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PAPER

Helperly: An All-Inclusive Healthcare Application

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ABSTRACT

This work presents the development of a comprehensive healthcare app designed to improve early disease detection and enhance healthcare accessibility. The application integrates cutting-edge yet lightweight machine learning (ML) algorithms like Multinomial Naive Bayes and Decision Tree for symptom analysis and incorporates a range of innovative healthcare APIs like Edamam and Exercise API by Ninjas. Its primary objectives include empowering users with proactive health insights, facilitating timely medical assistance, and promoting overall well-being through personalised health recommendations. Key features of the app include accurate disease prediction through ML-driven symptom analysis, healthy recipe recommendations, customised exercise plans, and a conversational chatbot for diagnosis and treatment suggestions. By leveraging these functionalities, the app aims to enable users to take control of their health effectively, promoting paperless transactions via digital appointment and prescriptions. It also reduces physical visits to healthcare facilities, lowering carbon emissions associated with travel, which eventually paves the way to reduce environmental impact. The database integration via Firebase Auth offers data accessibility and security to data via services like encryption and Cloud Store. The intuitive navigation through the chatbot makes it approachable for users, including those who are less tech-savvy. Dark mode support aligns with sustainability goals by reducing eye strain and energy consumption. Thus, the work adheres to material design principles. With a user-centric approach, this app combines innovative ML-driven features and healthcare APIs to set a new standard in the digital health space, paving the way for advancements in early detection, personalised care, accessible healthcare services and long-term societal impact.

KEYWORDS

healthcare app, machine learning (ML) algorithms, symptom analysis, healthcare APIs, disease prediction

1 INTRODUCTION

In today's dynamic healthcare landscape [59, 75, 86], the demand for streamlined and accessible healthcare services continues to grow [34, 72]. In clinical settings, the major source of preventable harm is diagnostic error [35, 58, 88]. The 2015 report

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of the US National Academy of Medicine concluded that at least one diagnostic error occurs to most people in their lifetime [6]. Also, the traditional appointment system suffers from long wait times, lack of coordination and integration [74]. If it is an infectious disease, it is problematic if local authorities (e.g., New South Wales (NSW) Ministry of Health) still rely on manual paper forms and communicate via email or fax [5]. It may be susceptible to incomplete information or incorrect information [68]. Acknowledging the challenges posed by traditional appointment booking systems, the work introduces "Helperly," a versatile healthcare application aimed at revolutionising the way patients and healthcare providers interact. Drawing inspiration from industry trends and research, the work integrates cutting-edge technologies like machine learning (ML) and comprehensive healthcare APIs into an intuitive Android platform.

Recognising the limitations of conventional appointment booking processes, Helperly aims to redefine the healthcare experience by offering advanced features tailored to user needs. The current work uses ChatGPT in counselling and mental health education [10], [13, 49], [89]. For therapy process, mobile-based apps are much in progress [39], [57], [52, 71]. Aligning on similar work, the proposed work has leveraged ML for symptom analysis and disease prediction; the application empowers users to assess their health conditions and make informed decisions regarding their medical care. Additionally, Helperly provides functionalities like healthy recipe recommendations, personalised exercises, and a chatbot for diagnosis and treatment suggestions, enhancing user engagement and promoting proactive health management.

Through meticulous software development, ML modelling, and user interface design, Helperly seeks to address key pain points in the healthcare journey. By prioritising features like healthy recipe recommendations and personalised exercises, Helperly offers a comprehensive healthcare solution that meets the evolving needs of users. By combining innovative technology with a user-centric design philosophy, Helperly aims to make quality healthcare services more accessible and efficient for all users.

2 LITERATURE SURVEY

The Table 1 describes the vital properties covered by each paper referred by us. The eventual goal of the work is to maximise how many such properties can be covered in order to create a new innovative solution.

2.1 Literature summary

This paper by Ajayi et al. [9] explores the realm of medical appointment scheduling and consultation within the field of medicine. While previous research has predominantly focused on appointment booking, often limited to a specific doctor, this study aims to develop a real-time appointment scheduling system. In this system, patients can select a preferred time and date, and the system automatically assigns an available doctor. Additionally, it facilitates the rescheduling of appointments and integrates live online consultations between patients and doctors. The methodology involves object-oriented analysis and design, with implementation carried out through an Android application developed using Android Studio. Java serves as

the primary programming language for both the logic and frontend of the application, while PHP and MySQL are utilised for the backend. This research contributes significantly to medical practice by enabling patients to schedule appointments in real-time and facilitating seamless online interactions between patients and healthcare providers.

In this research [15], the proposed smart appointment booking system aims to streamline the process of scheduling doctor appointments online, alleviating the manual burden on healthcare staff. By providing a web-based platform, patients can conveniently view available booking slots, select preferred dates and times, and cancel appointments as needed. Additionally, the system includes a feature for doctors to track their monthly earnings, enhancing financial management efficiency. Utilising ASP.NET for the front end and SQL database for the back end, this work addresses the challenge of managing appointments according to user demands while offering a user-friendly solution for both patients and healthcare providers. In another interaction system presented, doctors and patients engage through an administered network, allowing seamless communication and consultation. Patients gain access to hospital server nodes, enabling interaction with doctors regarding symptoms and diagnosis. This system introduces a novel approach to appointment booking, allowing patients to schedule appointments online based on doctor availability and their own time constraints. Moreover, doctors can adjust their working hours dynamically based on patient volume, with notifications sent to patients regarding their approximate time of arrival. This innovative system eliminates the need for technician installation and provides flexibility in information customisation during installation, enhancing accessibility and usability for both patients and healthcare providers.

