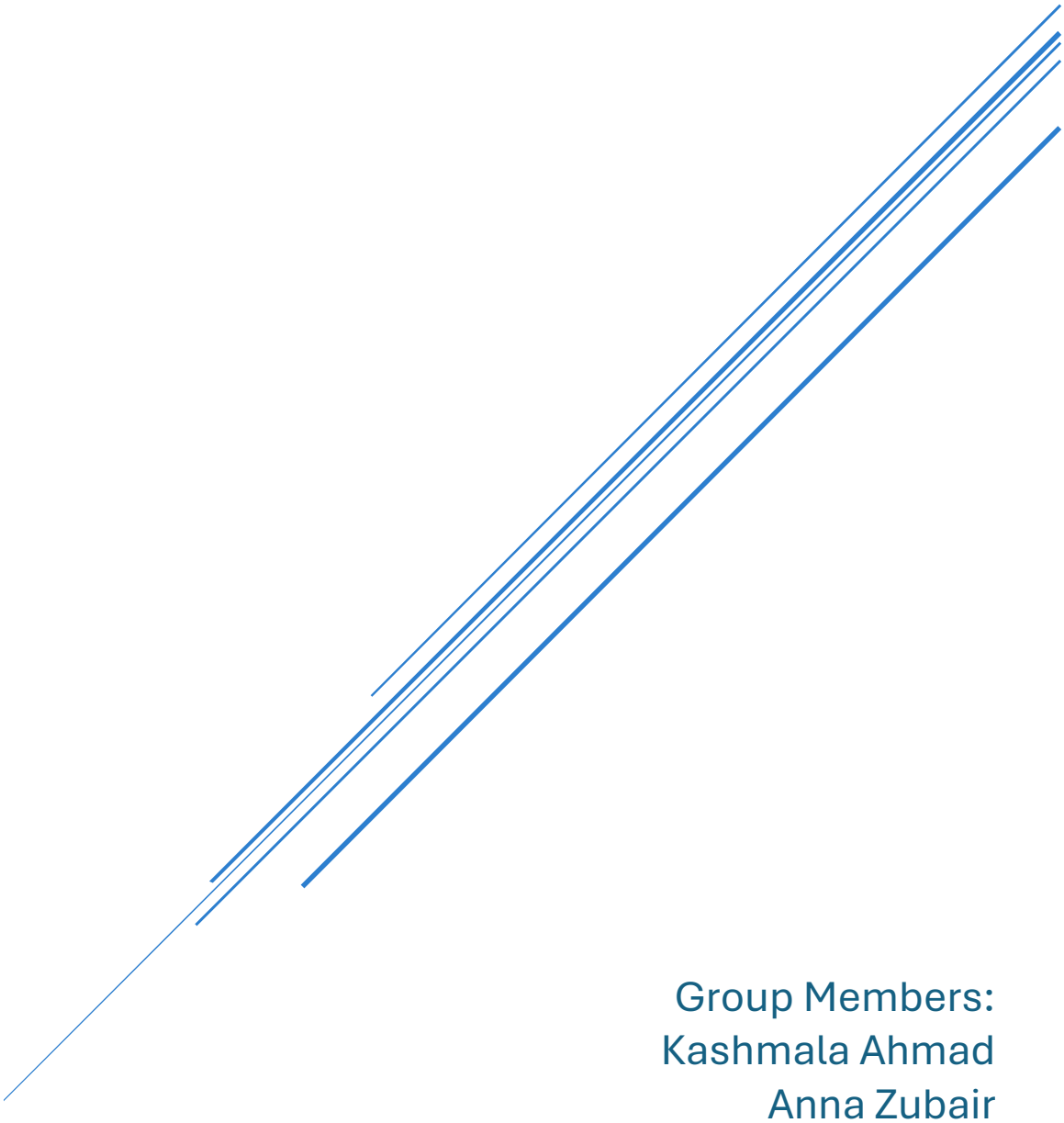
AI INTEGRATED FITNESS BAND

SDA LAB PROJECT



Group Members:
Kashmala Ahmad
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INTRODUCTION:

Description:

The AI-Integrated Fitness Band, is not just a watch, it is a wellness companion with the convenience of wearable technology. The Fitness Band monitors heart rate, tracks steps, and even suggests workouts tailored to your fitness level and goals. Its sleep tracking feature analyzes your patterns, offering tips for a better night's rest. With its app, health data is analyzed to give personalized health insights, allowing to track progress. The Fitness Band also blends in with daily life by notifying about calls and messages, ensuring connectedness without ever having to pick up the phone.

Main Functionalities:

- Heart Rate Monitoring
- Step Tracking
- Personalized Workout Suggestions
- Sleep Pattern Analysis
- Health Insights
- Companion Mobile App
- Meal Prep Ideas
- Calorie Burn Estimation
- Hydration and Nutrition Tracking

Project Phase II

1.1 SYSTEM PURPOSE:

Ai integrated fitness band:

Our system is designed to be the user's supportive friend whenever he/she is feeling stressed or overwhelmed. With features like continuous heart rate monitoring, step tracking, personalized workout plans, sleep improvement suggestions, diet recommendations, calorie tracking, and daily reminders, we aim to help our user maintain a healthy lifestyle.

There is also a special feature: a chatbot where user can talk to an AI whenever they need someone to listen and provide therapy. Whether the user is feeling anxious, sad, or just need a friendly conversation, our AI is here to lend an empathetic ear and offer helpful advice to support your mental well-being.

1.2 SYSTEM SCOPE:

The AI INTEGRATED FITNESS BAND project seeks to create a holistic solution for managing stress and enhancing overall wellness. It includes features such as continuous heart rate monitoring, real-time step tracking, and calorie calculation for physical health monitoring. Wellness support features comprise personalized workout plans, sleep improvement suggestions, and dietary recommendations. Mental health support will be facilitated through a chatbot feature for therapeutic conversations, emotional support, and

empowerment to address mental well-being. User engagement and convenience will be ensured with a companion mobile app offering seamless access to health data and customizable daily reminders. The project adopts a holistic approach, addressing both physical and mental aspects of well-being, encouraging proactive health management, and promoting resilience and overall wellness in users' lives.

