Automation, Control and Intelligent Systems
2024; Vol. 12, No. 4, pp. 114-124
https://doi.org/10.11648/j.acis.20241204.13

Research Article

Heart Health Detector GPT Based on GPT-4o Model

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Abstract

The Heart Health Detector paper leverages advancements in artificial intelligence and machine learning to provide an accessible and user-friendly tool for monitoring and managing heart health. This innovative technology has the potential to revolutionize preventive healthcare by empowering individuals to take control of their cardiovascular well-being. By making heart health monitoring more accessible and user-friendly, the Heart Health Detector could lead to earlier detection of cardiac issues and improved patient outcomes. Furthermore, this tool may help reduce the burden on healthcare systems by promoting proactive heart health management and potentially decreasing the incidence of severe cardiac events. Cardiovascular diseases are a leading cause of death globally, and their early detection and management can significantly reduce risks and improve outcomes. This study bridges the gap between complex medical data and user-friendly health monitoring through a web application that offers personalized health insights, proactive heart health management, and simplified user experiences. It ensures data privacy and security, and encourages preventive health measures. The application uses GPT-4 to analyze user-provided health data using data analysis on two data files: a) hospital file and b) heart file, delivering personalized recommendations. It empowers users to take proactive steps toward optimizing their cardiovascular well-being, democratizing access to heart health information, and contributing to the prevention and management of heart diseases on a broader scale. The development involved meticulous conceptualization, data acquisition, model training, and validation, resulting in a sophisticated yet user-friendly platform that integrates advanced AI algorithms to analyze health metrics and provide actionable insights and recommendations. While artificial intelligence and machine learning offer promising opportunities for developing user-friendly heart health monitoring tools, they also present significant challenges in terms of data privacy, security, and the effective integration of complex medical information into accessible applications. The Heart Health Detector aims to bridge this gap by providing personalized insights and recommendations, yet it must carefully balance sophisticated AI algorithms with user-friendliness to ensure widespread adoption and impact. Although such tools have the potential to democratize access to heart health information and promote preventive measures, their limitations and challenges must be carefully considered to maximize their effectiveness and reliability in real-world healthcare settings.

Keywords

Heart Health Detector, Custom GPT Using ChatGpt, Early Diagnosis, Geolocation, Data Analysis

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Received: 2 December 2024; **Accepted:** 12 December 2024; **Published:** 30 December 2024

1. Heart Health Detector GPT

The primary idea behind the Heart Health Detector project is to leverage the advancements in artificial intelligence and machine learning to provide individuals with a simple, accessible, and effective tool for monitoring and managing their heart health. Cardiovascular diseases are among the leading causes of death globally, and early detection and management can significantly reduce the risk and improve outcomes. This paper aims to bridge the gap between complex medical data and user-friendly health monitoring through the following key concepts:

a) Accessibility to Advanced Health Monitoring

Traditional heart health monitoring often requires regular visits to healthcare facilities and the use of specialized medical equipment, which can be inconvenient and costly for many individuals. The Heart Health Detector aims to bring advanced heart health monitoring to the fingertips of users, allowing them to access personalized health insights anytime and anywhere through a web application.

b) Personalized Health Insights

Each individual's health profile is unique, and personalized health insights are crucial for effective monitoring and management. The Heart Health Detector uses the power of GPT-4 to analyze user-provided health data and deliver personalized recommendations and insights. This personalized approach helps users understand their specific risk factors and take proactive steps to maintain or improve their heart health.

c) Proactive Heart Health Management

The paper explains to empower users with the information they need to manage their heart health proactively. By asking a series of questions related to their health, lifestyle, and symptoms, the application gathers essential data to evaluate their heart health. Users receive tailored advice and recommendations that can help them make informed decisions about their lifestyle and health practices.

d) Simplified User Experience

Understanding and managing heart health can be daunting for many people due to the complexity of medical terminology and data. The Heart Health Detector simplifies this process by providing a conversational interface that guides users through the data input process and delivers insights in an easy-to-understand manner. This user-friendly approach ensures that even those with limited medical knowledge can benefit from the application.

e) Data Privacy and Security

Health data is highly sensitive, and ensuring its privacy and security is paramount. The Heart Health Detector paper incorporates robust security measures, including data encryption and multi-factor authentication, to protect user data. By adhering to HIPAA regulations, the paper ensures that users' health information is handled with the utmost care and confidentiality.

f) Encouraging Preventive Health Measures

Prevention is better than cure, especially when it comes to heart health. The Heart Health Detector encourages users to adopt preventive health measures by providing actionable insights and recommendations. By identifying potential risks early, users can take steps to mitigate these risks, leading to better long-term health outcomes.

