

DEVELOPING BUSINESS APPLICATIONS USING GEN-AI (BIA 810-A)

FINAL PROJECT

AI-POWERED FITNESS TRACKER AND HEALTH MONITORING BOT

Empowering users with actionable health insights through AI-driven analytics.

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INTRODUCTION

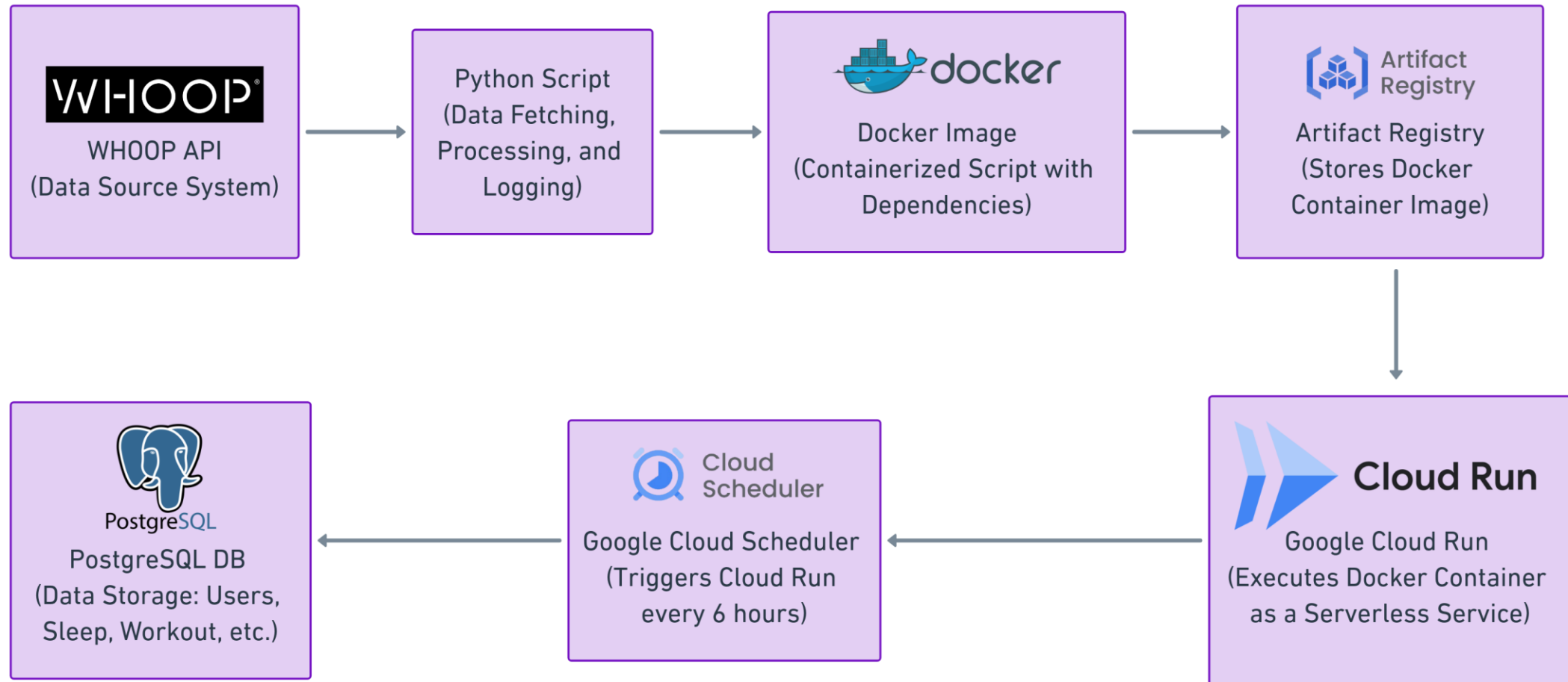
PROBLEM STATEMENT:

- With the rise in wearable health devices and growing health concerns, People face challenges interpreting complex wearable health data and make informed decisions.
- Our bot bridges this gap by transforming raw data into meaningful insights

OBJECTIVES:

- **Simplify health data analysis for end-users.**
- **Provide actionable insights and tailored recommendations.**
- **Enable dynamic visualizations of health metrics.**
- **Leverage AI to ensure a smooth and intuitive experience.**

DATA PIPELINE



DATA PIPELINE

WHOOOP DATA FETCH AND STORAGE:

- API Authorization: Secure connection to WHOOOP API using OAuth2 credentials.
- Data Retrieval: Fetch data through specific endpoints: Profile, Body Measurements, Cycle, Recovery, Sleep, and Workout.
- Data Storage: Store fetched data into corresponding PostgreSQL tables.
- Logging: Record execution details for monitoring and debugging.
- Error Handling: Manage API failures and database errors for reliable execution.
- Deployment: Deploy as a Flask API hosted on Google Cloud Run for scalability and accessibility.

