support for physical exams, final diagnoses, and test result analysis due to the limitations of mobile apps in realizing these processes. Additionally, the amount of personal, demographic, and health information required for establishing patient history varied among the six apps analysed.

Table 1: Features available in different healthcare application
CDO: consult doctors online, BDA: book doctor's appointment, BLT: book lab test, BMO: book medicine online, PHI: provide health information, PDR: provide diet recommendation.

	Service Provided						
App name	CDO	BDA	BLT	BMO	PHI	PMI	PDR
CliniNet	✔	✔	✔	✔	✔	✔	✔
Practo	✔	✔	✔	✔	✔	_	_
mfine	✔	✔	✔	✔	_	_	_
DocsApp	✔	_	✔	_	✔	_	_
1mg	✔	_	✔	✔	✔	✔	_
Netmeds	✔	_	_	✔	✔	_	_
Lybrate	✔	✔	✔	_	✔	_	_
MediBuddy	✔	_	✔	✔	_	_	_
Medlife	✔	_	✔	✔	_	_	_
Ask Apollo	✔	✔	✔	✔	_	_	_
India Health Line	✔	_	_	✔	_	_	_
Lifecare Health	✔	_	✔	_	✔	_	_
I Doctor Online	✔	✔	_	_	_	✔	_
Ask a Doctor	✔	_	_	_	✔	_	_
ML Xpress	✔	_	_	✔	_	_	_
CallDoc App	_	✔	_	_	✔	_	_
Doctor Insta	✔	✔	✔	✔	_	_	_
DocOnline	✔	✔	_	_	_	_	_
India Dental World	✔	✔	_	_	✔	_	_

III. IMPLEMENTATION OF OUR APPLICATION

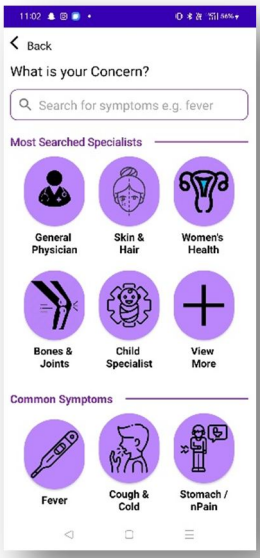
Our application comprises a user module that offers a range of features, empowering users to access healthcare services remotely without the need to visit a physical location. While there are existing systems that share some similarities with our application's features, we provide additional unique functionalities not found in any other application. Some of the features implemented are as follows

A. Instant Doctor Consultation using WhatsApp API

To incorporate the Instant Doctor Consultation feature into the healthcare application, we can integrate the WhatsApp API, enabling users to directly connect with doctors via WhatsApp for quick consultations. The implementation methodology is as follows:

1) Obtain WhatsApp API credentials: Register with the WhatsApp Business API platform to acquire the necessary credentials, including the API key and phone number.
2) Integrate WhatsApp API into the application: Utilize the WhatsApp API client library to establish a connection between the application and WhatsApp. This library provides methods for sending messages, initiating chats, and handling incoming messages.
3) User authentication and doctor selection: Implement a user authentication system within the application. Once authenticated, users are presented with a list of available doctors from which they can choose for consultation.
4) Initiate WhatsApp chat: When a user selects a doctor, utilize the WhatsApp API to initiate a chat with the doctor's WhatsApp number. Pass relevant details such as the user's identification and the purpose of the consultation.
5) Chat interface: Display the chat interface within the application, allowing users to exchange messages with the doctor. Utilize appropriate UI components to show message history, send text messages, and handle multimedia content if necessary.
6) Real-time notifications: Implement real-time notifications to inform both users and doctors about new messages or consultation requests. This ensures that both parties are promptly notified of incoming messages and can respond in a timely manner.

B. Appointment Booking



The Appointment Booking feature enables users to schedule appointments with doctors or healthcare providers. The implementation methodology includes the following steps:

1) Create a database: Set up a database to store information related to doctors, their availability, and appointment bookings. Include tables for doctors, users, appointments, and any other relevant entities.
2) User authentication: Implement a user authentication system in the application to ensure that only authenticated users can book appointments and access personalized features.
3) Doctor availability management: Provide doctors with a platform to manage their availability. This may involve defining working hours, setting available appointment slots, and updating their schedules.

