

Privacy Preserving Personalized Artificial Intelligence Based Healthcare Recommendation System

Sneha Adina, Department of Data Science, Jain Deemed-to-be University, Bengaluru, Karnataka India
jupg24mtech11452@jainuniversity.ac.in

Ajay Kumar Singh, Professor, Department of Computer Science and Engineering, Jain Deemed-to-be University, Bengaluru, Karnataka, India, ajay.k.singh@jainuniversity.ac.in

Abstract— The Privacy Preserving AI and Personalized Healthcare Recommendation System is a hi-tech platform to produce personalized health and wellness recommendations utilizing the Block chain technology and the Gemini AI. The system enables the user to enter information about age, gender, height, weight, medical history, medication, allergies, and level of activity, dietary preference, and personal goals. Gemini AI uses these inputs to intelligently create a weekly meal plan, a 5-day workout plan to be done at home, and lifestyle recommendations tailored to individuals, with the tips to sleep, stay hydrated, and manage stress. To maintain confidentiality of data, the whole system uses the privacy- preserving mechanism, which is based on Blockchain, and provides the decentralization of the data storage, security, and integrity, avoiding unauthorized access and manipulation. Such integration guarantees that the data about personal health is safely handled, and it will provide a high level of accuracy in AI-based recommendations. In general, the system facilitates a safe, personalized, and intelligent healthcare ecosystem that fills the technology-personal wellness management gap.

Keywords— Gemini AI, blockchain, Privacy preservation, personalized healthcare, diet plan, workout recommendation, medical data security, artificial intelligence, decentralized system, wellness analytics.

1. Introduction

Individualization of healthcare has emerged as one of the most important innovations in the current medical technology. Personalized Healthcare Recommendation System with Privacy Preserving AI combines the capabilities of Gemini AI and Blockchain to provide privacy preserving data-driven health recommendations. It gives the opportunity to register, create an account, and enter information regarding personal and medical background, including physical parameters, underlying conditions, drugs, and lifestyle habits. This information is fed into the AI engine to create individualized weekly diets, 5-day workout plans to do at home, and lifestyle suggestions that will enhance a balanced health condition.

The privacy and confidentiality of user information is one of the largest issues in Artificial Intelligence(AI)-driven healthcare. Conventional centralized systems are susceptible to hacking, manipulations and unauthorized access. To address this, the proposed system will use the Blockchain technology as a decentralized storage and verification method. The blockchain ensures the data of the users is encrypted, cannot be changed and can be accessed only by the certified entities.

The Gemini AI model takes a focal point as it examines the multi-dimensional information and customizes the suggestions in terms of medical experiences and user objectives. Its use in combination with Blockchain makes it more reliable and use of ethical data. The system gives not only a personal user, but also opens the opportunities to integrate with further healthcare systems, hospitals, and smart IoT devices. Through this project, therefore, a secure, intelligent, and transparent structure of digital healthcare transformation is set.

2. Objective

The main goal of the project is to develop and deploy a privacy- conscious AI-based healthcare recommendations engine to provide individual diet, fitness and wellness information. It will use Gemini AI to conduct intelligent analysis of user information and Blockchain technology to store and share sensitive medical data safely. The project aims at improving the access to healthcare, offering correct AI-generated recommendations and sustaining data confidentiality, transparency and integrity. It also aims at creating user trust by managing data in a decentralized way, which consequently contributes to creating a secure online setting to improve personal health and track wellness.

3. Motivation

As the demand increases in regards to the need to have a more personal approach to health, users are turning to systems with AI which are capable of advising them on the type of diet plans and fitness programs that would suit their conditions. Yet, the majority of available platforms trade off the privacy and transparency, exposing their users to the abuses of sensitive health data. The motivation behind this project is to create a safe, intelligent and privacy-sensitive healthcare recommendation system with the help of AI as a personalization tool and blockchain as a data

protection tool. It will provide people with trusted health information and make sure it is trustworthy, transparent and data ownership in a fast- digitizing healthcare environment.