DATABASE DESIGN AND STORAGE




DATABASE PLATFORM:

- Google Cloud SQL is used for hosting the database.
- PostgreSQL is the database system chosen for structured and efficient data management.

TABLE STRUCTURE:

- Data is stored in normalized tables for clarity and efficient querying.
- Key tables include:
 - users: Stores user details (user_id, first_name, last_name, email).
 - sleep_data: Sleep metrics (total sleep time, REM sleep, deep sleep, efficiency).
 - recovery_data: Recovery scores, resting heart rate, and HRV (Heart Rate Variability).
 - workout_data: Detailed workout data (distance, strain, kilojoules).
 - body_measurements: User body stats (height, weight, max heart rate).

COMPARISON OF LLMs USED

MODEL	PROS	CONS	FINAL VERDICT
 Gemini (Google) 1.5 Pro	Free API availability.	Failed in SQL query generation, especially for complex prompts.	Did not meet requirements.
	Able to generate basic insights for provided data.	Not suitable for dynamic code generation.	
 OpenAI GPT-4	Performed well in generating SQL queries, including tricky prompts.	Struggled with Python code generation for visualizations.	Partially met requirements.
	Good at generating insights and recommendations.	Required manual fixes to complete workflows.	
 Claude 3.5 Sonnet Claude 3.5 Sonnet	Outstanding in SQL query generation for complex data retrieval.		Best choice – Chosen model.
	Generated accurate and dynamic Python visualizations.	Less than 2% failure rate in Python code generation for visualizations.	
	Delivered high-quality insights and recommendations.		

CHATBOT ENGINE

USER INTERACTION AND QUERY PROCESSING

- User Interaction:
 - The user inputs natural language queries such as:
 - "What is my average sleep time?"
 - "Show me my top 5 heart rates recorded."
- Query Processing:
 - The Claude AI (Claude 3.5 Sonnet) API processes the user input to:
 - Generate accurate SQL queries to retrieve health metrics from the database.
 - Handle context-specific queries intelligently.

CHATBOT ENGINE

DATA RETRIEVAL AND INSIGHT GENERATION

Data Workflow:

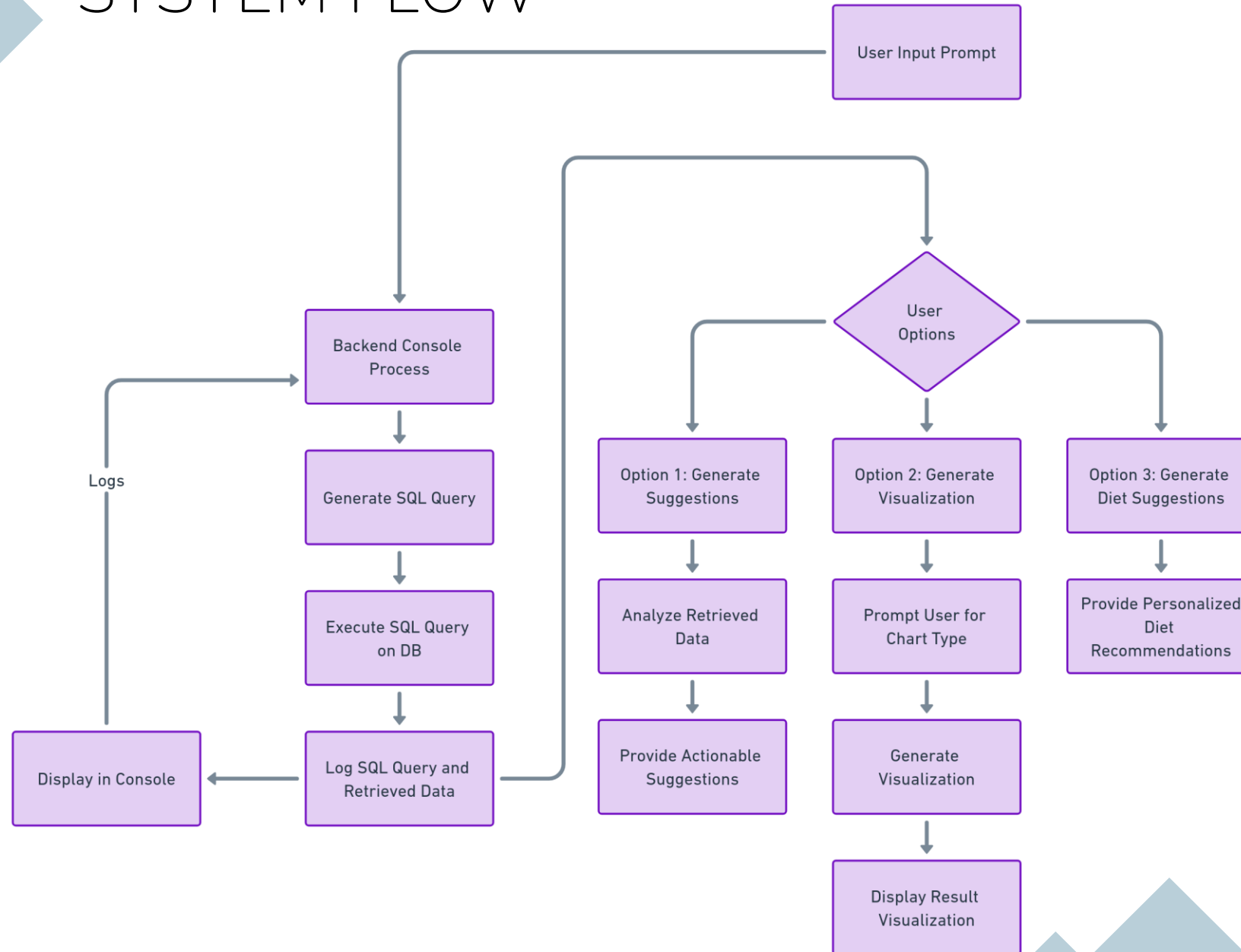
- SQL Query Execution:
 - The generated SQL query fetches relevant data from the PostgreSQL database.
- Insight Generation:
 - The fetched data is analyzed using Claude AI to generate:
 - Summarized trends
 - Actionable insights (e.g., "You had more deep sleep this week").
- Tailored Suggestions:
 - Based on the insights, the chatbot provides actionable health recommendations:
 - Example: "Maintain consistent sleep timings to improve sleep efficiency."

CHATBOT ENGINE

DYNAMIC VISUALIZATIONS

- Automated Visualization Generation:
 - Health metrics are visualized dynamically using Matplotlib for better data interpretation.
 - Examples include:
 - Bar Charts for comparing heart rates or sleep efficiency.
 - Line Charts to observe trends in recovery scores or workout performance.
- Customizable Visualizations:
 - Users can specify their desired visualization type (e.g., bar, line, scatter plots).
 - The AI adapts and generates Python code for accurate visual output.
- Enhanced User Experience:
 - Charts are presented seamlessly in the chatbot interface.
 - Visual trends simplify complex health data into actionable insights.

SYSTEM FLOW




EXAMPLES

PROMPT: *“how my active days influenced my heart rate this month provide me top 5 results with distinct days”*

Generate SQL Query is:

```
SELECT DISTINCT ON (DATE(cd.created_at))
    DATE(cd.created_at) AS date,
    cd.strain AS daily_strain,
    cd.average_heart_rate,
    cd.max_heart_rate,
    rd.resting_heart_rate
FROM cycle_data cd
JOIN recovery_data rd ON cd.user_id = rd.user_id AND DATE(cd.created_at) =
DATE(rd.created_at)
WHERE cd.user_id = 21406427
    AND cd.created_at >= DATE_TRUNC('month', CURRENT_DATE)
    AND cd.created_at < DATE_TRUNC('month', CURRENT_DATE) + INTERVAL '1 month'
ORDER BY DATE(cd.created_at), cd.strain DESC
LIMIT 5;
```

GENERATING INSIGHTS



AI-Powered WHOOP Health Monitoring Chatbot

Ask about your health data insights, visualizations, or suggestions.