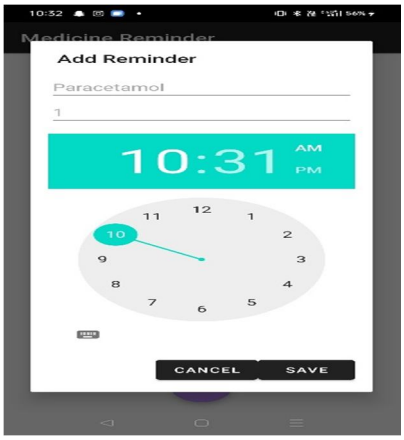
4) User interface for appointment booking: Develop a user-friendly interface that allows users to browse available doctors, view their profiles, and select a suitable time slot for the appointment. Display relevant information such as doctor specialization, location, and ratings to assist users in making informed decisions.
5) Booking confirmation and reminders: Upon successful booking, send a confirmation notification to the user and store the appointment details in the database. Implement a reminder system to send notifications to users before their scheduled appointments.

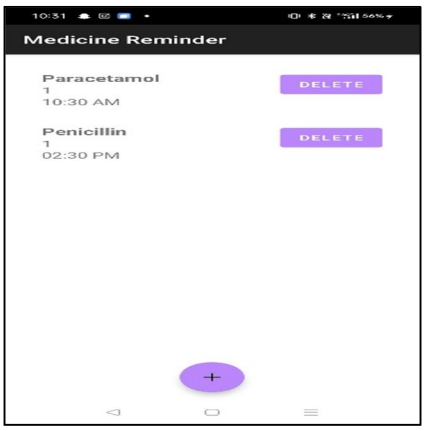
C. *Symptom Checker using NLP*

Implementing a Symptom Checker feature involves leveraging Natural Language Processing (NLP) techniques to analyze user-entered symptoms and provide potential diagnoses. The implementation methodology is as follows:

1) Preparing symptom and diagnosis data: Gather a comprehensive dataset of symptoms and associated diagnoses. This dataset should include information such as symptom descriptions, severity, duration, and possible medical conditions.
2) NLP model training: Employ machine learning techniques to train an NLP model on the symptom and diagnosis dataset. This entails preprocessing the text data, extracting relevant features, and training the model to classify symptoms and predict potential diagnoses.
3) User input processing: Implement a text input interface where users can enter their symptoms. Clean and preprocess the user's input, removing irrelevant information or noise, and standardize the format.
4) NLP model inference: Apply the trained NLP model to the preprocessed user input. The model should generate potential diagnoses based on the entered symptoms. Rank and display the diagnoses according to their likelihood or confidence scores.
5) Additional information and recommendations: Provide users with supplementary information about each potential diagnosis, including symptoms, treatment options, and when to seek medical attention. Offer recommendations such as self-care measures or advice on scheduling a doctor's appointment.

D. *Reminder Feature with Alarm:*





The Reminder Feature allows users to set reminders for taking medication, doctor appointments, or any other healthcare-related tasks. The implementation methodology is as follows:

1) User interface for reminder creation: Develop an intuitive user interface where users can set reminders. Include options to select the reminder type, date, time, recurrence (if applicable), and any additional notes.
2) Alarm manager: Utilize the Android Alarm Manager API to schedule and manage reminders. Set alarms for the specified date and time and handle recurring reminders as needed.
3) Notification system: When the alarm triggers, display a notification to the user. Include relevant details about the reminder, such as the reminder type and any additional notes provided by the user.
4) Reminder management: Provide users with the ability to view, edit, and delete existing reminders. Implement a list or calendar view to display all active reminders, enabling users to manage them easily.