In summary, the idea behind the Heart Health Detector paper is to harness the capabilities of AI and machine learning to provide a comprehensive, user-friendly, and secure platform for heart health monitoring. By making advanced health insights accessible and understandable, the paper aims to empower individuals to take control of their heart health and improve their overall well-being.

1.1. Background and Motivation

Heart diseases remain a significant public health concern globally, posing a considerable burden on healthcare systems and individuals alike. Early detection and management of risk factors such as hypertension, high cholesterol, obesity, and diabetes [1] are crucial in mitigating the impact of heart diseases and improving patient outcomes. However, many individuals lack access to convenient and affordable health monitoring solutions tailored to their specific needs. The Heart Health Detector paper addresses this challenge by harnessing artificial intelligence (AI) and machine learning to develop a sophisticated yet user-friendly web application. This platform empowers users to monitor their heart health in real-time, facilitating proactive steps towards optimizing cardiovascular well-being. By delivering personalized health insights and recommendations directly to users' fingertips, the paper aims to democratize access to heart health information and contribute to the prevention and management of heart diseases on a broader scale.

Early detection of cardiovascular risk factors such as hypertension, high cholesterol, obesity, and diabetes is crucial in reducing the risk of developing heart diseases and associated complications. Despite the proven benefits of early intervention, many individuals remain unaware of their risk factors or lack access to convenient and affordable health monitoring solutions. This knowledge gap underscores the critical need for accessible and user-friendly platforms that empower individuals to effectively monitor and manage their heart health.

The motivation behind the Heart Health Detector paper is to address the aforementioned challenges and empower individuals with the necessary tools to prioritize their cardiovascular health. By harnessing the capabilities of artificial intelligence (AI) and machine learning, the paper aims to develop a sophisticated yet user-friendly web application that enables users to monitor their heart health in real-time, conveniently from the comfort of their homes.

Traditional methods of heart health monitoring often involve periodic visits to healthcare professionals or specialized medical facilities, which can be inconvenient,

time-consuming, and cost-prohibitive for many individuals. The Heart Health Detector paper seeks to bridge this gap by leveraging cutting-edge technology to deliver personalized health insights and recommendations directly to users' fingertips. By providing an intuitive and accessible platform for heart health monitoring, the paper aims to empower individuals to take proactive steps towards optimizing their cardiovascular well-being [2].

1.2. Introduction

A clinical heart health detector, powered by artificial intelligence such as GPT (Generative Pre-trained Transformer), represents a significant advancement in cardiology and healthcare technology. This virtual assistant is designed to support healthcare professionals by providing rapid, data-driven insights for diagnosing, treating, and managing heart-related conditions.

The heart health assistant utilizes extensive medical data [3], including research articles, patient records, and clinical guidelines, to offer tailored advice and support. It can analyze symptoms, suggest potential diagnoses, and recommend treatment plans based on current medical standards and personalized patient data by using data analysis on two data files a)hospital file and b)heart file. Additionally, it assists in monitoring patient progress, flagging potential complications, and providing ongoing patient education on heart health management.

In clinical settings, such a tool enhances the capabilities of cardiologists and other healthcare providers by enabling quick access to a vast amount of medical knowledge, streamlined data analysis, and patient management. This not only improves the efficiency of healthcare delivery but also aims to increase the accuracy of heart disease diagnosis and the effectiveness of treatments, ultimately leading to better patient outcomes.

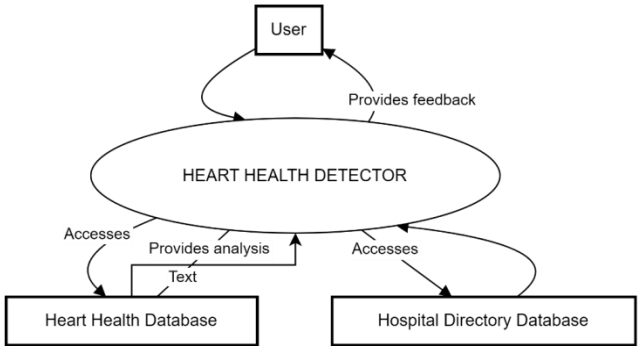

Figure 1. *DFD0 of heart health detector.*

1.3. Goals and Scope

The objectives and scope of the Heart Health Detector web application as shown in figure 1, which operates primarily through direct conversation, are as follows:

Conversational Data Input [4]: Users interact with the application directly through conversation, providing health metrics, symptoms, and lifestyle information related to their heart health.