[21] The emergence of the Internet of Things (IoT) has led to its widespread application across various domains, including healthcare. In the realm of smart health, the management of appointments for patients and healthcare practitioners becomes paramount. With a rising number of patients seeking treatment annually, there's a growing need for efficient appointment management systems. Particularly in cases where continuous symptom monitoring is required, follow-up appointments are essential. While some hospitals currently utilise telephones or SMS for appointment reminders, this approach can be costly and prone to errors. This paper introduces an automated patient appointment reminder system through a cross-platform mobile application. Patients receive timely notifications before their scheduled appointments, offering the flexibility to easily postpone or cancel appointments as needed. Furthermore, both doctors and patients have the capability to track and manage appointments via the mobile application. The performance of the application is evaluated based on user satisfaction scores, emphasising the importance of user experience and feedback in assessing its effectiveness. This innovative solution leverages IoT technology to enhance appointment management efficiency, ultimately benefiting both patients and healthcare providers in ensuring smoother and more streamlined healthcare delivery.

The contemporary pace of life often makes it challenging for individuals to secure medical appointments in person, leading to a necessity for more convenient and efficient healthcare solutions [22]. This paper presents a solution aimed at providing ease and comfort to patients by simplifying the process of appointment scheduling with doctors, thereby addressing common issues encountered during appointment booking. The proposed system, named Mr Doc, utilises an Android application as a client interface, while a website serves as a server, maintaining a

database containing details of doctors, patients, and appointments. The literature review highlights existing research in this domain, showcasing various approaches to healthcare management and appointment scheduling. Intelligent agent-based appointment systems and Android applications for medication reminders are among the solutions discussed. Additionally, studies on online databases for patient monitoring and handheld healthcare devices are referenced, along with efficient algorithms for appointment scheduling and self-inspection. The proposed Online Hospital Management Application streamlines the appointment scheduling process through its Android platform. The system comprises two modules: one for patients and another for administrators. Patients can register, view hospital and doctor details, request appointments, receive notifications, and interact with healthcare providers. Meanwhile, administrators manage doctor and patient details, appointments, and clinic registration. The paper concludes by outlining the design interface, tools used and implementation details and provides screenshots of the system in action.

The paper by Oorsyahira Ismail et al. [40] introduces a medical appointment application designed to improve the efficiency of scheduling medical appointments for patients. The application includes features like appointment scheduling and reminders to enhance convenience for both patients and healthcare providers. The paper discusses the development process, features, and potential benefits of the application while also addressing challenges encountered during its implementation. Overall, the application presents a digital solution to streamline the medical appointment process, offering insights into its usability and effectiveness.

The paper by Putra et al. [63] presents a study on the application of natural language processing (NLP) for symptom identification in disease diagnosis. The authors developed an NLP system that utilises named entity recognition to identify digestive disease symptoms from electronic medical records, which are often plagued by improper grammar. 1. This research contributes to the clinical decision support (CDS) field by providing a method for early symptom identification, potentially improving disease control measures and preventing the spread of diseases. 2. The study also addresses the challenges of language processing in medical contexts, particularly when translating between Indonesian and English. The paper underscores the importance of accurate NLP pre-processing and the impact of dataset variety on the performance of NER models.

The work presented in [76] shows a prescriptive analytics framework designed to optimise outpatient appointment systems. It addresses the challenge of increasing demand for outpatient services and the concurrent issue of patient no-shows, which significantly impact provider productivity and healthcare costs. 1. The framework utilises ML algorithms to classify patients based on their likelihood of missing appointments and proposes scheduling rules that consider multiple design decisions. This approach aims to enhance patient satisfaction and resource utilisation, contributing to more personalised, patient-centred care.

The paper by Symey et al. [78] presents a critical analysis of the current patient appointment and registration processes within healthcare settings, identifying inherent inefficiencies and the repetitive nature of these procedures. In response, the paper proposes a novel system utilising Near Field Communication (NFC) technology in conjunction with an Android mobile application to streamline workflows, reduce waiting times, and enhance the overall patient experience. This innovative system is designed to overcome existing limitations by integrating features like prioritisation, enhanced security measures, and appointment reminder systems. Implementation involves the utilization of NFC hardware, Android SDK, PHP, and MySQL database

technologies, with the overarching goal of revolutionising hospital waiting times and medication collection processes. The paper by Trianna et al. [81] discusses a framework for selecting optimal neural network models tailored for mobile health applications, particularly focusing on intelligent disease diagnostics. Addressing the challenge of accurate disease detection in resource-constrained settings, the study develops a multi-model system capable of diagnosing multiple diseases concurrently. Employing evolutionary algorithms, the research evolves neural network architectures and evaluates their performance using publicly available medical datasets. Implemented on the Android Studio platform, the proposed mobile application showcases high accuracy and rapid detection times, presenting a promising tool for healthcare workers and patients in rural areas. This study contributes to the field by introducing a novel application for disease prediction and underscores the significance of early diagnosis and proactive health management in resource-limited environments.

The paper presented discusses the creation of a mobile application aimed at simplifying the process of scheduling doctor appointments. Authored by S. Usharani et al. [84], the study explores the integration of real-time patient choice in appointment systems, allowing patients to select consultation dates and times, while the system assigns an available doctor. Notably, the paper underscores the incorporation of live video appointments, which enhances the accessibility of medical consultations. Emphasising the importance of mobile applications in optimising time management across various sectors, particularly healthcare, the research delves into the impact of such applications on healthcare system efficiency. Leveraging the Android platform for application development due to its open-source nature and widespread usage, the paper highlights the system's capacity to furnish doctors with real-time patient health parameters, thus bolstering patient care through enhanced monitoring and prompt alerts in critical scenarios.