You:

how my active days influenced my heart rate this month provide me top

Fetching data, please wait...

Insight: Key insights from the data:

- Highest daily strain was on 2024-12-05 at 10.349495, significantly higher than other days.
- Highest average heart rate was on 2024-12-16 at 91 bpm.
- Max heart rate peaked on 2024-12-16 at 164 bpm.
- Resting heart rate varied between 53-68 bpm, lowest on 2024-12-16 and highest on 2024-12-05.
- There's a gap in data between 2024-12-06 and 2024-12-16.

Generate Suggestions

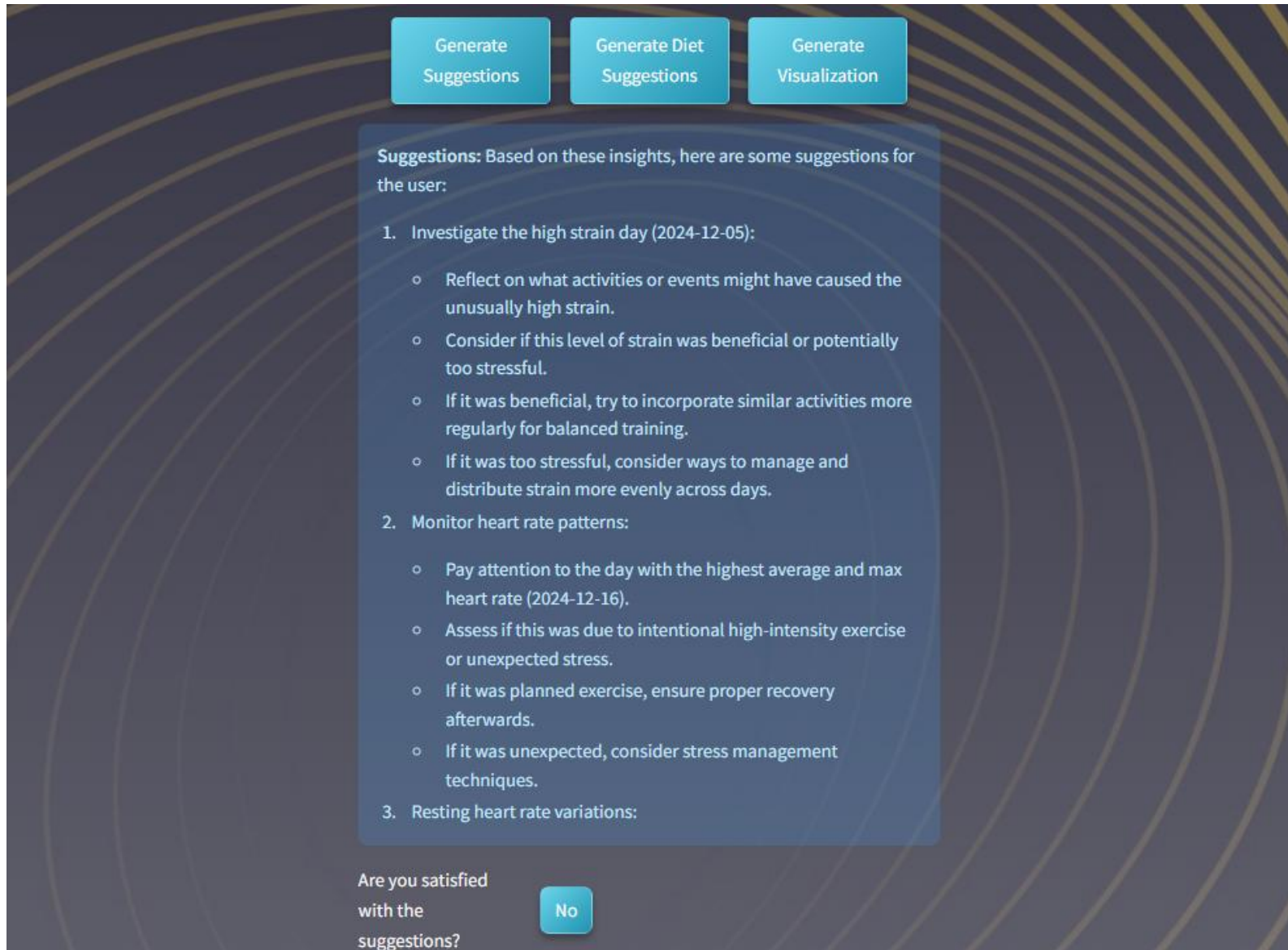
Generate Diet Suggestions

Generate Visualization

Generated Data is:

	date	daily_strain	average_heart_rate	max_heart_rate	resting_heart_rate
0	2024-12-01	4.974375	66	140	59.0
1	2024-12-04	5.213223	82	123	55.0
2	2024-12-05	10.349495	74	152	68.0
3	2024-12-06	5.813436	75	153	60.0
4	2024-12-16	8.102052	91	164	53.0

GENERATING SUGGESTIONS



Generate Suggestions Generate Diet Suggestions Generate Visualization

Suggestions: Based on these insights, here are some suggestions for the user:

1. Investigate the high strain day (2024-12-05):
 - Reflect on what activities or events might have caused the unusually high strain.
 - Consider if this level of strain was beneficial or potentially too stressful.
 - If it was beneficial, try to incorporate similar activities more regularly for balanced training.
 - If it was too stressful, consider ways to manage and distribute strain more evenly across days.
2. Monitor heart rate patterns:
 - Pay attention to the day with the highest average and max heart rate (2024-12-16).
 - Assess if this was due to intentional high-intensity exercise or unexpected stress.
 - If it was planned exercise, ensure proper recovery afterwards.
 - If it was unexpected, consider stress management techniques.
3. Resting heart rate variations:

Are you satisfied with the suggestions?

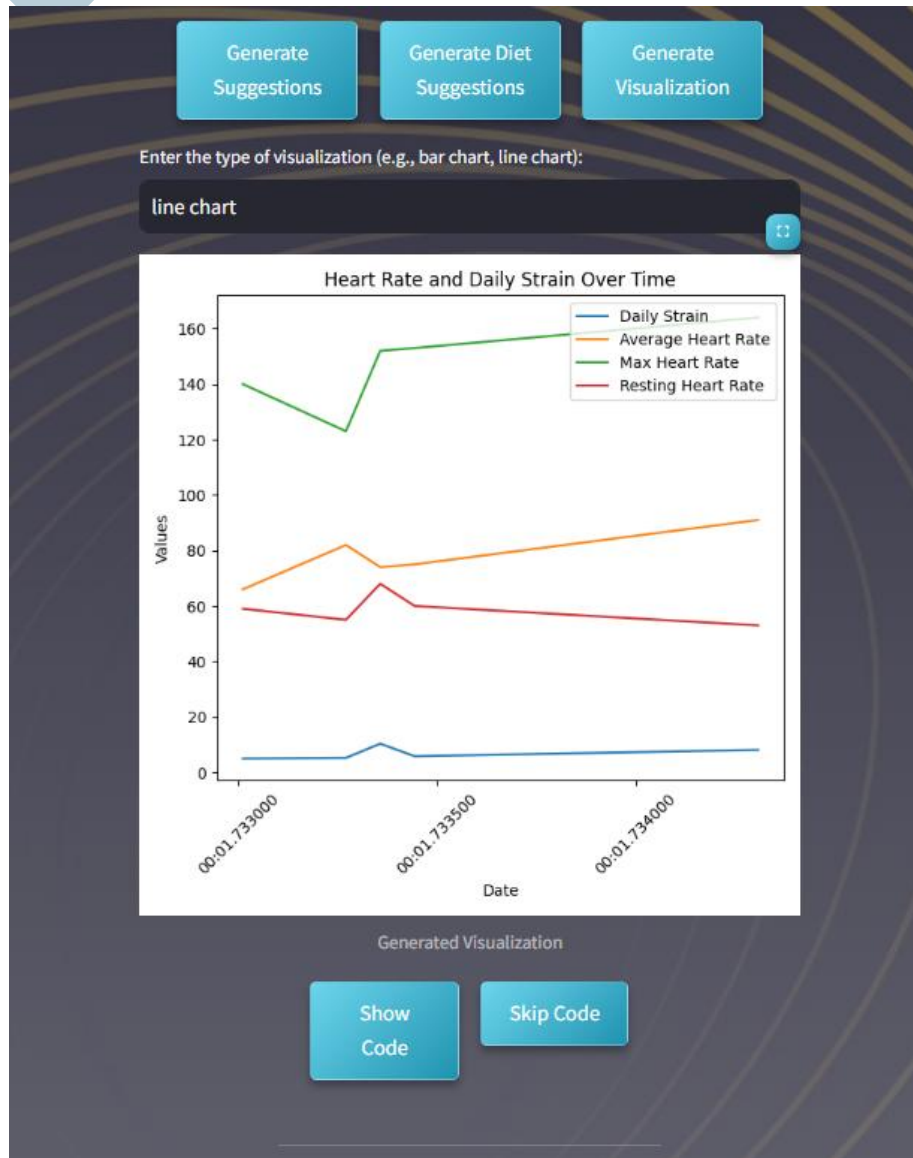
GENERATING DIET SUGGESTIONS

Generate Suggestions Generate Diet Suggestions Generate Visualization

Diet Suggestions: Based on the health data and insights provided, here are some personalized diet suggestions:

1. High-Intensity Days (like 2024-12-05 with highest strain):
 - Increase complex carbohydrate intake for sustained energy (e.g., whole grains, sweet potatoes)
 - Ensure adequate protein for muscle recovery (lean meats, fish, legumes)
 - Hydrate well with water and electrolyte-rich foods (coconut water, bananas)
2. For Days with High Average Heart Rate (like 2024-12-16):
 - Focus on foods that support cardiovascular health (omega-3 rich fish, berries, leafy greens)
 - Include magnesium-rich foods to support heart function (nuts, seeds, avocados)
 - Consider adding some calming foods like chamomile tea or turkey (contains tryptophan)
3. To Support Lower Resting Heart Rate:
 - Incorporate potassium-rich foods (bananas, spinach, potatoes)
 - Include foods high in fiber to promote heart health (oats, beans, apples)