1.3 FUNCTIONAL REQUIREMENTS:

Section	Requirement
FR1	The system shall continuously monitor and update the user's heart rate, providing alerts in case of abnormal heart rate.
FR2	The system shall accurately count and update the number of steps taken by the user in real time on the device.
FR3	The system shall suggest personalized workout plans based on the user's past activities and progress.
FR4	The system shall suggest ways to improve sleeping schedules.
FR5	The system shall suggest a diet based on the user's nutritional needs.
FR6	The system shall calculate the number of calories burned by the user based on activity levels, workout data, and personal health metrics.
FR7	The system shall provide daily reminders for workouts, meal preparation, and water intake, customizable based on the user's schedule and preferences.
FR8	The system shall integrate a chatbot feature where users can chat with AI to receive therapy and support for stress management and mental well-being.
FR9	Requirement: The system shall store user preferences and goals related to fitness, nutrition, schedule, and mental well-being.

1.4 NON-FUNCTIONAL REQUIREMENTS:

1.4.1 Quality Requirements:

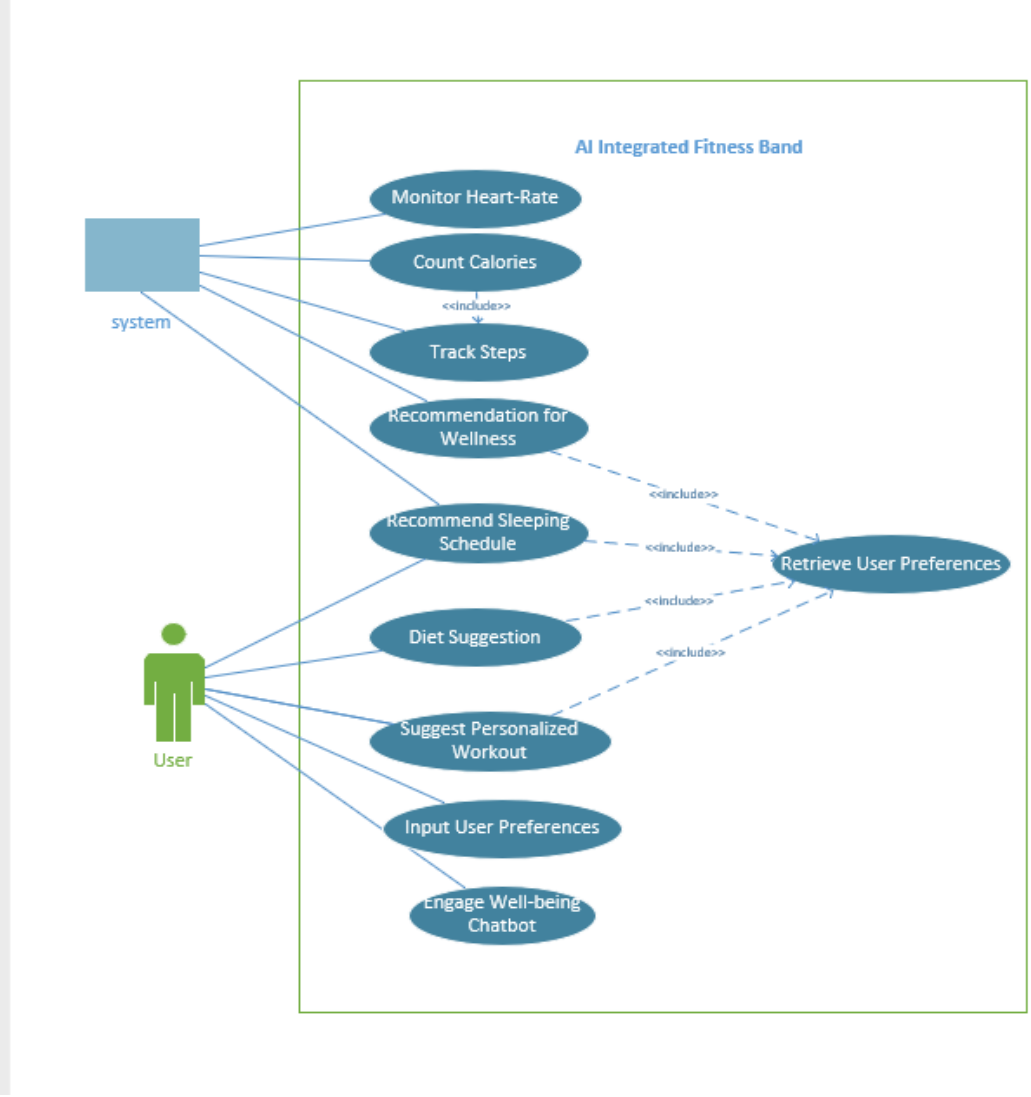
Section	Quality Requirements
QR1	The system shall respond to abnormal heart rate events within 5 seconds to ensure timely alerts to the user.
QR2	The step counting functionality shall accurately update step counts in real-time with less than 1% margin of error.

QR3	The user interface for displaying heart rate alerts, step counts, personalized workout plans, sleep improvement suggestions, diet recommendations, and mental well-being support shall be intuitive and easy to navigate for users of all ages.
QR4	The chatbot interface for mental well-being support shall provide clear instructions and guidance for users interacting with it.
QR5	Access to sensitive data such as sleep patterns, dietary preferences, and mental well-being interactions shall be restricted to authorized personnel only.