AI-Powered Data Analysis: The application utilizes advanced AI algorithms, powered by GPT-4, to analyze the data collected from user conversations. This analysis enables the application to assess the user's heart health status and identify potential issues or risks [5, 6].

Result Reporting and Recommendations: Based on the analysis conducted, the application generates detailed reports on the user's heart health metrics and provides personalized recommendations for maintaining or improving heart health.

User Engagement and Feedback: The application fosters user engagement by providing a conversational interface that encourages active participation and feedback from users. Users can ask questions, seek clarification, or provide additional information as needed.

Continuous Monitoring and Updates: The application supports continuous monitoring of heart health by allowing users to engage in ongoing conversations to track changes in their health status over time. Users can revisit previous conversations to review recommendations and track progress.

Privacy and Confidentiality: The application prioritizes user privacy and confidentiality by ensuring that all user conversations and data are securely stored and processed. User data is encrypted both in transit and at rest to protect sensitive information.

In conclusion, key features of heart health detector GPT [7] are:

(1) Evaluate user-provided health parameters: users will be able to input various health metrices such as blood pressure, cholesterol levels, heart rate etc.
(2) Identify potential heart issues: using medical algorithm and guidelines, it accesses the risk of heart related problems like chances of heart attack based on the provided data as in file heart file.
(3) Provide guidance on next steps: Offers advice on further actions such as life style changes, medical consultations, or emergency actions if critical issues are detected.
(4) Suggest nearby hospitals: In case of high risk, it can recommend nearby hospitals for immediate evaluation.
(5) Data processing: capable of processing user-uploaded CSV files containing health metrics and hospital data.
(6) Visualization: Can generate visual representation of health data for better understanding.
(7) Interactive responses: Engaged with user to refine data input and provide tailored advice.
(8) Geolocation Services: Uses location data to suggest nearby hospitals.

2. Capabilities of Heart Health Detector GPT

The final working of heart health detector custom GPT is divided into following stages [8-10].

2.1. Input Data Handling

The system accepts user inputs through two primary methods:

(1) Direct Input: Users can manually input their health parameters.

(2) File Upload: Users can upload CSV files containing their health data.

Example Code Snippet:

```
import pandas as pd
def load_user_data(file_path):
data = pd.read_csv(file_path)
return data
# Sample usage
user_data = load_user_data('/mnt/data/heart.csv')
```

2.2. Data Analysis

The system processes the input data using medical guidelines and algorithms to analyze the health parameters.

```
def analyze_health_data(data):
results = {}
if 'blood_pressure' in data.columns:
bp = data['blood_pressure'].iloc[0]
systolic, diastolic = map(int, bp.split('/'))
if systolic > 130 or diastolic > 80:
results['blood_pressure'] = 'Hypertension risk'
else:
results['blood_pressure'] = 'Normal'
if 'cholesterol' in data.columns:
cholesterol = data['cholesterol'].iloc[0]
if cholesterol > 200:
results['cholesterol'] = 'High cholesterol risk'
else:
results['cholesterol'] = 'Normal'
return results
# Sample usage
analysis_results = analyze_health_data(user_data)
```

2.3. Risk Assessment

The system evaluates the analyzed data to assess the risk of heart-related issues.

Example Risk Assessment Code:

```
def assess_risk(analysis_results):
risk_level = 'Low'
if 'Hypertension risk' in analysis_results.values() or 'High cholesterol risk' in analysis_results.values():
risk_level = 'High'
return risk_level
# Sample usage
risk_level = assess_risk(analysis_results)
```

User Guidance and Recommendations Based on the risk assessment, the system provides guidance and recommendations for the next steps.

Example Recommendations Code:

```
def provide_recommendations(risk_level):
recommendations = []
if risk_level == 'High':
recommendations.append('Consult with a healthcare provider.')
recommendations.append('Consider lifestyle changes such as a healthier diet and regular exercise.')
else:
recommendations.append('Maintain a healthy lifestyle and regular check-ups.')
return recommendations
# Sample usage
recommendations = provide_recommendations(risk_level)
```

2.4. Hospital Directory Integration Example Hospital Directory Code

The system uses a database of hospitals to suggest nearby facilities for further evaluation.

```
def load_hospital_data(file_path):
hospitals = pd.read_csv(file_path)
return hospitals
def suggest_nearby_hospitals(user_location, hospitals):
# Assuming hospitals DataFrame has columns 'name', 'address', 'distance'
nearby_hospitals = hospitals.sort_values(by='distance').head(5)
return nearby_hospitals
# Sample usage
hospitals_data = load_hospital_data('/mnt/data/hospital_directory.csv')
nearby_hospitals = suggest_nearby_hospitals(user_location='User Location', hospitals=hospitals_data)
```

2.5. Response Generation

Finally, the system generates a detailed response incorporating the analysis, risk assessment, recommendations, and hospital suggestions.