The work in [33] demonstrated the potential of mobile gamification in enhancing occupational health and safety education. Their study revealed that a gamified mobile application effectively improved students' understanding of workplace hazards and safety protocols. A study by [64] explored the integration of project-based learning (PjBL) and STEAM education in metal welding curricula. The researchers found that the PjBL-STEAM approach significantly improved students' cognitive, affective, and psychomotor skills compared to traditional teaching methods. [62] investigated the impact of virtual laboratory-based distance learning on students' performance in a Computer Numerical Control course. Their study demonstrated that the virtual laboratory was effective in improving students' cognitive abilities and practical skills, leading to significant gains in learning outcomes. Another study by [82] explored the use of augmented reality (AR) as an instructional media for engineering mechanics, where they found that AR-based learning media significantly improved students' understanding of basic concepts and skills and also supported independent learning and provided direct feedback. [48] investigated the economic impact of air pollution from fossil fuel power plants in Indonesia. Their study revealed that the externality costs, particularly those related to public health, were substantial and varied depending on the type and age of the power plant. A study by [56] examined the health index of the Anyer-Asahimas 150 kV overhead transmission line. The researchers found that the health index, which reflects the overall health status of the transmission line, was influenced by factors like asset condition, electrical safety, and environmental safety.

Further research has been conducted as well on healthcare applications. A growing number of studies have highlighted the potential of mobile health applications to transform healthcare delivery. [87] provide an overview of the various types of mobile health applications and their impact on clinical practice. Their study emphasises the need for further research to explore the benefits and challenges of mobile health technology. For example, apps like Medscape can provide up-to-date medical news and research, while apps like UpToDate can offer evidence-based clinical guidelines. [66] explored the potential of mobile health apps in transforming healthcare delivery. The study highlights the numerous benefits of mobile apps, including improved patient engagement, remote monitoring, and access to healthcare information, especially while highlighting the use cases during the COVID-19 pandemic. The research in [54] investigated the role of mobile health applications in modern healthcare. Their study demonstrated that mobile apps can enhance the efficiency and effectiveness of healthcare delivery by providing tools for time management, patient communication, and CDS. [51] proposed a mobile health application using Flutter to facilitate remote healthcare delivery. The application enables patients to consult with doctors online, order medications, and access emergency services, thereby improving healthcare accessibility rapidly. Another study by [38] proposed a mobile health application to facilitate healthcare access and management. The application offers a range of features, like hospital information, appointment booking, and health tips, to improve user experience and health outcomes. They introduce a cabin booking feature through which users can find a suitable hospital and request a cabin.

The study by [45] investigated the usability of healthcare mobile applications for elderly users and identified several design factors that can enhance the user experience. They conducted a usability evaluation based on a performance matrix and a subjective evaluation employing the system usability scale (SUS). By implementing strategies like providing assistance, increasing font size, and incorporating sound feedback, the researchers were able to significantly improve the usability of the application for elderly users. Another study by [25] proposed an e-healthcare mobile application to address the challenges of healthcare delivery in rural areas. The application, through its IoT-based m-Healthcare model framework, offers features like online appointment booking, electronic health record management, and remote patient monitoring, providing accessible and efficient healthcare services to rural populations. [79] investigated the sustainability of mHealth applications from the perspective of healthcare providers. Their study highlighted the importance of addressing contextual factors and involving healthcare professionals in the design, implementation, and evaluation of mHealth interventions. A growing body of research examines the factors that contribute to the successful adoption of mHealth technologies. [37] conducted a study to understand the perceptions of Malaysians towards mHealth. The study highlighted the importance of addressing perceived barriers and emphasising the benefits of mHealth to encourage user adoption. The research by [61] investigated the role of big data in transforming the healthcare industry. Their research demonstrates the potential of big data to enhance patient outcomes, optimise resource allocation, and accelerate medical discoveries. [24] investigated the impact of smartphone apps on dietary behaviour and weight management. Their research suggests that smartphone apps can be a valuable tool for promoting healthy eating and physical activity and improving health outcomes.

A growing number of studies explore the potential of AI-powered chatbots to transform healthcare delivery. [65] present a case study on the development and

implementation of an AI-powered healthcare chatbot. Their study highlights the potential of AI-powered chatbots to provide efficient and effective healthcare services, particularly in remote and underserved areas. A recent study by [85] proposed an AI-powered chatbot system to deliver healthcare services. The system leverages AI to provide users with information and guidance on a range of health-related issues, demonstrating the potential of AI to enhance healthcare delivery. [60] proposed an AI-powered healthcare chatbot to enhance healthcare accessibility. The chatbot leverages advanced language models, including Gemini, to provide users with accurate and informative responses to their health-related questions. [44] investigated the application of AI-powered chatbots in healthcare. Their research highlights the potential of chatbots to improve patient engagement, reduce healthcare costs, and enhance the overall patient experience.

The research by [16] developed a ML-based healthcare system to predict multiple diseases, including using a healthcare chatbot. The system utilises XGBoost to achieve high accuracy and efficiency in disease prediction. Another study by [17] presented a novel approach to symptom and skin disease diagnosis using a Streamlit-based application. The application leverages ML models to analyse user-provided symptoms and skin images, offering accurate and timely health assessments. Additional studies, like in [30], investigated the application of ML algorithms in disease prediction. Their study provides a comprehensive overview of the performance of different algorithms in predicting various diseases. [83] investigated the application of ML techniques in healthcare. Their study demonstrates the potential of ML to improve diagnostic accuracy, personalise treatment plans, and accelerate drug discovery. A growing number of studies examine the potential of APIs to transform healthcare. [26] conducted a study to identify various use cases for APIs in healthcare. Their study underscores the importance of APIs in improving patient care, research, and public health. [47] investigated the role of APIs in modernising healthcare delivery. Their research highlights the use of APIs to streamline medication management, facilitate access to urgent care, optimise benefits administration, and improve data interoperability. The study by [29] highlighted the challenges of interoperability in healthcare. The study emphasised the importance of APIs like SMART on FHIR in facilitating data exchange and improving patient care while also acknowledging the security risks associated with API usage.

A study by [36] explored the challenges and opportunities in healthcare appointment scheduling. The study highlighted the importance of IE/OR techniques in optimising appointment systems and improving patient access to care. Research conducted in [11] has a comprehensive review of existing literature to identify common vulnerabilities and threats. Their study underscores the importance of implementing robust security measures to protect sensitive patient data and ensure the integrity of healthcare systems.