1.4.2 Constraints:

Sections	Constraints
C1	The system architecture shall be modular and well-documented to facilitate future updates, enhancements, and maintenance tasks.
C2	The system must comply with industry-specific regulations and standards governing health data privacy and security
C3	The development and maintenance costs of the system must not exceed predetermined budgetary limits, necessitating efficient resource allocation and cost-effective solutions.

1.5 USE CASE DIAGRAM:



1.6 USE CASE SPECIFICATIONS:

1.6.1 FR1 Heart Rate Monitoring:

Section	Content
Designation	UC-01
Name	Hear Rate Monitoring
Authors	Kashmala Ahmad
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system shall continuously monitor and update the user's heart rate, providing alerts in case of abnormal heart rate

Trigger Event	Abnormal Heart Rate detected
Actors	User
Pre-condition	1. User is wearing the fitness Band. 2. User's Normal heartbeat record is maintained. 3. There's any abnormal change in heartbeat.
Post-condition	4. AI give suggestions to users to control the heartrate. 5. Band continues monitoring the real time heartbeat of user.
Result	Successful detection of abnormal heart rate patterns.
Main Scenario	6. The system initiates continuous heart rate monitoring. 7. The system continuously compares real-time heart rate data to established heartbeat patterns. 8. An abnormal heart rate pattern is detected, the system triggers an alert to notify the user. 9. The user acknowledges the alert. 10. The fitness band displays relevant information about the abnormal heart rate event, including the nature of the abnormality and recommended actions.
Alternative Scenario	5.1 User Dismiss the alert. 5.2 System will continue functioning normally.
Exception Scenarios	Low Battery Level: If the device battery is low, the system may display a warning and prompt the user to recharge the device to ensure continuous heart rate monitoring.
Qualities	Q1, Q3

1.6.2 FR2 Step Tracking

Section	Content
Designation	UC-02
Name	Step Tracking
Authors	Kashmala Ahmad
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system shall accurately count and update the number of steps taken by the user in real time on the device
Trigger Event	Step taken by user while fitness band is on.
Actors	User
Pre-condition	ıe user is wearing the fitness band and it is functioning correctly.

	here's any motion detected.
Post-condition	he system accurately counts the number of steps taken by the user in real time. ser have access to up-to-date step count information on the device interface.
Result	Accurate counting and real-time updating of the number of steps taken by the user
Main Scenario	15. The system initiates step counting functionality. 16. The system interprets the movements as steps taken by the user. 17. For each detected step, the system increments the step counter by one in real time. 18. The current step count is updated and displayed on the device interface in real time.
Alternative Scenario	3.1 If the user pauses or stops physical activity, the system pauses step counting until motion and acceleration are detected again.
Exception Scenarios	Low Battery Level: In low battery situations, the system may prioritize conserving battery life by reducing the frequency of step count updates or temporarily suspending real-time updating. Users should be notified of the battery conservation mode and encouraged to recharge the device.
Qualities	Q2,Q3

1.6.3 FR3 Personalized Workout Suggestions:

Section	Content
Designation	UC-03
Name	Personalized Workout Suggestions
Authors	Kashmala Ahmad
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system shall suggest personalized workout plans based on the user's past activities and progress.
Trigger Event	User asks for the personalized workout Plan
Actors	User
Pre-condition	he user is wearing the fitness band, and it is functioning correctly. he user has provided relevant personal information such as age, gender, weight, ness level, and any specific health considerations.

	ıfficient historical activity data is available for analysis to generate personalized ɔrkout plans.
Post-condition	The system provides the user with personalized workout plan suggestions for their fitness goals, preferences, and capabilities.
Result	The provision of tailored workout plans to the user based on their past activities and progress.
Main Scenario	22. User Requests for Personalized Workout suggestions. 23. The system retrieves user profile information, including past activity data, fitness goals, preferences, and any relevant health conditions. 24. The system analyzes the user's past activities, including types of exercises, duration, intensity levels, and frequency. 25. Using machine learning algorithms and fitness guidelines, the system generates personalized workout plan recommendations according to the user's fitness profile and objectives. 26. The system presents the personalized workout plan suggestions to the user through the device interface. 27. The user has the option to review the suggested workout plans and provide feedback.
Alternative Scenario	28. If the user rejects the suggested workout plans, the system may offer alternative recommendations or prompt the user to provide more specific feedback to refine the suggestions.
Exception Scenarios	Insufficient Data: If there is insufficient historical activity data available for analysis, the system may prompt the user to engage in additional activities to provide more comprehensive input for generating personalized workout plans.
Qualities	Q3,Q5

1.6.4 FR4 Recommend Sleeping Schedule:

Section	Content
Designation	UC-04
Name	Improve Sleeping Schedule
Authors	Anna Zubair
Priority	Importance for system success: **High**
Criticality	**High**

Description	The system shall suggest ways to improve sleeping schedules based on user behavior and sleep history.
Trigger Event	29. User requests sleep improvement advice 30. system detects irregular sleep patterns
Actors	User
Pre-condition	1. The user is wearing the properly functioning fitness band. 2. The user has enabled sleep tracking. 3. The sleep history is available for analysis.
Post-condition	1. User receives recommendations for improving sleep schedule. 2. User has options to accept, reject, or adjust the suggested changes.
Result	Personalized sleeping schedule improvement suggestions are provided to the user.
Main Scenario	User requests sleep improvement suggestions. The system retrieves user's sleep data. The system generates personalized suggestions based on the data analysis. The system presents suggestions to the user through interface. User reviews and responds to the suggestions.
Alternative Scenario	1.1 system detects the need 5.1 User rejects the suggestions. 5.2 System may ask for reason 5.3 System further refine future suggestions.
Exception Scenarios	If the user has **not enabled** sleep tracking or there is **insufficient sleep data**, the system may prompt the user to enable sleep tracking and collect sufficient data.
Qualities	**QR1, QR4, QR5**

1.6.5 FR5 Diet Suggestion:

Section	Content
Designation	UC-05
Name	Diet Suggestion
Authors	Anna Zubair
Priority	Importance for system success: **Medium**
Criticality	**High**
Description	The system shall suggest a diet based on the user's calorie consumption, activity levels, and personal health goals.
Trigger Event	User requests diet suggestions or completes a dietary and nutritional goal.
Actors	User
Pre-condition	36. The user inputs their dietary preferences and goals.