Example Response Generation Code:

```
def generate_response(analysis_results, risk_level, recommendations, nearby_hospitals):
response = f"Health Analysis Results: {analysis_results}\n"
response += f"Risk Level: {risk_level}\n"
response += "Recommendations:\n"
for rec in recommendations:
response += f"- {rec}\n"
response += "Nearby Hospitals:\n"
for _, hospital in nearby_hospitals.iterrows():
response += f"- {hospital['name']}, {hospital['address']} (Distance: {hospital['distance']} km)\n"
return response
# Sample usage
```

response = generate_response(analysis_results, risk_level, recommendations, nearby_hospitals)

print(response)

When a user interacts with the Heart Health Detector GPT, the following steps occur and by combining these components, heart health detector GPT delivers a comprehensive and user-friendly tool for monitoring and managing heart health:

(1) The user inputs their health data or uploads a CSV file.

(2) The system analyzes the health data.

(3) A risk assessment is performed based on the analysis.

(4) The system provides personalized recommendations.

(5) If necessary, the system suggests nearby hospitals for further evaluation.

(6) The response is generated and presented to the user.

Flow chart for the working of heart health detector as shown in figure 2.

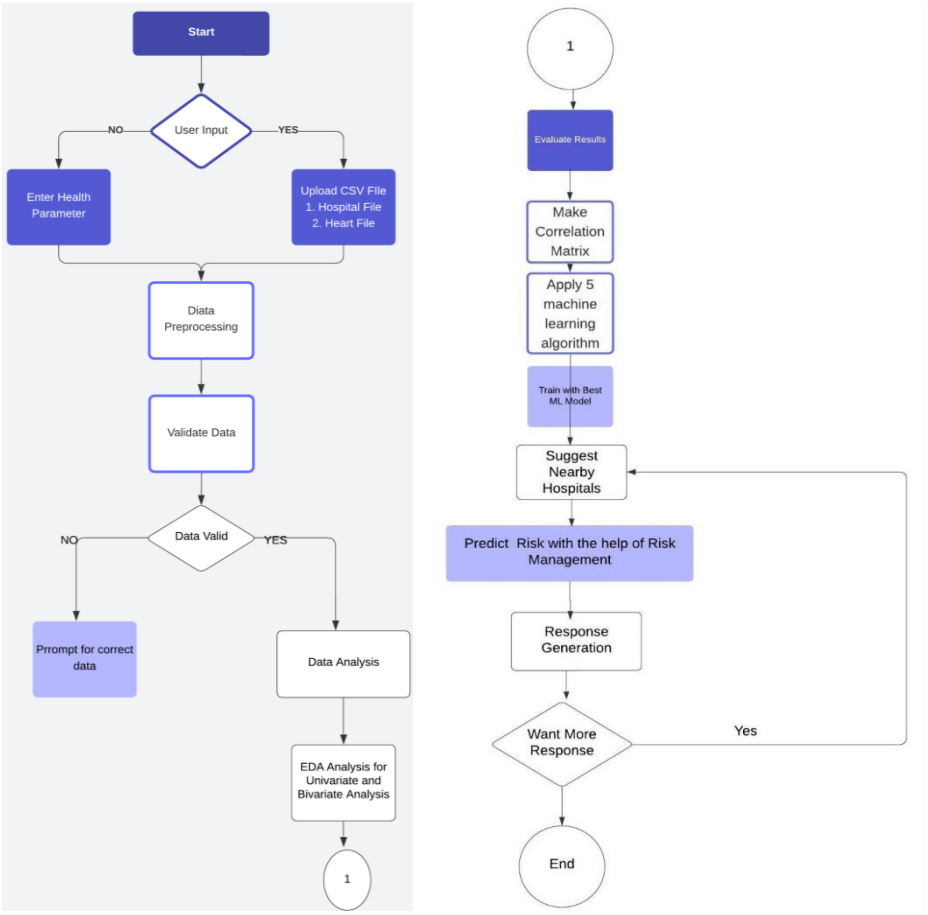

Figure 2. *Flowchart to show working of heart health detector.*

3. Creation of GPT-4o Model for Heart Health Detector GPT

The development of the GPT-4o model [11-15] for the Heart Health Detector project was a meticulous process driven by a strategic combination of expertise in natural language processing (NLP) and a keen understanding of heart health metrics. Here's a detailed overview of how the model was created:

3.1. Conceptualization and Planning

The journey began with a thorough conceptualization phase, where the scope and objectives of the GPT-4o model were defined. Extensive research was conducted to identify key features and metrics relevant to heart health monitoring, laying the groundwork for subsequent development phases.