E. Diet Recommendation based on BMI Index

Implementing a Diet Recommendation feature based on the BMI (Body Mass Index) index involves calculating the user's BMI and providing personalized diet suggestions. The implementation methodology is as follows:

1) User profile setup: Allow users to create a profile within the application. Collect necessary information such as height, weight, age, gender, and activity level.
2) BMI calculation: Utilize the user's height and weight information to calculate the BMI using the appropriate formula. Display the calculated BMI to the user.
3) BMI interpretation: Classify the BMI into categories (underweight, normal weight, overweight, obese, etc.) based on standard thresholds. Determine the user's BMI category and display it to the user.
4) Diet recommendation algorithm: Develop an algorithm or utilize pre-existing guidelines to recommend appropriate diets for each BMI category. Consider factors such as caloric intake, macronutrient distribution, portion sizes, and specific dietary restrictions (if any).
5) Personalized diet suggestions: Display personalized diet recommendations to the user based on their BMI category. Provide meal plans, food suggestions, and nutritional guidelines tailored to the user's needs.
6) Nutritional information: Incorporate a comprehensive food database to retrieve nutritional information for various food items. Display the nutritional content, such as calories, proteins, carbohydrates, and fats, for recommended foods and meals.

F. Lab Tests

1) Comprehensive Database for Lab Test Information: To store and manage lab test information, we create a comprehensive database. This database holds details such as test names, descriptions, prices, and any other relevant information. By organizing the data effectively, we ensure that it can be easily accessed and displayed to users when needed.
2) Search Functionality for Lab Tests: To enhance the user experience, we implement search functionality. This allows users to enter keywords or select specific categories to find the lab tests they are interested in. The search algorithm then matches the user's input with the relevant lab tests, providing them with accurate results.
3) Detailed Test Information: Detailed information about each lab test is crucial for users to make informed decisions. We include comprehensive descriptions of the tests, including instructions for preparation, sample collection, and expected results. This information helps users understand the purpose and process of each test, making it easier for them to choose the appropriate one.
4) Booking System for Lab Tests: To facilitate the booking process, we integrate a booking system into our application. This system enables users to schedule lab tests according to their preferences. They can select the desired date, time, and location for the test. Once the booking is confirmed, users receive a confirmation message containing the details of the scheduled test, including the date, time, and location. This ensures that users are well-informed and prepared for their upcoming lab tests.

By implementing these steps, we create a seamless experience for users to browse, search, and schedule lab tests in our healthcare application.

The user-friendly interface, along with detailed information and a reliable booking system, empowers users to access the necessary lab tests conveniently and efficiently.

G. E-pharmacy

1) User-Friendly Interface for Medication Purchase: To implement the E-pharmacy feature in our healthcare application, the first step is to design a user-friendly interface where users can explore and purchase various medications and healthcare products. The interface should be intuitive and visually appealing, making it easy for users to navigate and find what they need.

2) Comprehensive Database/API for Medication Information: Next, we create a comprehensive database or API to store all the necessary information about the available medications. This includes details such as medication names, dosages, descriptions, and prices. The database ensures that the information is organized and easily retrievable for displaying to the users.

3) Search and Filtering Functionalities: To enhance the user experience, we implement search and filtering functionalities. These features enable users to search for specific medications based on their requirements, such as the name of the medication, the condition it treats, or the desired dosage. Filtering options allow users to narrow down their choices based on various criteria, such as price range or specific categories.

4) Shopping Cart Functionality: One crucial aspect of E-pharmacy is the shopping cart functionality. We integrate a shopping cart system that allows users to add medications or healthcare products to their cart as they browse through the options. They can review their selections, modify quantities if needed, and proceed to the checkout when they are ready to make a purchase.