	37. The user uses the fitness band for activity tracking.
Post-condition	38. User receives personalized diet suggestions. 39. User can review, alter and accept suggested diet plans.
Result	Personalized diet plans are provided to the user.
Main Scenario	40. User requests diet suggestions. 41. The system retrieves the user's dietary preferences, goals, and recent activity data. 42. The system generates personalized diet plans. 43. Diet suggestions are displayed to the user. 44. The user shall interact with the suggestions to customize them.
Alternative Scenario	5.1 User rejects the diet suggestions. 5.2 System asks for feedback and refines the suggestions.
Exception Scenarios	If essential dietary information or preferences are **missing**, the system may prompt the user to complete their dietary profile.
Qualities	**QR3,QR5**

1.6.6 FR6 Calories Count:

Section	Content
Designation	UC-06
Name	Calories Burnt Calculation
Authors	Anna Zubair
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system shall calculate the number of calories burned by the user based on activity levels, workout data, and personal health metrics.
Trigger Event	User completes a physical activity or requests a calorie count report.
Actors	User
Pre-condition	45. The user is wearing properly functional fitness band. 46. The user has completed a physical activity while wearing the band.
Post-condition	47. The system calculates and displays the estimated calories burned during the activity. 48. The user can view their daily and historical calorie burn data.
Result	Accurate calculation and display of calories intake and calories burned by the user.
Main Scenario	. User completes a physical activity.

	. The system automatically detects activity completion and starts calorie calculation. . The system uses the user's activity data, personal health metrics, and workout intensity to calculate calories burned. . The system updates the user's profile with the new calorie intake and burn data. . The user views the updated calorie burn information.
Alternative Scenario	N/A
Exception Scenarios	If the fitness band or device sensors fail to record activity accurately due to **malfunction or damage.** The system should notify the user and suggest service or troubleshooting steps
Qualities	**QR1, QR2, QR3**

1.6.7 FR7 Daily Reminder for Wellness Activities:

Section	Content
Designation	UC-07
Name	Daily Reminder for Wellness activities
Authors	Muhammad Basim
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system provides daily reminders for workouts, meal preparations, and water intake which is customizable based on user's schedules and preferences.
Trigger Event	User's engagement with wellness remainder feature
Actors	User
Pre-condition	1. The user has set up their schedule and preference for workout, meal preparation and water intake. 2. The user has access to the system.
Post-condition	Daily reminders for workouts, meal preparations, and water intake are provided based on schedule and preferences.
Result	Providing personalized reminders for the user's wellness activities.
Main Scenario	User accesses the system. The system retrieves the user's schedule and preferences for workouts, meal preparation, and water intake. Based on the user's schedule and preferences, the system generates daily reminders for workouts, meal preparation, and water intake. Reminders are sent to the user at appropriate times throughout the day.

Alternative Scenario	N/A
Exception Scenarios	N/A
Qualities	**QR3,QR5**

1.6.8 FR8 Integration of Chatbot for Mental Well-being Support:

Section	Content
Designation	UC-08
Name	Integration of Chatbot for Mental Well-being Support
Authors	Muhammad Basim
Priority	Importance for system success: **High**
Criticality	**High**
Description	The system integrates a chatbot feature where users can chat with AI to receive therapy and support for stress management and mental well-being.
Trigger Event	User's engagement with the chatbot feature.
Actors	User, AI Chatbot
Pre-condition	The user has access to the system.
Post-condition	Users can engage with the AI chatbot to receive therapy and support for stress management and mental well-being.
Result	Provision of mental well-being support through AI chatbot interactions.
Main Scenario	User accesses the chatbot feature. The chatbot prompts the user for interaction. User engages with the chatbot by typing or speaking. The chatbot responds with therapy and support for stress management and mental well-being based on user interactions.
Alternative Scenario	N/A
Exception Scenarios	N/A
Qualities	**QR4,QR5**

1.6.9 FR9 User Preferences and Goals Management:

Section	Content
Designation	UC-09
Name	User Preferences and Goals Management
Authors	Muhammad Basim
Priority	Importance for system success: **High**
Criticality	**High**

Description	The system shall store user preferences and goals related to fitness, nutrition, schedule, and mental well-being.
Trigger Event	User provides or updates preferences and goals.
Actors	User
Pre-condition	1. The user is interacting with the system. 2. The user has access to the system's preferences and goals management interface.
Post-condition	User preferences and goals are successfully stored or updated in the system.
Result	User preferences and goals are effectively stored and managed by the system.
Main Scenario	62. User accesses the preferences and goals management interface. 63. The system displays options for managing fitness preferences, nutrition preferences, schedule preferences, and mental well-being preferences. 64. The user provides or updates relevant personal information such as age, gender, weight, fitness level, dietary preferences, meal timings, preferred workout schedules, stress levels, sleep patterns, and any specific health considerations. 65. The user sets specific fitness goals such as weight loss, muscle gain, endurance improvement, etc., along with corresponding timelines and metrics for tracking progress. 66. The system stores the provided preferences and goals securely in the user's profile.
Alternative Scenario	4.1. If the user's provided fitness goals are unrealistic or potentially harmful, the system may prompt the user to reconsider and adjust them to ensure safety and effectiveness.
Exception Scenarios	**Insufficient Data:** If the user fails to provide necessary information to set preferences and goals, the system may prompt the user to provide additional details or suggest default settings based on general guidelines until more specific data is provided
Qualities	-

2.System Architecture & Pattern:

2.1Architecture Description:

Based on the nature of the system (real-time system) event-based architecture and its suitability for various aspects such as scalability, performance, and resilience to change, it is the best choice for the AI-integrated fitness band system:

1. Real-time Responsiveness:

Event-based architecture enables the system to react promptly to events such as sensor data updates, user interactions, or system alerts. This is crucial for providing real-time feedback and suggestions to users, ensuring a seamless and responsive user experience.