4. Literature Survey

[1] S. Raj, K. Prasad, and D. Sharma, "The article is called AI-Driven Healthcare Prediction and Recommendation Systems", 2022. The paper explores the application of Artificial Intelligence (AI) and Machine Learning (ML) within the field of patient health data analysis and providing individual healthcare recommendations. The research is concerned with prediction models of chronic diseases like diabetes, hypertension, and obesity as well as using user specific attributes like age, gender, lifestyle choices and medical history. In this article, the authors prove that AI-based healthcare prediction increases early disease detection and personalized treatment strategies, as well as decreases the amount of manual diagnostic errors.

[2] The authors P. Gupta and R. Kaur, "The article is titled - Blockchain in Healthcare: Enhancing Security and Data Integrity", 2021. The authors indicate that the presented concept can improve the provision of security and data integrity within healthcare. The paper focuses on the use of blockchain technology in the security and decentralization of electronic medical records. The authors dwell on transparency, tamper- proof storage, and interoperability using distributed ledger technologies and smart contracts that would guarantee secure health data management. The results indicate that blockchain enhances patient trust, provides the immutability of health records storage, and reinforces the interoperability of digital healthcare systems.

[3] A. Kumar, T. Singh, and V. Jain in "Personalized Recommendations of Health Generative AI to provide", 2023, the study proposes that GPT and Gemini are examples of Generative AI models that have been mentioned in this article to design customized and personalized diets, exercises, and wellness systems. The article notes that generative models are flexible to the health outcomes of users in real-time, lifestyle interventions, and the adjustment of goals. The authors show that generative AI may be implemented to enhance the individualization, responsiveness, and attraction of people to health and wellness applications.

[4] R. Das and S. Banerjee, "Smart healthcare and AI/Blockchain Integration", 2022. The presented work suggests a hybrid model combining Artificial Intelligence in the analysis of the data with blockchain in storing the information in a secure and verifiable way. The novelty examined in the study is the area of real-time data validation, decentralized processing, and secure communication in healthcare networks. The findings have shown the enhancing system reliability, higher data security, and better transparency, which provide smart and credible healthcare decision-making.

[5] M. Li and X. Zhang, "IoT and AI to Continuous Health Monitoring", 2020. The authors discuss how the IoT wearable devices can help in gathering real-time health information like heart rate, glucose levels, sleep patterns, and exercise. They talk about the application of the AI-based algorithms to analyse such data to predict risks and intervene early. The research finds that the connection of AI and IoT allows implementing continuous, proactive health care through active monitoring and analysis of health changes in a patient.

[6] M. Ali, S. Khattak and L. Li, "The article is titled Blockchain-Enabled Secure Personal Health Records Management System", 2021. The paper presents a blockchain-based design of ensuring the security of personal medical records based on ensuring their immutability and verifiable access control. The system operates on the system of the distributed ledger technology preventing data tampering so that patients will be able to have the complete ownership and monitoring of their health history. Smart contracts provide access control between providers of healthcare. It is demonstrated through the study that blockchain can have a great positive impact on the integrity of data, transparency, and privacy of digital healthcare systems and minimizes the risks of unauthorized access and manipulation.

[7] N. Hassan, F. Omar and D. Patel, "The article titled Adaptive Health Coaching Systems Generation with Generative AI Models", 2023. In the article, the authors mention that the latest generation of generative AI models (GPT-4, Gemini, PaLM) can be applied to create individualized and adaptable wellness plans. It is concerned with how the LLMs comprehend the complex user health profiles and constantly re-generated proposals in the domain of diet, exercises, and wellness conducts as user changes. This is also confirmed by the paper, the generative AI provides more interesting, more context-sensitive, and adaptable recommendations than non-context-sensitive designs generated by specialists, which results in the increased personalization and user incentives.