Hemlata et al. [70] proposed the use of blockchain for empowering patient data, bringing its secure communication and data security. Sagnik [69] has proposed blockchain to secure patient data to increase transparency. Additionally, the system uses AES, RSA, EdDSA, and ECDSA techniques to authorise the users. But incorporating encryption techniques will slow the app. Ashish et al. [14] proposed blockchain and mobile technology to access medical domain-related information with a shared network. Blockchain [19, 43, 53] prevents loss of information; thus, it has significant potential for medical history. Similarly, AI can be used to analyse the continuous data to enable pre-emptive treatment decisions [77]. But AI usage needs rigorous vigilant management and ethical guidelines [55]. Saxena et al. [73] proposed the use

of AI and big data analytics in the domain of mobile health. The presence of disorganised and unstructured datasets can be processed by deep learning algorithms.

2.2 Analysis of research gap

Analysing the research presented in the provided papers, it's evident that there's a significant focus on developing various systems and applications to streamline the process of medical appointment scheduling and consultation. However, despite the abundance of research in this area, several research gaps and opportunities for further exploration emerge:

- Integration of real-time patient choice and doctor availability: While some studies, like the work by Ajayi et al. [9] and S. Usharani et al. [84], emphasise real-time appointment scheduling where patients can select preferred times, there's still room to explore how to better integrate this feature with the availability of doctors. Designing algorithms or frameworks that dynamically match patient preferences with doctor availability in real-time could enhance the efficiency and satisfaction of both patients and healthcare providers.
- Personalised appointment scheduling algorithms: Many existing systems focus on providing a general appointment scheduling interface, but there's potential to develop algorithms that personalise the scheduling process based on individual patient needs and historical data. This could involve considering factors like patient preferences, medical history, urgency of appointments, and doctor specialisation to optimise scheduling outcomes.
- Enhanced communication and interaction features: While some systems incorporate features for online consultations between patients and doctors, there's room to explore how to enhance the quality and effectiveness of these interactions. This could involve integrating additional communication tools, like secure messaging or video conferencing, and developing frameworks for efficient information exchange and decision-making during online consultations.
- Utilisation of emerging technologies: Although some papers explore the integration of IoT technology [21] and NFC technology [78] to enhance appointment management and patient experiences, further research could investigate the potential of other emerging technologies, like blockchain or artificial intelligence, in improving various aspects of medical appointment scheduling, consultation, and healthcare delivery.
- Accessibility and usability in resource-limited settings: Several papers address the challenge of healthcare accessibility, particularly in resource-constrained environments [81], [63]. However, there's a need for more research focused on designing and evaluating systems that are specifically tailored to the needs and constraints of these settings. This could involve considering factors like limited internet connectivity, low smartphone penetration, and cultural or linguistic diversity in healthcare delivery.

In conclusion, while existing research has made significant strides in developing systems for medical appointment scheduling and consultation, there are still several opportunities for further exploration and innovation. Future research efforts could focus on addressing the identified research gaps to advance the state-of-the-art in healthcare delivery systems and improve patient outcomes.

Through our application, we aim to address these critical research gaps in medical appointment scheduling and consultation systems, notably the lack of real-time patient choice and doctor availability integration, limited personalised appointment scheduling, and inadequate communication features. By incorporating ML-driven symptom analysis and disease prediction and leveraging innovative APIs for diverse features like nutrition and exercise recommendations, Helperly bridges these gaps. Specifically, it enhances scheduling efficiency and patient satisfaction, provides proactive health insights, streamlines healthcare provider workflows, and improves overall healthcare delivery.

3 OBJECTIVE

- Develop a user-centric system utilising ML algorithms for symptom analysis to predict diseases accurately.
- Train robust ML models on comprehensive datasets to empower users with proactive health insights.
- Leverage public and innovative APIs for implementing diverse features, from nutrition recommendations to exercise tips, to enhance user experience and promote proactive health management.
- Enhance healthcare accessibility and streamline the process of seeking medical assistance.
- Conduct rigorous testing and validation to evaluate the effectiveness of the integrated system.

Table 1. Comparison of research papers

Citations	Recipe for Diet	User Input	NLP	Disease Classification	Symptomatic Dataset	Location-Based Booking	Booking Facility
				List of Papers			
[22]	×	×	×	×	×	×	✓
[15]	×	✓	×	✓	✓	×	✓
[40]	×	✓	×	×	✓	✓	✓
[78]	×	✓	×	✓	✓	×	✓
[9]	✓	×	×	✓	✓	×	×
[84]	×	✓	×	✓	✓	×	✓
[63]	✓	✓	×	✓	×	×	×
[81]	×	✓	×	✓	✓	×	✓
[21]	×	✓	×	×	✓	✓	✓
[76]	×	✓	✓	✓	✓	×	✓
Helperly	✓	✓	✓	✓	✓	✓	✓

- Facilitate early disease detection and improve overall healthcare outcomes.
- Contribute to the advancement of digital health technologies.
- Create a scalable and user-friendly solution empowering individuals to take control of their health.