2.Asynchronous Processing:

The asynchronous nature of event-driven architecture allows event consumers to process events independently, without waiting for other components. This is particularly beneficial for a fitness band system handling continuous streams of data from sensors and requiring quick processing of user interactions.

3. Flexibility and Extensibility:

Event-driven architecture supports loose coupling among components, making it easier to add or remove event producers and consumers without affecting other parts of the system. This flexibility is valuable for accommodating future enhancements or integrating new features into the fitness band system.

4. Scalability:

The architecture's ability to handle multiple event producers and consumers makes it highly scalable. As the system grows and the volume of data increases, new components can be added to distribute the workload, ensuring optimal performance and scalability.

5. Integration of AI Components:

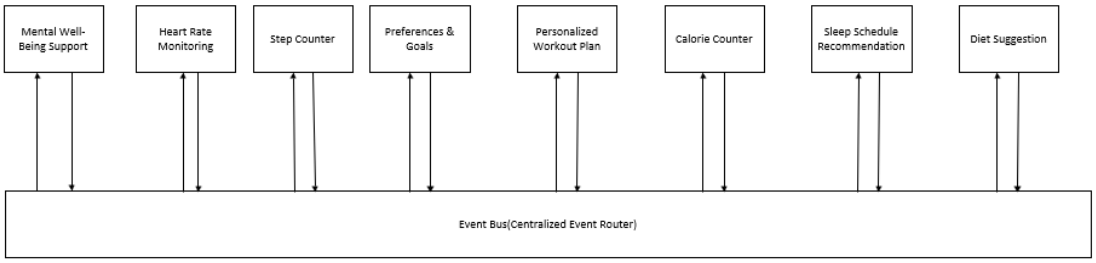
AI components such as personalized workout planners and mental well-being support through a chatbot can seamlessly integrate into the event-driven architecture. These AI modules can act as event consumers, reacting to specific events generated by user interactions or changes in the system's state.

6. Fault Tolerance:

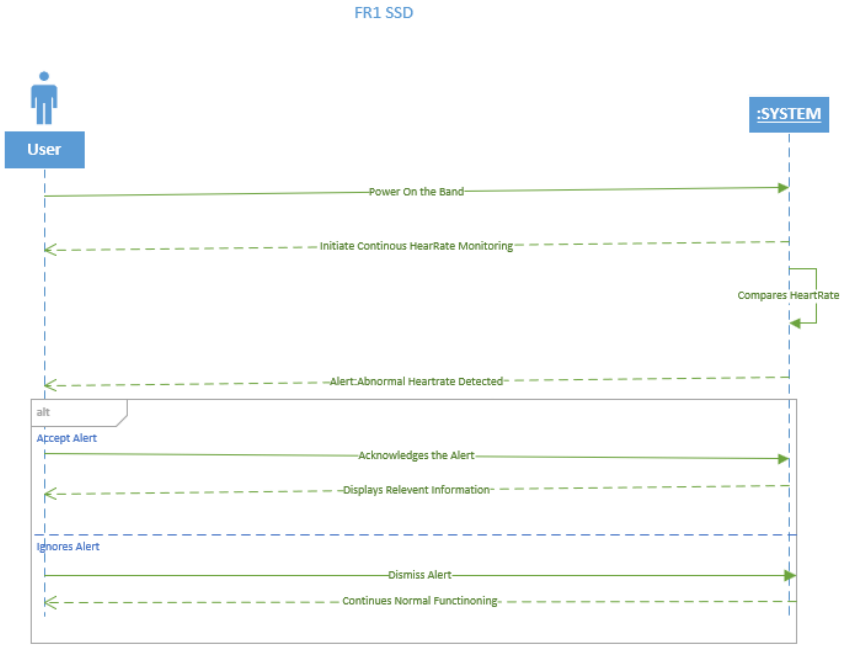
Event-driven architecture enhances fault tolerance by isolating components and minimizing dependencies. If a particular component fails, other parts of the system can continue to function independently, ensuring system stability and availability.

7.Low Latency and High Volume of Data:

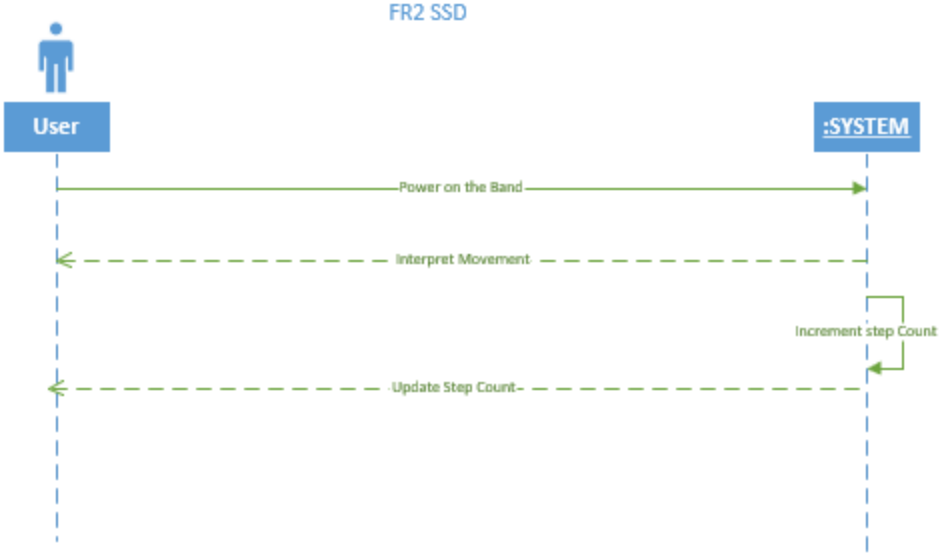
Event consumers can process events in near real-time, thanks to the asynchronous processing capabilities of event-driven architecture. This is beneficial for handling the high volume of data generated by sensors in a fitness band and providing timely feedback to users.