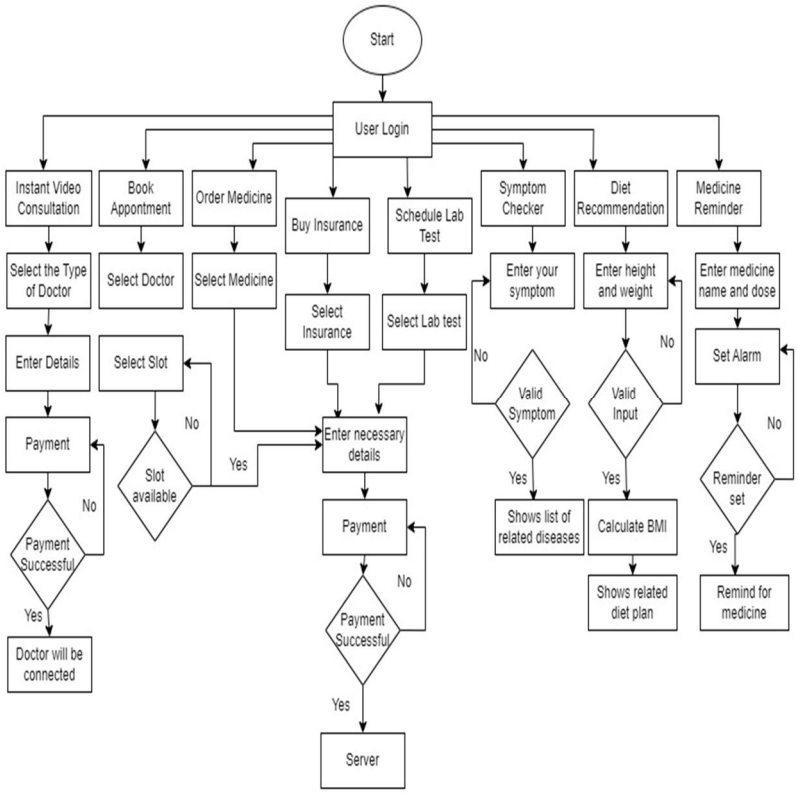


Fig. 2: Workflow of the application

IV. METHODOLOGY

A. Performance Evaluation

To evaluate the performance of CliniNet, various metrics were measured, including response time, resource utilization, and system stability. These metrics were assessed under different scenarios, such as peak usage hours and varying network conditions. Performance tests were conducted on multiple Android devices with different specifications to ensure compatibility and optimal performance across a wide range of devices.

The response time of CliniNet was measured by recording the time taken for different operations, such as appointment scheduling, medication purchase, and symptom checking. Resource utilization, including CPU and memory usage, was monitored during various interactions within the application to ensure efficient resource management. System stability was assessed by performing stress tests and monitoring any system crashes or performance degradation.

B. User Satisfaction Analysis

After carefully studying and analysing all the necessary details of our application, a formal questionnaire for the survey was developed. Then we asked a group of people to use our application and take part in the survey. We made sure to include people from different gender and age group to participate in this survey to get a complete understanding of how these factors along with some other affect the result of this study. A total of 40 people took part in this survey, out of which 15 were female and 25 were male, 25% were above the age of 50, 30% were below the age of 20 and 45% were between the age range of 20-50.

The survey consisted of questions related to the application's usability, user interface, functionality, performance, security and overall experience. Users were asked to rate their satisfaction levels on a scale, and qualitative feedback was also collected to gather insights into their experiences. Some of the question asked in the survey conducted were as follows

1) Did CliniNet effectively fulfill your requirements for scheduling appointments for consultations, surgeries, and lab tests?
2) Were you able to easily book instant video consultations through CliniNet?
3) Were you satisfied with the process of purchasing medicines and medical insurance through CliniNet?
4) Did the medication reminder feature of CliniNet help you manage your medications effectively?
5) Did you find the general diet plan provided by CliniNet helpful in accordance with your calculated Body Mass Index (BMI)?
6) Was the symptom checker feature helpful in identifying potential diseases or conditions?
7) Did you encounter any technical issues or bugs while using CliniNet?
8) Would you recommend CliniNet to others seeking healthcare services?

The survey data was analysed using statistical techniques to derive user satisfaction scores and identify areas for improvement. Common themes and patterns in the qualitative feedback were also identified to gain a deeper understanding of user preferences and expectations. The user response is shown in table and the user satisfaction rating is represented by table

C. Results

The performance evaluation demonstrated that CliniNet exhibited excellent response times, with operations such as appointment scheduling and medication purchase completing within seconds. The application demonstrated efficient resource utilization, ensuring smooth and seamless user experiences even during peak usage hours. System stability tests revealed no instances of crashes or performance degradation.