4 DESIGN AND METHODOLOGY

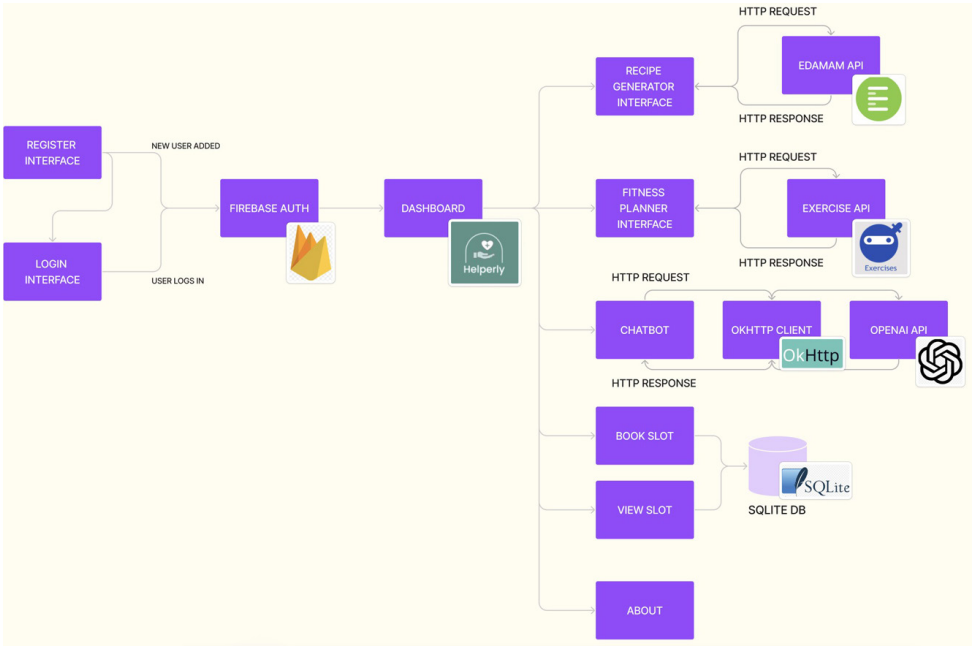

Fig. 1. Software architecture

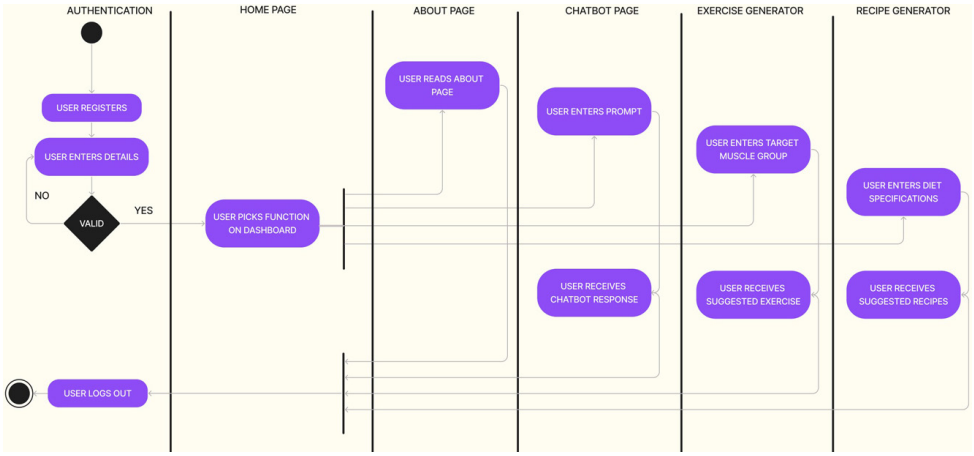

Fig. 2. Methodology

Table 2. Comparison with other APIs for nutrition and recommendation recipe

Feature	Edamam	Spoonacular	USDA FoodData Central	Nutritionix
Recipe Search	✓	✓	×	×
Nutrition Analysis	✓ (Detailed)	✓ (Limited)	✓ (Food only)	✓
Diet/Allergy Filters	✓	✓	×	✓
Ingredient Search	✓	✓	×	✓
Database Size	Very Large	Medium	Small (USDA foods)	Small
API Documentation	Excellent	Good	Average	Good
Custom Recipe Support	✓	×	×	✓

Table 3. Comparison with other exercise API

Feature	Exercise API (API-Ninjas)	Alternative APIs (e.g., ExerciseDB, RapidAPI)
Database Size	Large and well-curated	Varies by API, some may lack equipment or niche exercises.
Filtering Capabilities	Yes (muscle, equipment, difficulty)	Some offer filters but may be less comprehensive.
Ease of Integration	Simple RESTful API, JSON format	May require SDKs or more complex integrations.
Cost	Free tier available, affordable pricing	Many have higher costs or limited free tiers.
Response Speed	Fast and lightweight	Some APIs may have higher latency due to more detailed responses.
Documentation Quality	Excellent	Varies; some APIs have less clear documentation.
Customization	Highly customizable	Customization may be limited or harder to implement.

In our Android app development process, the process employed is using Android Studio with Kotlin and XML, harnessing the power of ML to enhance the user experience. The software architecture & design methodology of the proposed app is illustrated in Figure 1 and Figure 2 respectively. The app has tailored and customised ML algorithms to suit our specific healthcare use case, ensuring accurate symptom analysis and disease prediction functionalities. The proposed work has used the OpenAI API [8] to create the chat agent. For ranking of disease according to the disease labelled for given symptoms in the Disease-Symptom Knowledge Database [20], the chatbot has used ML algorithms like the Multinomial Naive Bayes and Decision Tree algorithms to predict the disease. OpenAPI GPT enhances NLP responses but relies on the database for core predictions. For hyperparameter tuning, the GridSearchCV technique is adopted to obtain accurate and reliable predictions. Other algorithms like KNN, SVM, and XGBoost can be integrated as part of future work. Moreover, the app's capabilities are enhanced by integrating external APIs to provide users with a diverse range of features. The knowledge database comprises disease-symptom associations generated from textual discharge summaries of patients at New York Presbyterian Hospital admitted during 2004. For suggesting doctors based on location, the dataset titled Doctor-Fee-Prediction (Practo) [7], which is a compilation of medical practitioners in India. This dataset was fed into the chatbot agent to look up and response to the user's query for a doctor based on location and the disease predicted by the symptom descriptions. A few fields of the dataset predominantly referred in the proposed work are the name of the doctor, location, city, and speciality.