3.2. Data Acquisition and Preprocessing

A diverse and comprehensive dataset comprising heart health-related information was curated from reputable sources such as medical journals, research publications, and healthcare databases. This dataset encompassed a wide range of parameters, including vital signs, medical history, lifestyle factors, and diagnostic tests. Prior to model training, rigorous preprocessing techniques were applied to ensure data consistency, completeness, and relevance.

3.3. Model Architecture and Training

The GPT-4o model was developed using the Community Builder platform provided by OpenAI, which facilitated the creation of custom language models tailored to specific domains or use cases. Leveraging state-of-the-art deep learning architectures and transformer-based methodologies, the model architecture was meticulously crafted to accommodate the complexity and nuances of heart health data. Training commenced using the curated dataset, with a focus on optimizing model performance, accuracy, and robustness through iterative experimentation and fine-tuning.

Steps to Obtain API Key for OpenAI Platform

Here's how I generated my API key for accessing GPT models:

Sign Up or Log In: First, I visited the OpenAI Platform website and signed up for an account since I didn't have one already. If you already have an account, simply log in using your credentials.

Navigate to API Keys Section: After logging in, I navigated to the API Keys section of the OpenAI Platform. This section contains information about your API keys and how to manage them.

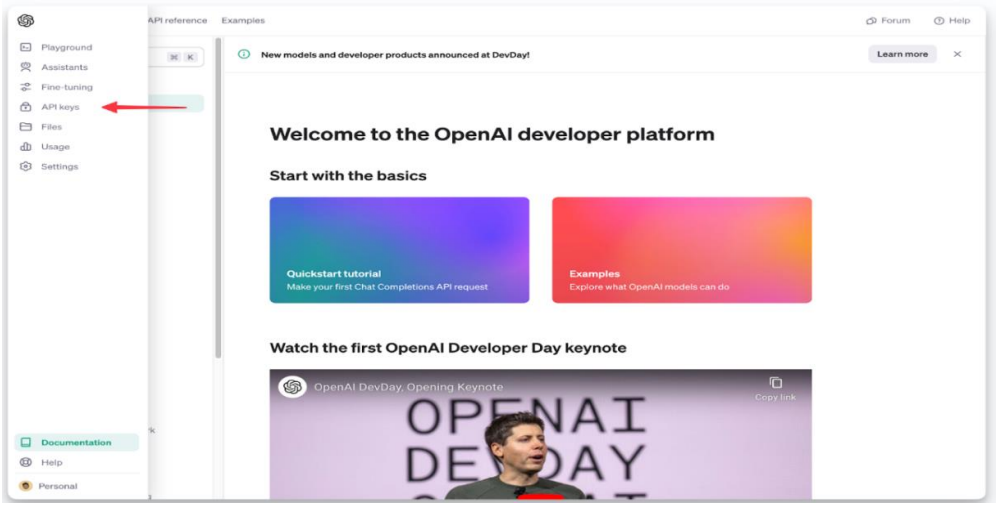

Figure 3. *Creation of API key.*

Create a New API Key: In the API Keys section, there is option to create a new API key as shown in figure 3. I clicked on this option to generate a new API key specifically for my project.