5. Related Work

The suggested system introduces an AI platform of privacy- sensitive nature that is grounded on Blockchain and ensures data confidentiality besides providing a personalized healthcare guidance. The users create a safe account, fill their medical and lifestyle data and receive AI-based diet and exercise recommendations, depending on their health issues. Gemini AI ensures that the recommendations become dynamic, accurate, and goal-oriented, whereas Blockchain provides decent polluted storage of sensitive data that cannot be manipulated. The system is patient-

centred and privacy, transparency, and trust are valued, hence making people assured that they have taken the control of their health experience.

The flow chart given below, is the user experience of the Privacy Preserving AI and Personalized Healthcare Recommendation System. It begins with the page of Home, on which they can either Register or Login. Once the users have logged in, they are asked to provide personal details which include Age, Gender, Height, and Weight then proceed with Medical Conditions, Medications, Allergies and Activity Level, Diet Preferences and Personal Goals. Moreover, the users give the Time to work out and prepare the diet. After all the data is filled in, this information is processed by the system to Give an Output, which will be a Weekly Diet Plan, 5-Day Home Workout Plan, and Lifestyle tips on how to sleep better, hydrate and manage stress. The system is privacy guaranteed by blockchain technology, and offers a personalized health and wellness management experience. The system workflow is illustrated in Figure 1.

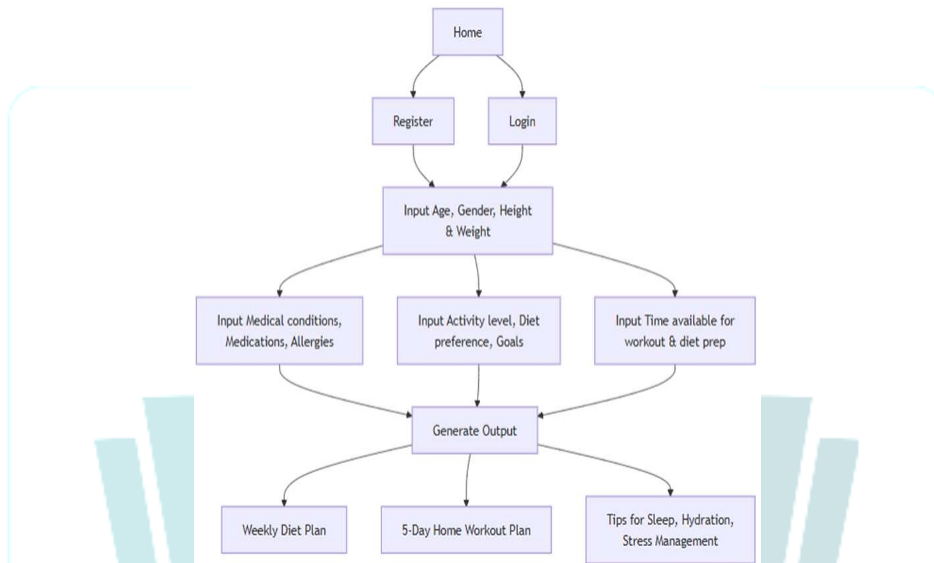


Figure 1: Block diagram for proposed system

6. Methodology

The proposed research approach combines a safe and smart pipeline of creating personalized medical advice. The frontend gathers vital demographic, medical, and lifestyle data of users, and forwards the data to the Django backend. The backend authenticates and validates the inputs, builds an optimized prompt and communicates with Gemini AI to produce structured personalized diet, workout, and wellness recommendations. The stored data in the form of relational database are the parsed AI outputs whereas the hashed form of the recommendation data is safely written in the blockchain in order to guarantee immutability, transparency and tamper proof record keeping. The completed individual plans are translated into a contemporary dashboard with the help of which the customer can see, download, or edit his or her suggestions. The approach will provide an all-encompassing, privacy-sensitive, and smart healthcare guidance system by integrating AI-based personalization and blockchain-based security.