For nutrition recommendations and recipe suggestions, it has been seamlessly integrated with the Edamam Recipe API [67]. This API offers a vast repository of recipes along with nutritional information, enabling users to make informed dietary choices and access a variety of healthy meal options tailored to their preferences. The rationale for selecting this versatile API is that it provides both recipe and nutrition analysis in detail. It also provides personalised meal planning by having various dietary and allergy filters. A comparison Table II is provided with other external APIs like Spoonacular [4], USDA FoodData Central [2], and Nutritionix [3]. If the focus is only on food recipes, USDA Food Data Central would support.

Additionally, to provide users with exercise tips and personalised workout recommendations, the Exercise API by APINinjas [28] is incorporated. This API offers

a comprehensive database of exercises, workout routines, and fitness tips curated by experts. By leveraging this API, the app empowers users to adopt healthy lifestyle practices and achieve their fitness goals effectively. The rationale for selecting this app is that it is a lightweight API without complex integrations. It can be integrated with AI-driven fitness agents. It provides filtering options like muscle, equipment, etc., compared to less comprehensive filters offered by other APIs like ExerciseDB [1] by RapidAPI. A comparison Table III is shown which highlights the rationale for selecting Excessive API by Ninjas.

Furthermore, the app features seamless appointment booking and viewing functionalities facilitated by SQLite database integration. This ensures efficient management of user appointments, enhancing the overall user experience and streamlining the healthcare service delivery process.

Through the integration of these external APIs, customisation of ML algorithms, and utilisation of SQLite database for appointment management, the app offers a comprehensive healthcare solution that addresses various aspects of user wellness. From symptom analysis and disease prediction to nutrition guidance, exercise recommendations, and appointment management, the app strives to provide users with comprehensive support for their health and well-being journey.

4.1 Software requirements (SR)

- Android Studio for Android application development, utilising Kotlin for coding and XML for UI design.
- Integration of external APIs like the Edamam Recipe API for nutrition recommendations and the Exercise API by API-Ninjas for exercise tips.
- Custom ML algorithms, tailored to the healthcare use case, for symptom analysis and disease prediction.
- SQLite for seamless integration of appointment booking and viewing functionalities, ensuring efficient management of user appointments.

5 CONTRIBUTION TOWARDS THE SOCIETY AND ENVIRONMENT

- Improved healthcare accessibility: The work contributes to society by enhancing healthcare accessibility through its user-centric approach. By enabling users to accurately predict diseases based on symptoms and localising nearby physicians, individuals gain easier access to medical assistance, especially in remote areas.
- Early disease detection: Through proactive symptom analysis using ML algorithms, the work facilitates early disease detection. Detecting diseases at an early stage not only improves treatment outcomes but also reduces healthcare costs and burdens on healthcare systems, benefiting both individuals and society at large.
- Reduced environmental impact: By streamlining the process of seeking medical assistance and facilitating timely intervention, the work potentially reduces unnecessary travel and resource consumption associated with healthcare visits. This leads to a reduced carbon footprint and contributes to environmental sustainability by minimising emissions from transportation.
- Empowerment through information: The work empowers individuals with valuable health information, enabling them to make informed decisions about their well-being. By understanding their health status and potential risks, users are better equipped to adopt preventive measures and engage in healthier lifestyle choices, ultimately promoting individual and societal well-being.

- Adoption in resource-limited settings: In today's digital age, access to the internet is vital for an individual to access information and participate in social forums [46]. But communities still face digital hindrance, causing social inequality and exclusion in the digital realm [50]. Addressing the digital divide via digital literacy [80] schemes like Indian Government-led Digital Literacy Training programs (DLTP) [23] emerge as a pivotal strategy to bridge the digital divide to empower marginalised communities. Such DLTP address the resource-limited settings like under-skilled personnel, lack of infrastructure [42], overburdened public services [41], and post-disaster regions. The internet connectivity in the Indian scenario rose over 52% in 2024 from 14% in 2014 [18]. The mobile users in rural India exceed the urban population [12]. Thus, the simple UI design of the chatbot of the proposed app helps even the less tech-savvy communities to utilise early disease detection, and get suggestions for dietary and exercise plans. Also, the use of multiple languages and locals helps the application to adopt to different cultural conventions of the user base.

5.1 Low-level design (LLD)

- Programming languages: Kotlin for Android application development, XML for UI layout.
- API integration: Utilise external APIs like the Edamam Recipe API for nutrition recommendations and the Exercise API by API-Ninjas for exercise tips, integrated into the Kotlin codebase.
- Database integration: SQLite for seamless integration of appointment booking and viewing functionalities, ensuring efficient management of user appointments.
- Authentication: Firebase Authentication for secure user authentication, integrated into the application's login and registration processes.
- Data encryption: Firebase services protect data in transit using HTTPS. It also has services like Firebase App Check [32], and Cloud Firestore [31] to protect data at rest. Also, it has a provision to provide access to personal data to employees or uses who can sign in with Google Sign-In and 2-factor authentication.

5.2 High-level design (HLD)

- Modular architecture: Implement a modular and scalable architecture for the application, facilitating easy maintenance and future enhancements.
- User interface design: Create an intuitive and user-friendly interface using XML layouts, with Kotlin code handling UI interactions and logic.
- API integration: Integrate external APIs like the Edamam Recipe API for nutrition recommendations and the Exercise API by API-Ninjas for exercise tips seamlessly into the application.
- Database integration: Utilise SQLite for seamless integration of appointment booking and viewing functionalities, ensuring efficient management of user appointments.
- Security and authentication: Implement Firebase Authentication for secure user authentication, ensuring user data privacy.

6 USE OF ADVANCED CONCEPTS

- Navigation components: Utilising the Navigation Architecture Component provided by Android Jetpack to implement a cohesive and intuitive navigation

flow within the application, ensuring smooth transitions between different screens and functionalities.