Table 2: Survey Response from Users

S.No.	QUESTION	No (in %)	Yes (in %)
1.	Did CliniNet effectively fulfill your requirements for scheduling appointments for consultations, surgeries, and lab tests?	8.9	91.1
2.	Were you able to easily book instant video consultations through CliniNet?	10.5	89.5
3.	Were you satisfied with the process of purchasing medicines and medical insurance through CliniNet?	7.6	92.4
4.	Did you find the general diet plan provided by CliniNet helpful in accordance with your calculated Body Mass Index (BMI)?	15.6	84.4
5.	Did the medication reminder feature of CliniNet help you manage your medications effectively?	5.5	94.5
6.	Did you encounter any technical issues or bugs while using CliniNet?	7.5	92.5
7.	Was the symptom checker feature helpful in identifying potential diseases or conditions?	13.7	86.7
8.	Would you recommend CliniNet to others seeking healthcare services?	6.0	94.0

The user satisfaction analysis indicated high levels of satisfaction among CliniNet users. The application's user-friendly interface, seamless navigation, and comprehensive features received positive feedback. Users appreciated the convenience of scheduling appointments for consultations, surgeries, and lab tests, as well as the option for instant video consultations.

The ability to purchase medicines and medical insurance within the app was well-received. Users also found the medication reminder feature helpful in managing their medication schedules.

The BMI-based diet plan and symptom checker were deemed valuable additions to the application.

Table 3: User Satisfaction Rating

Aspects	Excellent	Good	Average	Poor
Usability	45%	35%	15%	5%
User Interface	40%	40%	15%	5%
Functionality	50%	30%	17%	3%
Performance	35%	45%	15%	5%
Security	30%	40%	20%	10%

Overall, the experimental data showcased CliniNet's strong performance, user satisfaction, and its effectiveness in delivering convenient and comprehensive healthcare services. The results validate the potential of CliniNet as an innovative Android application for improving access to healthcare and enhancing the healthcare experience for users.

V. CONCLUSION & FUTURE WORK

A. Conclusion

In this study, we have presented CliniNet, an innovative Android application that serves as a comprehensive online platform for various healthcare services. CliniNet offers a wide range of features, including appointment scheduling, instant video consultation booking, purchasing medicine and medical insurance, medication reminders, symptom checking, and diet plan recommendations based on Body Mass Index (BMI). Through CliniNet, users can conveniently access these services in one place, eliminating the need for multiple applications and saving valuable time.

The experimental data and user feedback gathered during the evaluation of CliniNet indicate its effectiveness in improving access to healthcare services and enhancing the overall healthcare experience for users. The application's user-friendly interface, seamless functionality, and integration of various healthcare services have contributed to its success. CliniNet addresses common issues faced by users, such as inadequate door-to-door medical facilities, medication non-adherence, and difficulties in accessing healthcare information.

B. Future Work

While CliniNet has demonstrated significant potential and positive outcomes, there are several areas for future improvement and development. One aspect to consider is the incorporation of additional healthcare services and features that are currently not covered by CliniNet. The future work could involve enhancing the security and privacy features of CliniNet to ensure the protection of sensitive user information and comply with data protection regulations. This could include implementing robust authentication mechanisms, secure data transmission protocols, and strict data access controls.Additionally, expanding the reach and user base of CliniNet would be a valuable future goal. This could involve marketing efforts to increase awareness of the application among the target audience, collaborating with healthcare institutions and professionals to promote its usage, and exploring partnerships with insurance providers and pharmaceutical companies to enhance the range of services available on the platform.

Continuous evaluation and improvement based on user feedback and changing healthcare trends is essential for the future development of CliniNet. Regular updates and enhancements to the application's features, user interface, and performance will ensure its relevance and competitiveness in the dynamic healthcare landscape. It can also involve the implementation of an admin interface for doctors and hospital staff within CliniNet. This would enable healthcare professionals to manage their appointments, access patient records, and communicate with patients more efficiently. An authentication system could be integrated to verify the authenticity of the practice licenses of healthcare providers, ensuring a secure and reliable healthcare ecosystem.