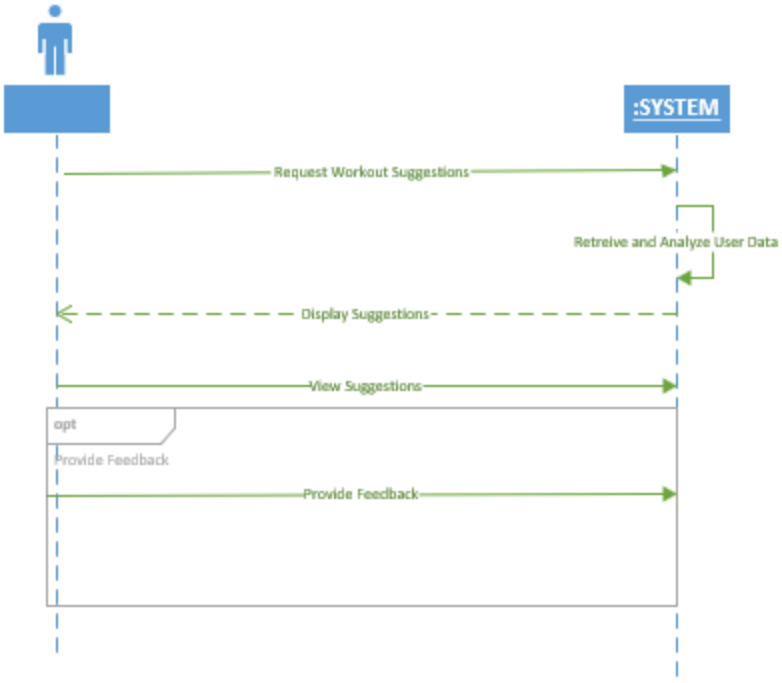
3.2:System Sequence Diagram



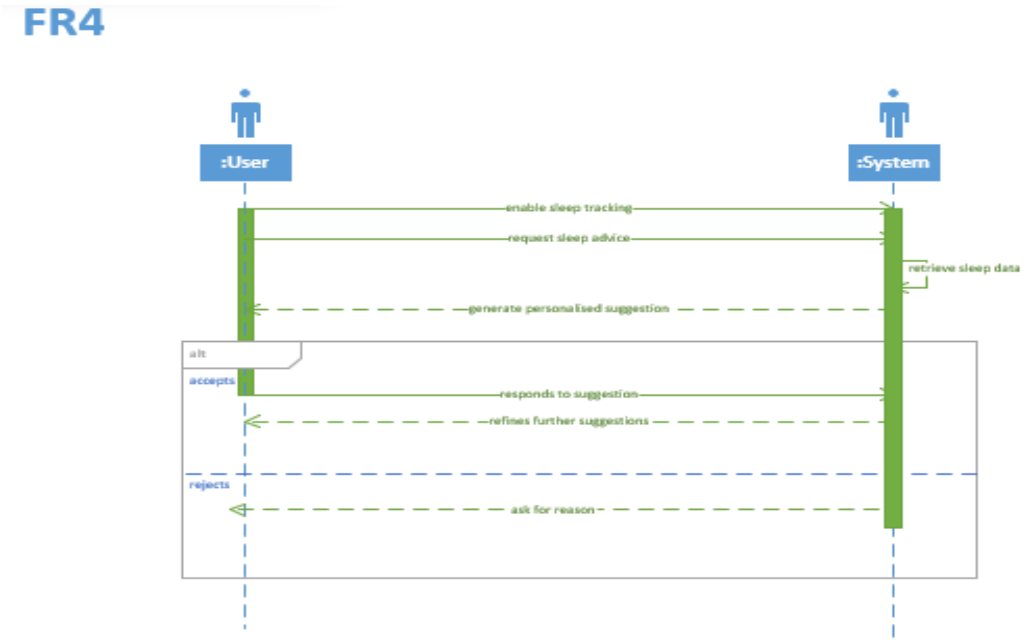
FR2 SSD

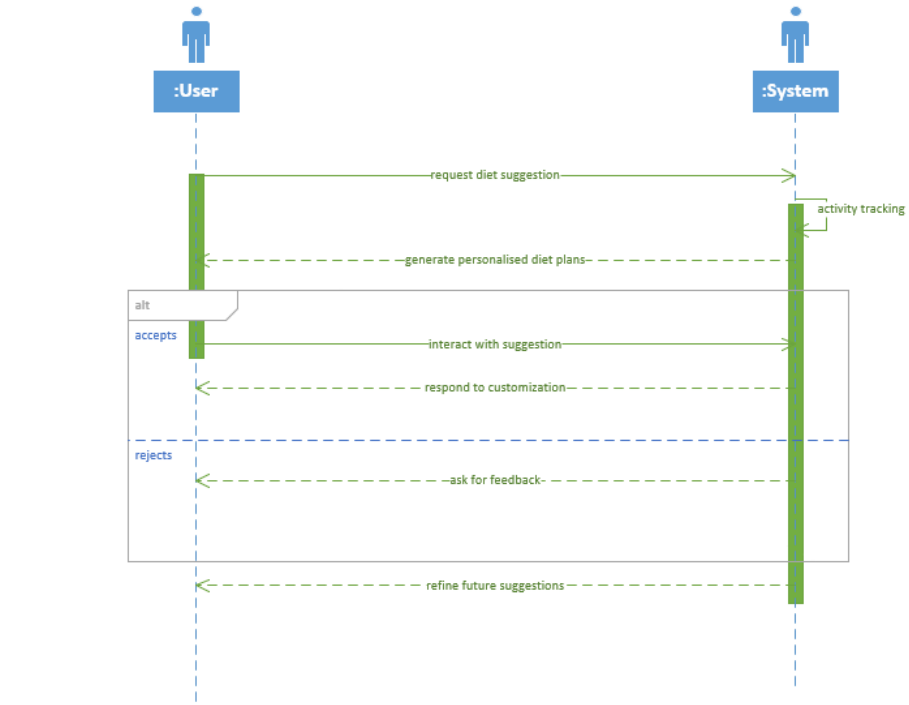


FR3 SSD



FR4 Main Flow