- Material design guidelines: Adhering to Google's Material Design principles to create a visually appealing and consistent user interface, which includes elements like cards, buttons, and typography that follow design guidelines for better usability.
- RecyclerView: Implementing RecyclerView to efficiently display large datasets or lists of items in the application, providing a smooth scrolling experience and optimising memory usage by recycling views.
- Fragment lifecycle management: Managing the lifecycle of fragments effectively, handling lifecycle events like onCreate(), onStart(), onStop(), etc., to ensure proper initialisation and cleanup of resources.
- Intents and intent filters: Using intents to facilitate communication between different components of the application, like launching activities, starting services, or broadcasting events, and defining intent filters to declare the types of intents that components can respond to.
- Shared preferences: Employing shared preferences to store and retrieve simple key-value pairs persistently, like user preferences or settings, providing a lightweight and simple way to manage application data.
- Error Handling and Logging: Implementing error handling mechanisms and logging frameworks like Logcat to capture and debug runtime errors, exceptions, or unexpected behaviour in the application during development and testing phases.
- Localization and internationalization: Supporting multiple languages and locales by externalizing strings and resources, allowing the application to adapt to different language preferences and cultural conventions for a wider user base.

7 RESULTS AND DISCUSSIONS

[see Figure 3] Illustrates the initial access points for users to register or log in to the Helperly app, ensuring secure access to personalised healthcare services. It provides an overview of key functionalities and options available to users upon accessing the Helperly app, facilitating easy navigation and access to various features. [see Figure 5] presents the user interface for interacting with the chatbot feature of Helperly, enabling users to input symptoms and receive prompt diagnosis and treatment suggestions. The about page offers insights into the purpose, features, and developers behind the Helperly app, fostering transparency and trust among users. [see Figure 4] allows users to schedule medical appointments conveniently through the Helperly app, ensuring timely access to healthcare services and efficient appointment management. [see Figure 4] provides users with an organised overview of their scheduled medical appointments, facilitating easy tracking and management of healthcare appointments for improved accessibility and convenience. [see Figure 6] displays a curated list of healthy recipe recommendations generated through the integration of the Edamam API, promoting nutritional awareness and wellness. [see Figure 6] showcases personalised exercise recommendations generated using the Exercise API, tailored to user preferences and health goals, fostering physical activity and well-being. [see Figure 5] demonstrates the chatbot's response interface, displaying the diagnosis and treatment suggestions provided based on user-entered symptoms, enhancing medical guidance and support.

The work has achieved the stated objectives, like early detection of disease through its integration with lightweight ML algorithms and recommendations for dietary and exercise plans based on your health conditions through efficient APIs like Edamam

and Exercise API by Ninjas. The app reduces physical visits and enables paperless transactions reducing environmental impact. The lightweight API integration, database integration, support for multiple languages and locale enables further adherence to material design principles and supports its adoption in resource-limited settings. Thus, the app provides a holistic approach for its user-friendly design, innovative ML for early disease detection, and recommendation plans in the digital health space. A qualitative analysis of the proposed app with other existing apps is shown in Table III-B, which highlights the key aspects achieved in the proposed app. As part of future work, blockchain can be integrated with the app to incorporate features like immutability and tamper resistance based on the feasibility of the scalability issue. An AI-based image detection would help infectious diseases like eye infections [27], enabling treatment without visiting hospitals. Also, support mechanisms for technical help, onboarding tutorials, and app features can be updated based on user feedback on usability.

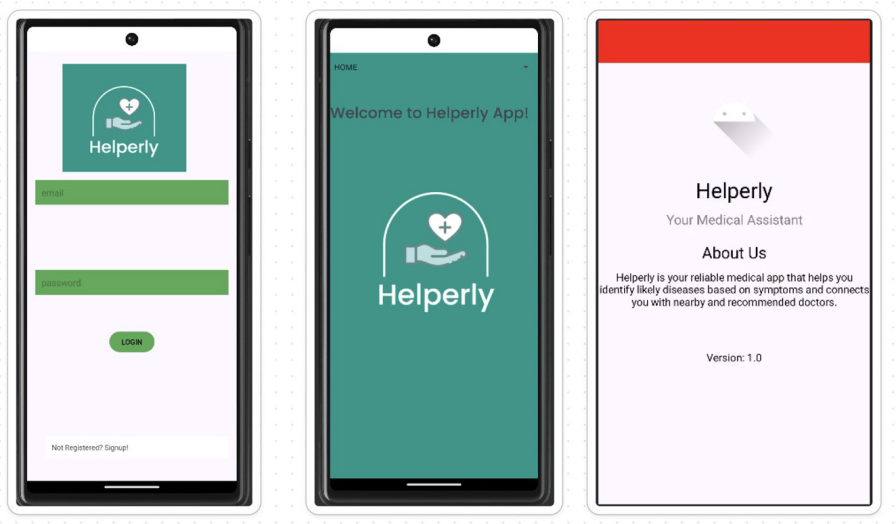

Fig. 3. Login and home dashboard

The user logs in successfully, reaches the home page and selects the about page, which contains details on the working of the app.

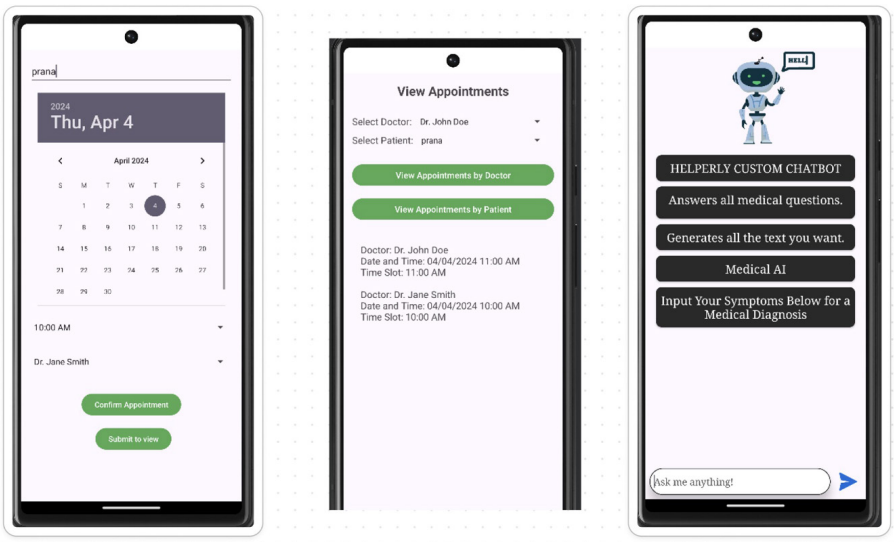

Fig. 4. Appointment booking and viewing, chatbot interface

The user books a slot with a specific time and date and views his appointment. User opens the main Chatbot user interface.