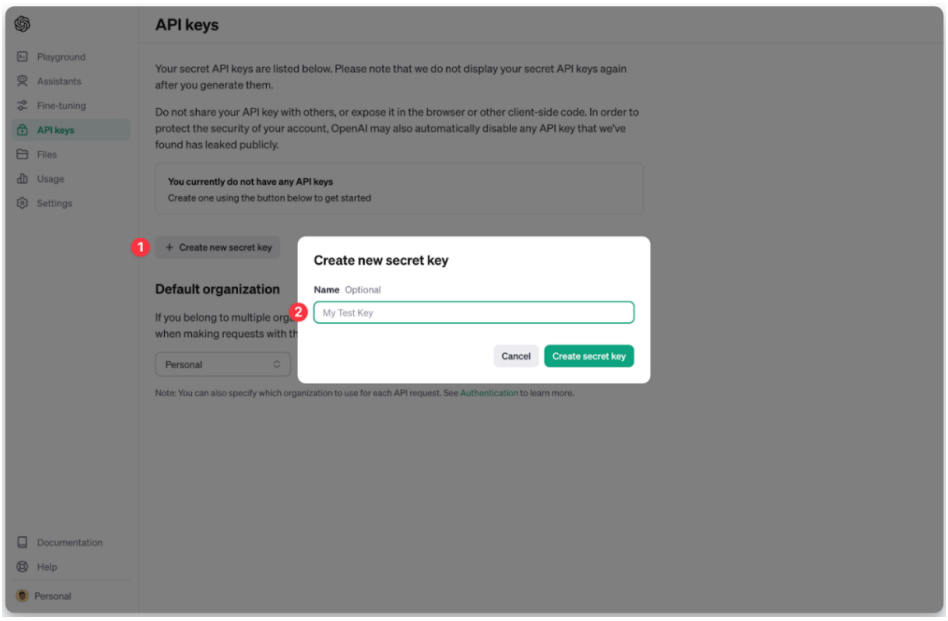

Figure 4. *Process to create API key.*

Specify Project Details: During the API key creation process, It was prompted to specify details about my project, such as its name or purpose as shown in figure 4. Necessary information as requested was provided.

Review Permissions and Usage: Before proceeding, permissions and usage limits associated with the API key was carefully reviewed as shown in figure 5. It's important to understand the terms of use and any restrictions that apply.

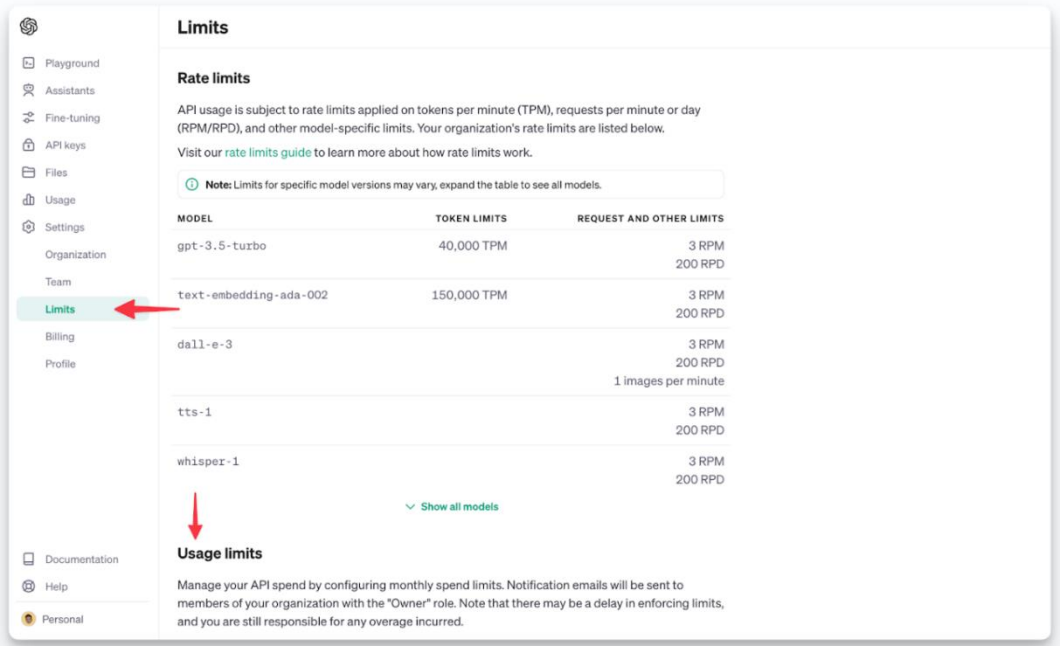

Figure 5. *Reviewing permissions and limits in the process of key creation.*

Generate API Key: Once the necessary details were provided and permissions were, API key was generated as shown in figure 5. The platform provided with a unique API key can be used to authenticate requests to the GPT models.

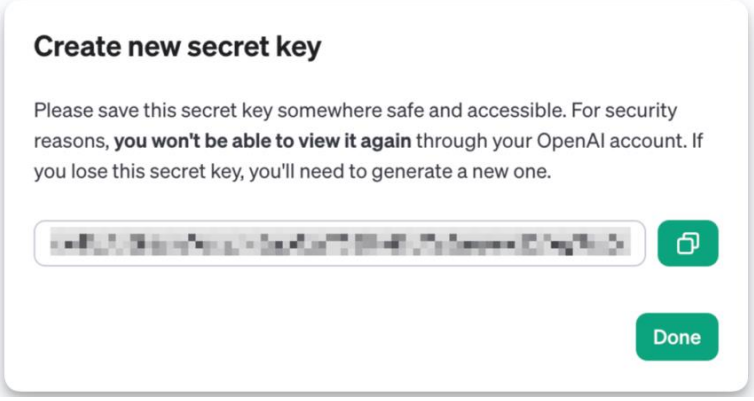

Figure 6. *Creation of new secret key.*

Secure and Manage API Key: After generating the API key, make it sure to keep it secure and manage access to it carefully as shown in figure 6.