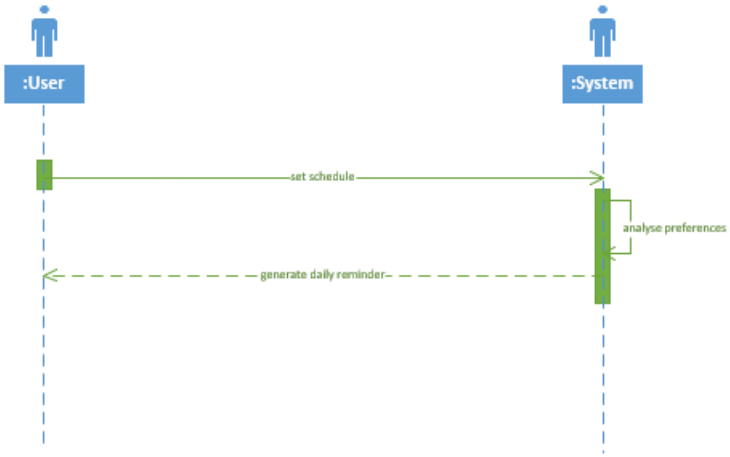




FR6

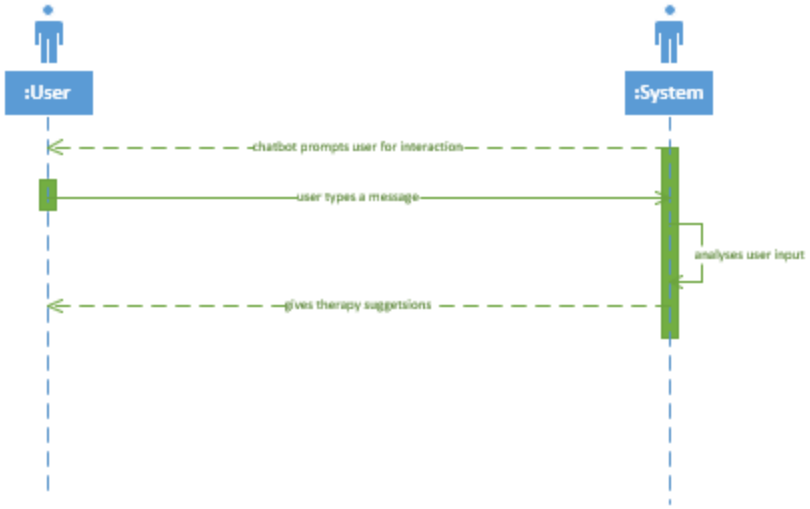
:User
:System
completes a physical activity
analyse health metrics
update calories burnt
opt
view historical data