The architecture of the AI-Powered Personalized Healthcare and Wellness System with the assistance of Blockchain and Generative AI is that of a multi-layered, privacy-sensitive architecture which integrates the Frontend and Backend elements, AI Processing and a Secure Storage into a workflow. At the user layer, an individual will be subjected to the system on a web or mobile platform whereby one can create an account, log in and provide the necessary health details such as age, gender, height, weight, medical conditions, medications and allergies, activity level and personal targets.

This data is delivered securely to the backend that is, Django based over HTTPS with encrypted requests. The application layer includes the backend that does validation, preprocessing and request orchestration and sends the refined user data to the Generative AI component (Gemini). Gemini is a dynamically composed and curated JSON data that contains a personalized weekly diet, a 5-day exercise plan, as well as stress, sleep and hydration wellness recommendations. Upon finding the output of the AI, the master records are then stored in a relational database that is easily accessible. At the same time, the hashed photo of the developed plan is encrypted and dispatched to the blockchain network to ensure the impossibility, safety and resistant storage. This authentication blockchain layer will make sure that the sensitive health information of the user is authentic and in no way can be altered. The final

outputs of the AI are displayed on the user dashboard in a systematic, easy to follow format of the diet, exercise programs, and health information.

A. **Modules and its Implementation**

User Module:

- **Register** - The user would register using name, email, and password.
- **Login** – The user would be able to securely log into the system with the help of a username and a password.
- **Health profile**- The user can input health information such as age, gender, weight, height, medications, goals, medical conditions.
- **View Diet plan** – The user can access the diet plan.
- **View workout plan**- The user also has the option to view workout plan.
- **View wellness plan**- The user can access wellness plan.
- **Logout**- The user securely logs out of the system.

7. **Discussion and Results**

Home Page: Health AI offers customized nutrition, fitness and wellness plans that are delivered through advanced AI, and the health data is stored safely on block chain technology. Become the healthier, more comfortable person you are with all the privacy.

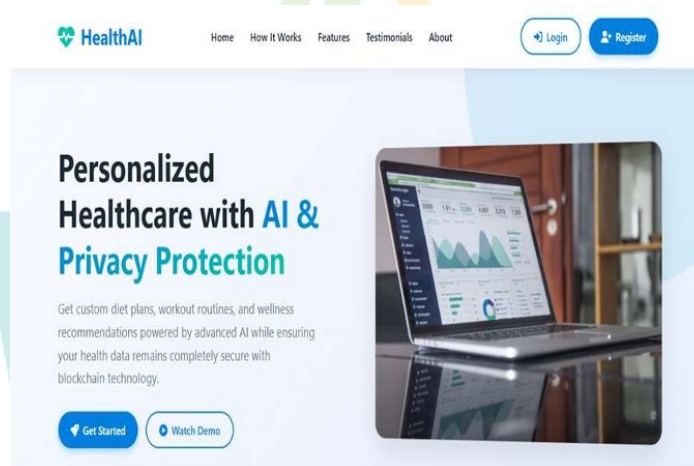


Figure 2. Health AI Home Page

Signup Page: Create an account and input your details and start your personalized healthcare process using AI-based suggestions and complete privacy.

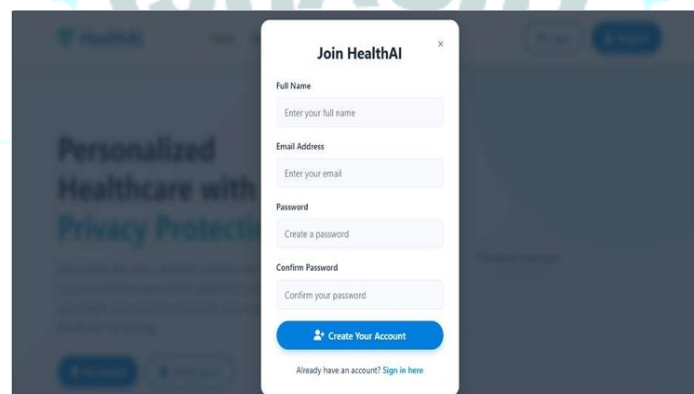


Figure 3: User Registration Portal

Login Page: Use your personalized healthcare plans and AI-centred recommendations on what to do to stay healthy with full privacy protection.