Integrate API Key: Finally, integrate API key into application code. This involved including the API key as part of the authentication process when making requests to the GPT models through the OpenAI Platform API.

3.4. Hyperparameter Optimization

Hyperparameter optimization played a crucial role in enhancing the efficacy and efficiency of the GPT-4o model. Parameters such as learning rate, batch size, and sequence length were systematically adjusted and tuned to achieve

optimal convergence and generalization performance. This iterative process involved rigorous experimentation and validation techniques to identify the most effective hyperparameter configurations for the given task of heart health detection and analysis.

3.5. Validation and Evaluation

Following model training and optimization, comprehensive validation and evaluation procedures were conducted to assess the performance and reliability of the GPT-4o model. Extensive testing was carried out using a diverse set of heart health scenarios and use cases, encompassing both common and rare conditions. Evaluation metrics such as accuracy, precision, recall, and F1-score were computed to quantify the model's performance and identify areas for improvement.

4. Heart Health Detector – Results

4.1. Sample of Execution of Queries on Hospital Dataset

Query 1

if state =haryana will u tell how many no of hospitals in Haryana

Result

1669

There are 1,669 hospitals listed in the state of Haryana in the dataset.

```
# Count the number of hospitals in the state of Haryana
haryana_hospitals_count = data[data['State'].str.lower() == 'haryana'].shape[0]
haryana_hospitals_count
```

Query 2

if city=panipat tell hw many hospitals are in Panipat

Result

89

There are 89 hospitals listed in the city of Panipat in the dataset.

```
# Count the number of hospitals in the city of Panipat
panipat_hospitals_count = data[data['District'].str.lower() == 'panipat'].shape[0]
panipat_hospitals_count
```

will u tell the address of 2 kidney hospitals

Result

```
Hospital_Name \
8323 Madaan Hospital
8330 R P Stone Clinic Pvt.Ltd., Panipat
Address_Original_First_Line
8323 Assandh Road, Model Town
8330 Scf: 30-31, Sector-11, Near Angel Prime Mall,...
```

```
# Extract the addresses of the kidney-specialized hospitals in Panipat
panipat_kidney_hospitals_address = data[
(data['District'].str.lower() == 'panipat') &
(data['Specialties'].str.lower().str.contains('kidney|nephrology'))
][['Hospital_Name', 'Address_Original_First_Line']]
panipat_kidney_hospitals_address
```