Overall, the future of CliniNet lies in continuous innovation, adaptability, and collaboration. By addressing the evolving needs of users, incorporating advanced technologies, and forging strategic partnerships, CliniNet can establish itself as a leading healthcare application that revolutionizes the way individuals access and manage their healthcare services.

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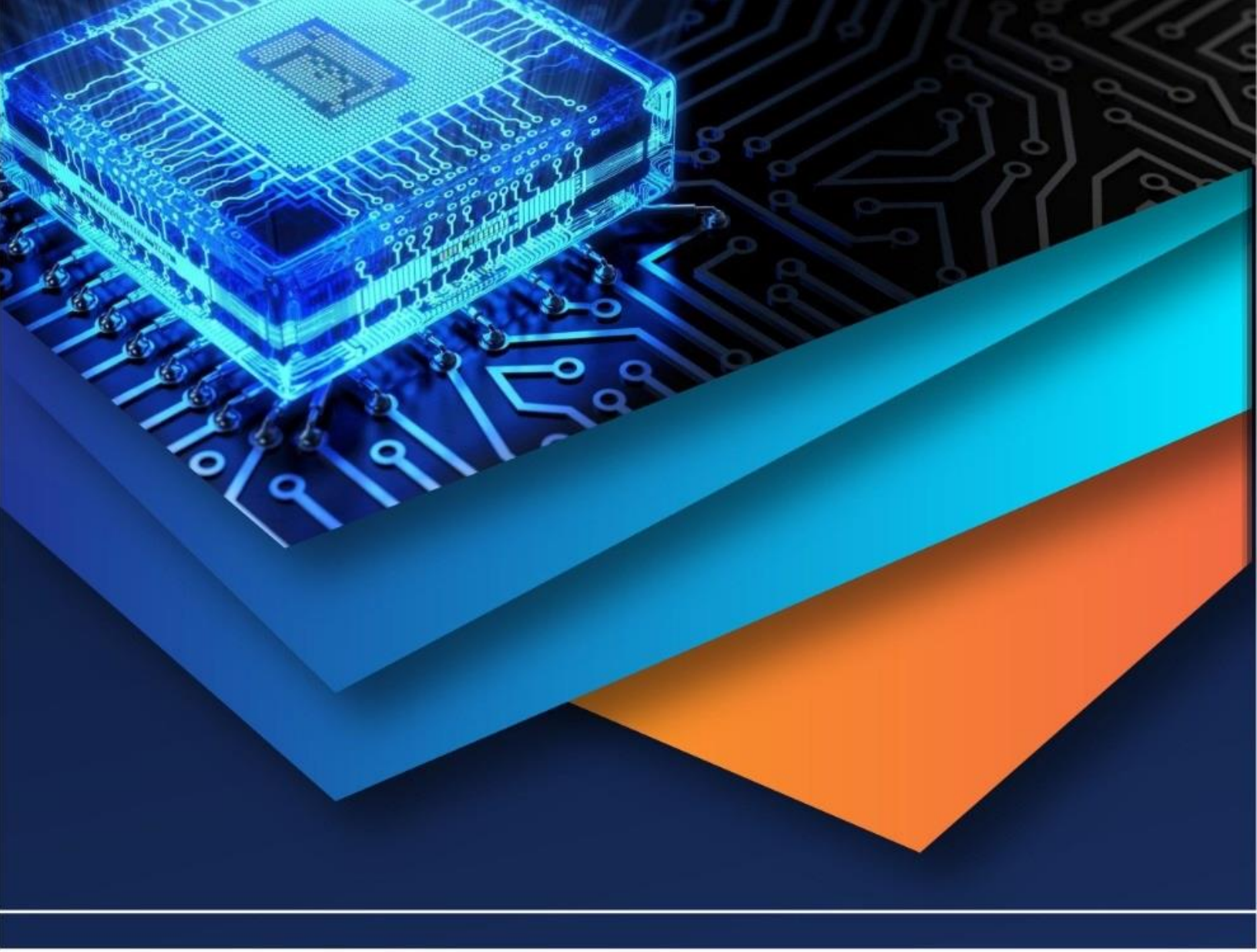

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