 - Consider adding garlic and onions to meals for their heart-healthy properties
4. General Recommendations:
 - Maintain consistent meal times to support metabolic health
 - Ensure

GENERATING VISUALIZATIONS



Generated Visualization Code:

```
import matplotlib.pyplot as plt
import pandas as pd

# Convert date to datetime
data['date'] = pd.to_datetime(data['date'], unit='s')

# Create the line chart
plt.figure(figsize=(6, 6))
plt.plot(data['date'], data['daily_strain'], label='Daily Strain')
plt.plot(data['date'], data['average_heart_rate'], label='Avg Heart Rate')
plt.plot(data['date'], data['max_heart_rate'], label='Max Heart Rate')
plt.plot(data['date'], data['resting_heart_rate'], label='Resting Heart Rate')

plt.xlabel('Date')
plt.ylabel('Value')
plt.title('Heart Rate and Daily Strain Over Time')
plt.legend()
plt.xticks(rotation=45)
plt.tight_layout()

# Save the plot
plt.savefig(r'D:\GenAI_Project\health_chatbot_project\visualizations\visualization.png')
File successfully created:
D:\GenAI_Project\health_chatbot_project\visualizations\visualization.png
```

The image features a light blue background with a dark blue rounded rectangular border. In the corners, there are decorative geometric shapes: the top-left and bottom-right corners have overlapping squares and triangles in various shades of blue, while the bottom-center has a large triangle pointing upwards. The word "DEMO" is centered in the middle of the frame.

DEMO

CONCLUSION

- OBJECTIVES ACHIEVED:
 - Simplified complex health data into meaningful insights.
 - Delivered personalized suggestions, visualizations, and diet recommendations.
- KEY FEATURES:
 - Dynamic SQL query generation. AI-powered insights and visualizations.
 - User-friendly chatbot interface with interactive options.
- IMPACT:
 - Enabled actionable insights for improved decision-making.
 - Enhanced user engagement through tailored responses.

FUTURE ENHANCEMENTS

- Adding support for additional health APIs (e.g., Apple Health, Fitbit).
- Improving chatbot capabilities with multimodal features (voice input, image recognition).
- Expanding visualization options with interactive dashboards.
- Incorporating predictive analytics for health forecasts.
- Enhancing dietary suggestions using nutrition databases and AI.



THANK YOU