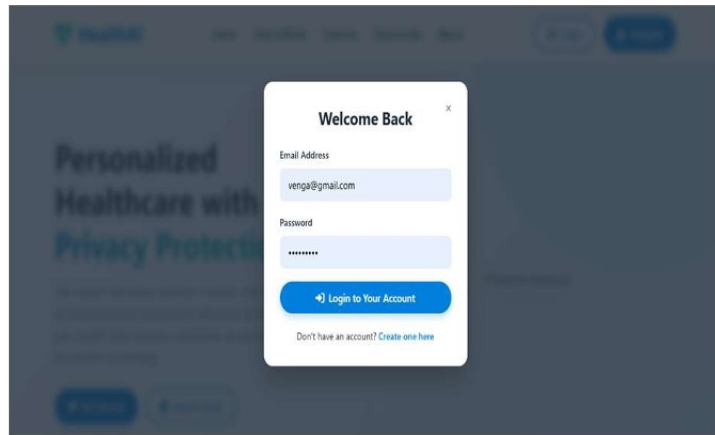


Figure 4: Health AI Login Page

Health profile page: Enter some of your health details and get personal recommendations in diet, work out plan and wellness plan generated by Gemini AI.

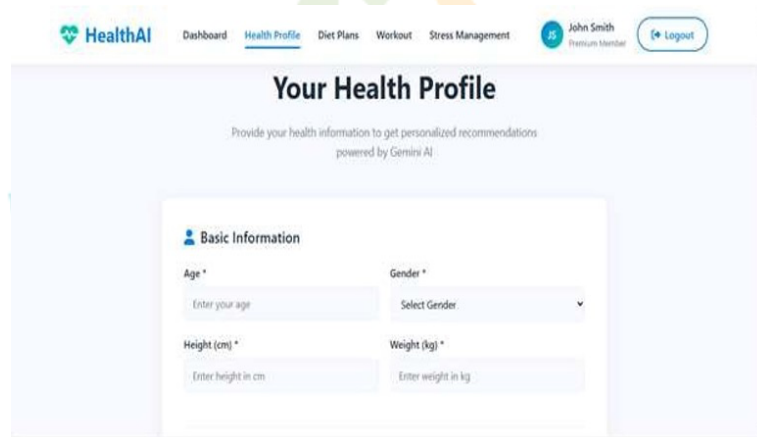


Figure 5: User Health profile page

Personalized Diet Plan: The diet program will focus on balanced foods, which contain whole grains, lean proteins, and healthy fats as the best source of nutrition. It entails particular food options and hints on why you may prefer healthier snacks as a way of ensuring healthy living.

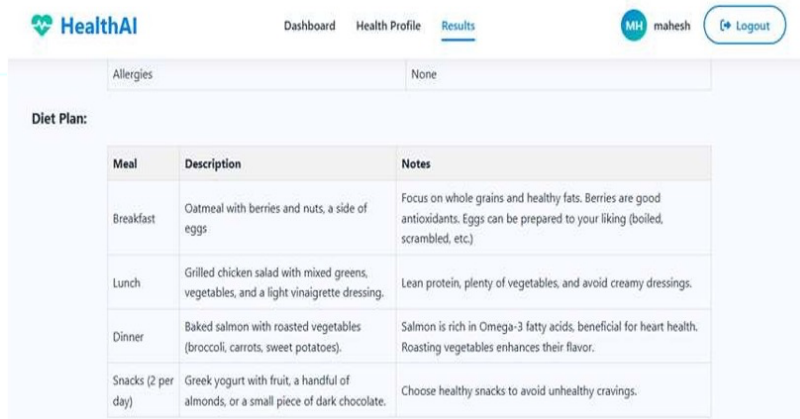


Figure 6: Personalized Diet Plan

Personalized Workout Plan: The physical training program involves various activities in each day, and it is based on various factors, including strength, flexibility, and cardiovascular fitness. Notes are given with each activity to determine the speed and intensity of activities that are most beneficial concerning health.