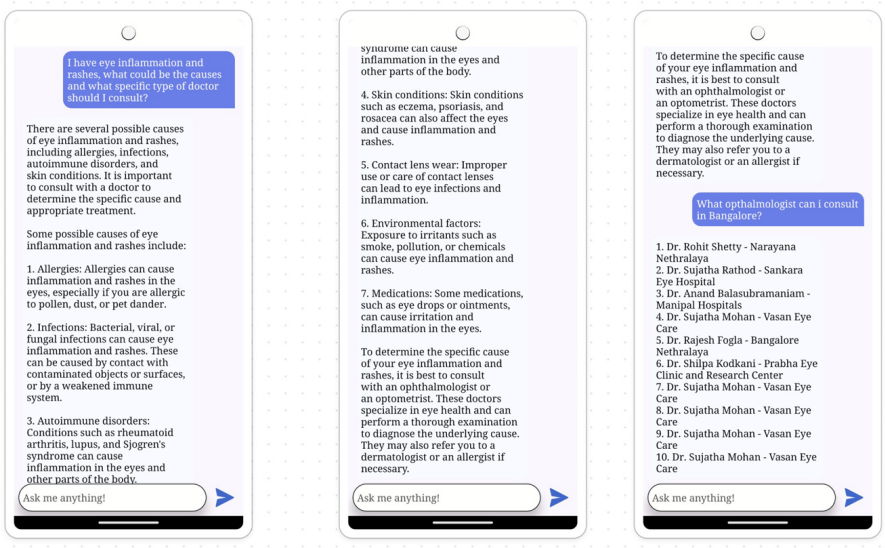

Fig. 5. Chatbot responses

The user describes his symptoms and receives treatment suggestions and contacts of doctors in his area.

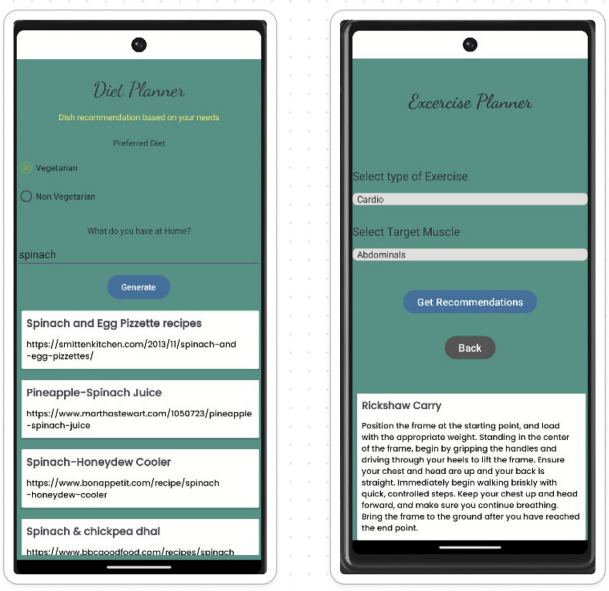

Fig. 6. Recipe generator and exercise planner

User with vegetarian diet receives recipe suggestions. The user receives exercise routines for his target muscle group.

8 CONCLUSION

In the rapidly evolving landscape of healthcare, the demand for more efficient and accessible services is constantly increasing. Traditional appointment booking

systems often come with challenges like sparse infrastructure, overburdened staff, under-skilled personnel, long waiting lines, lack of coordination, etc., Such challenges prompt the need for a modern solution, "Helperly" which is an innovative healthcare application designed to deal with these challenges and revolutionise the way patients and healthcare providers interact. As more individuals are digitally literate, the above challenges in resource-limited settings can better be addressed and tackled. The app enables paperless appointments, report storage, early detection of disease, and booking appointments with doctors irrespective of their locations.

Drawing inspiration from emerging industry trends and extensive research, Helperly integrates state-of-the-art technologies like ML and robust healthcare APIs into a user-friendly Android platform. By doing so, it aims to address the shortcomings of conventional appointment booking processes and introduce advanced features tailored to meet user needs.

Helperly's primary goal is to redefine the healthcare experience by offering a range of cutting-edge features. Leveraging ML algorithms for symptom analysis and disease prediction, the app empowers users to better understand their health conditions and make informed decisions about their medical care. Additionally, Helperly provides functionalities like healthy recipe recommendations, personalised exercise plans, and a chatbot for diagnosis and treatment suggestions. These features not only enhance user engagement but also promote proactive health management.

Through meticulous software development, ML modelling, and intuitive user interface design, Helperly endeavours to alleviate common pain points in the healthcare journey. By prioritising features that cater to individual wellness, like healthy recipe recommendations and personalised exercise plans, Helperly offers a comprehensive healthcare solution that adapts to the evolving needs of its users.

By combining innovative technology with a user-centric design philosophy, Helperly aims to democratise access to quality healthcare services, making them more efficient and accessible for all users there by ensuring adherence to material design principles. Blockchain features can be incorporated as future work to incorporate immutability of records. The app can be incorporated with AI-based image detection. It can further enhance and speed up the diagnosis of viral infection and help them to better contain them. Ultimately, Helperly strives to be a game-changer in the healthcare industry, ushering in a new era of streamlined and personalised healthcare experiences.

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