4.2. Screenshot of Frontend

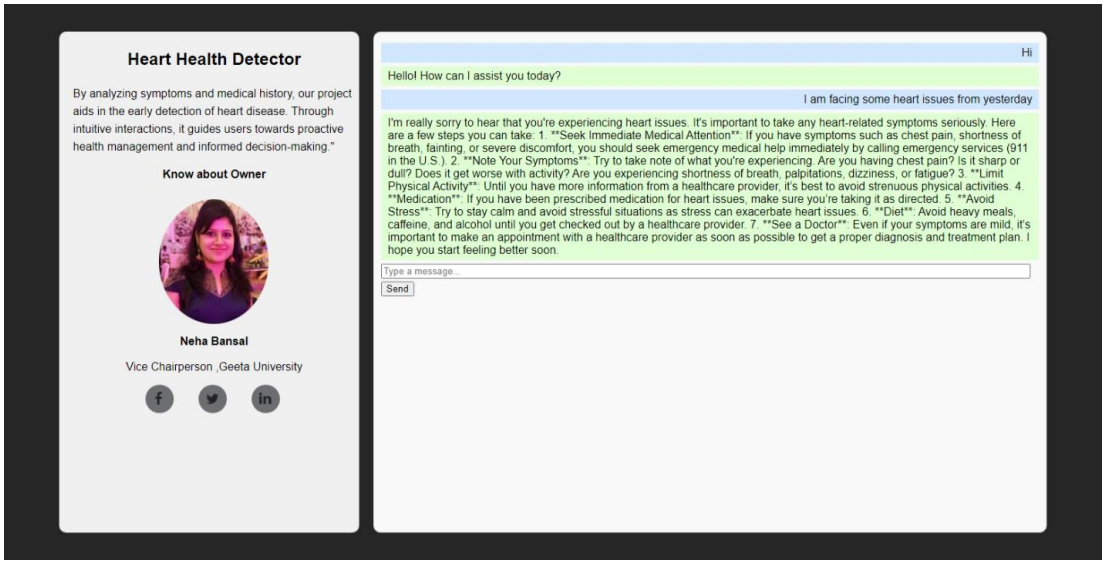

Figure 7. *Frontend of final project.*

5. Conclusion

The Heart Health Detector paper demonstrates the potential of AI and machine learning in revolutionizing cardiovascular health monitoring and management. By leveraging GPT-4, the paper successfully translates complex medical data into personalized, actionable insights, making heart health management accessible and user-friendly. The application empowers users to proactively monitor and improve their cardiovascular health, fostering preventive health measures and early intervention. The paper emphasis on data privacy and security ensures users can trust the platform with their sensitive health information. Ultimately, the Heart Health Detector represents a significant step forward in democratizing access to heart health information, contributing to the broader goal of reducing the incidence and impact of cardiovascular diseases. This innovative approach not only enhances individual health outcomes but also has the potential to alleviate the burden on healthcare systems by promoting preventive care and self-management among users. The paper underscores the transformative impact of integrating advanced AI technologies in healthcare, paving the way for future developments in the field.

Abbreviations

GPT	Generative Pretrained Transformer
GPT-4o Model	Web Integrated Custom GPT Using Chatgpt 4.0
AI	Artificial Intelligence
CSV	Comma Separated Values
NLP	Natural Language Processing
API	Application Programming Interface

Author Contributions

The main contribution of this paper is to develop custom GPT-4 for the Heart Health Detector project which is a strategic combination of expertise in natural language processing (NLP) and a keen understanding of heart health. The main purpose behind development of this GPT is to give nearest hospital related data to every person and to enable them to monitor their heart health via developed custom GPT. This is achieved by doing data analysis on two database files and training the custom GPT with machine learning models. The custom GPT developed was deployed on website so that any user having access to website can access the heart health detector custom GPT and can find information about hospitals for treatment and monitor their initial health values by themselves also.

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

Availability of data and materials: The paper uses two database files: Hospital file and heart file.

Hospital directory data set description: The file contains a detailed directory of hospitals with various attributes. Here's a brief overview in table 1 about the columns included:

Table 1. *Hospital dataset description.*

1.	Sr_No:	Serial number.
2.	Location_Coordinates:	Coordinates of the hospital.
3.	Location:	General location information.
4.	Hospital_Name:	Name of the hospital.
5.	Hospital_Category:	Category of the hospital (e.g., public, private).
6.	Hospital_Care_Type:	Type of hospital care provided.
7.	Discipline_Systems_of_Medicine:	Medical systems practiced (e.g., Allopathic, Ayurvedic).
8.	Address_Original_First_Line:	The first line of the hospital's address.
9.	State:	State where the hospital is located.
10.	District:	District where the hospital is located.
11.	Telephone, Mobile_Number, Emergency_Num:	Contact numbers.
12.	Hospital_Fax, Hospital_Primary_Email_Id, Hospital_Secondary_Email_Id, Website:	Contact details and online presence.

13.	Specialties, Facilities:	Information about specialties and facilities offered.
14.	Number_Doctor, Num_Mediconsultant_or_Expert, Total_Num_Beds:	Staff and capacity details.

The file also includes more specific details such as accreditation, registration numbers, nodal person information, and various other hospital-specific metrics.

Heart directory data set description:

The file appears to be a dataset containing medical information related to heart studies. Here are columns and a brief description of some of data in table 2.

Table 2. *Heart dataset description.*

1.	age:	Age of the patient
2.	sex:	Sex of the patient (1 = male, 0 = female)
3.	cp (Chest Pain Type):	Type of chest pain experienced (values from 1 to 4)
4.	trestbps (Resting Blood Pressure):	Resting blood pressure in mm Hg on admission to the hospital
5.	chol (Serum Cholestoral):	Serum cholesterol in mg/dl
6.	fbs (Fasting Blood Sugar):	Fasting blood sugar > 120 mg/dl (1 = true; 0 = false)
7.	restecg (Resting Electrocardiographic Results):	Results of electrocardiogram on rest
8.	thalach	(Maximum Heart Rate Achieved)
9.	exang (Exercise Induced Angina):	1 = yes; 0 = no
10.	oldpeak:	ST depression induced by exercise relative to rest
11.	slope	(Slope of the Peak Exercise ST Segment)
12.	ca:	Number of major vessels colored by fluoroscopy
13.	thal:	A blood disorder called thalassemia (1 = normal; 2 = fixed defect; 3 = reversible defect)
14.	target:	Diagnosis of heart disease (1 = disease; 0 = no disease)

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