Day	Activity	Duration	Notes
Monday	Brisk Walking / Jogging	60 minutes	Maintain a steady pace. Monitor blood pressure before and after if possible.
Tuesday	Strength Training (full body)	45 minutes	Focus on compound exercises: squats, push-ups, rows, overhead press. Use light weights.
Wednesday	Yoga / Stretching	60 minutes	Focus on flexibility and relaxation. Good for stress management.
Thursday	Cycling	60 minutes	Moderate intensity. Maintain a comfortable pace.
Friday	Strength Training (full body)	45 minutes	Focus on compound exercises: squats, push-ups, rows, overhead press. Use light weights.
Saturday	Swimming	60 minutes	A low-impact workout great for cardiovascular health and stress relief.

Figure 7: Personalized Workout Plan

View File Request: The stress reduction practices such as mindful meditation and deep breathing exercises are also included in the wellness tips. It also focuses on the need to have a balanced way of life, to have enough sleep, to stay hydrated, and to have social interactions in order to maintain good well-being.

Tip	Description
Mindfulness Meditation	Practice daily mindfulness meditation for 10-15 minutes to reduce stress and improve focus.
Deep Breathing Exercises	Incorporate deep breathing exercises throughout the day to lower blood pressure and promote relaxation.
Adequate Sleep	Aim for 7-8 hours of quality sleep each night. Establish a regular sleep schedule.
Limit Caffeine and Alcohol	Reduce your intake of caffeine and alcohol, as they can worsen hypertension.
Social Connection	Make time for social interaction with friends and family. Social support is important for stress management.
Monitor Blood Pressure Regularly	Regularly monitor your blood pressure and keep a log to share with your doctor.
Stay Hydrated	Drink plenty of water throughout the day to support overall health.

Figure 8: View File Request

8. Conclusion

In conclusion, the system has a long consumer-friendly interface, which utilizes smart AI, such as Gemini AI, to give personalized health directions. The blockchain technology offers privacy, transparency, and integrity of the data by ensuring the safety of the user data. The user experience is made easy and the customization of the platform into their own diet cooking plans, workout routines and health tips, enables the customer to have control over their health and well-being. The system can be optimized further to include telemedicine and predictive health analytics to become a complete system and manage and improve health outcomes because it will be further improved by adding real-time health tracking. Ultimately, this platform will be beneficial to the local community since it will produce a more informed and healthier community with secure and tailored online health management.

9. Future Scope

The system can be expanded in the future and have a few additional features added to it to make the process user-friendly and provide more opportunities. One of the potential additions will be the introduction of real-time health monitoring with the help of wearable gadgets that will enable users to directly add the information about the heartbeat rate, activity levels, and sleep patterns to the service to gain the more personalized and precise analysis of the user health. Moreover, the system might include machine learning algorithms to anticipate possible health problems with the history by offering preventive health notifications and suggestions.

The interactive dashboard to the user interface could be also improved, which would enable the user to monitor their progress towards their fitness goals through visual charts and analytics. Social-like functionality, e.g. the functionality to add friends, or health coaches, can encourage accountability and social support. The other potential improvement is the addition of telemedicine services, where a user should seek medical advice or checkup with healthcare professionals. This would be of great help especially to the users who have chronic diseases and require continuous checking.

Lastly, increasing privacy and security functions by adding new advanced encryption methods and multi-factor authentication would provide the guarantees that the data of the user is secured to the utmost level, which will create the sense of trust and increase the level of engagement. One more way that blockchain technology may be used is the safe transmission of health information to authorized third parties, which would give users greater control over their health data.

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