FR7

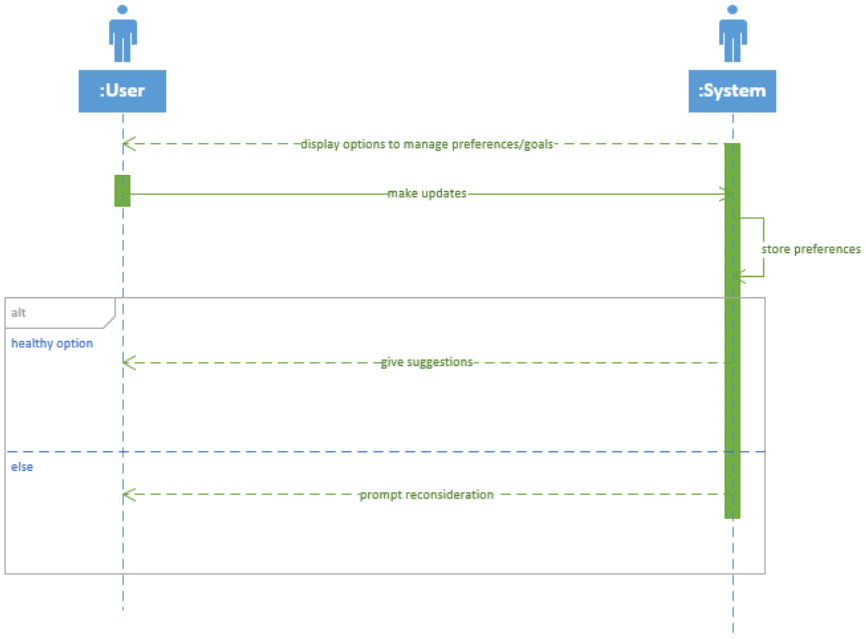

:User
:System
set schedule
analyse preferences
generate daily reminder

AI INTEGRATED FITNESS BAND

FR8

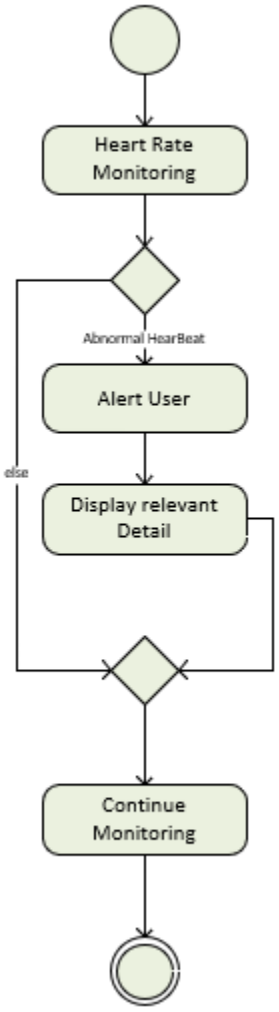


FR9

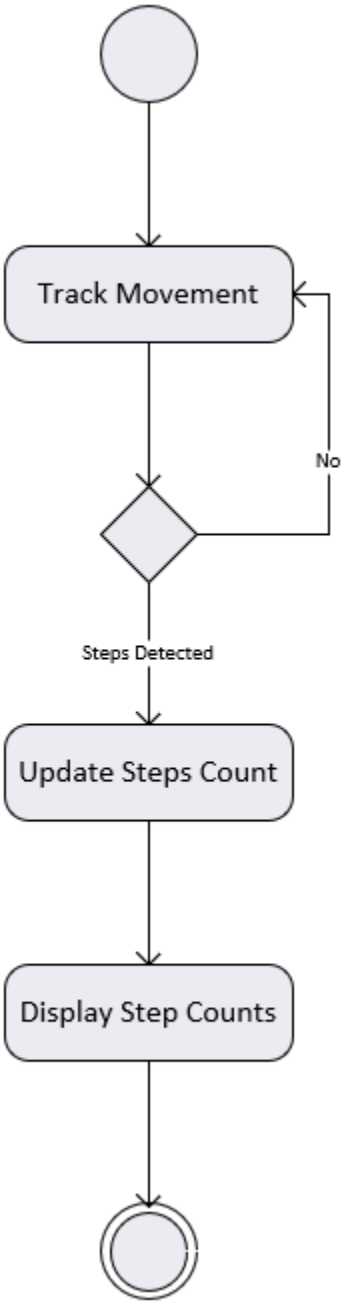


Activity Diagram

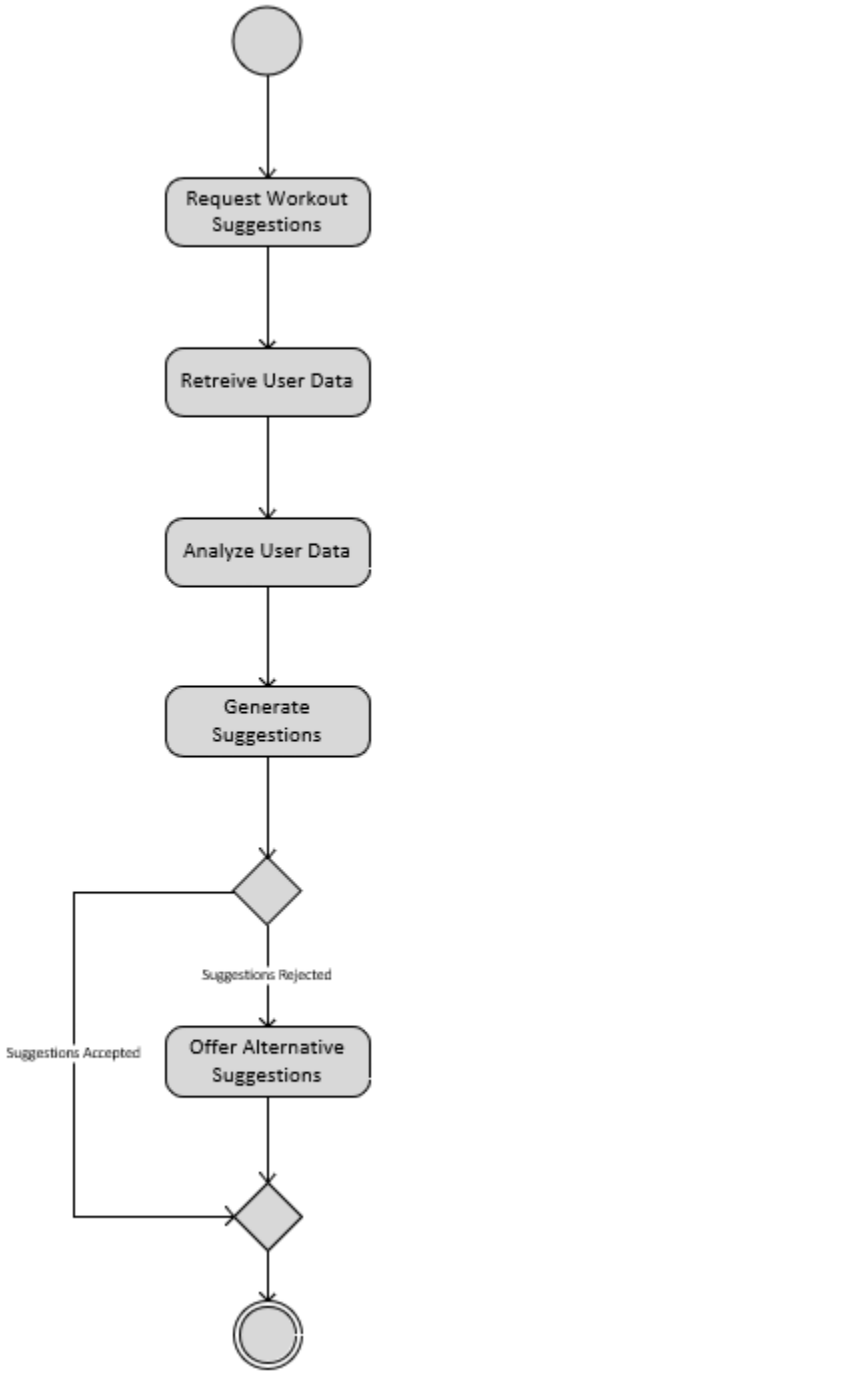
Heart Rate Monitoring Activity Diagram



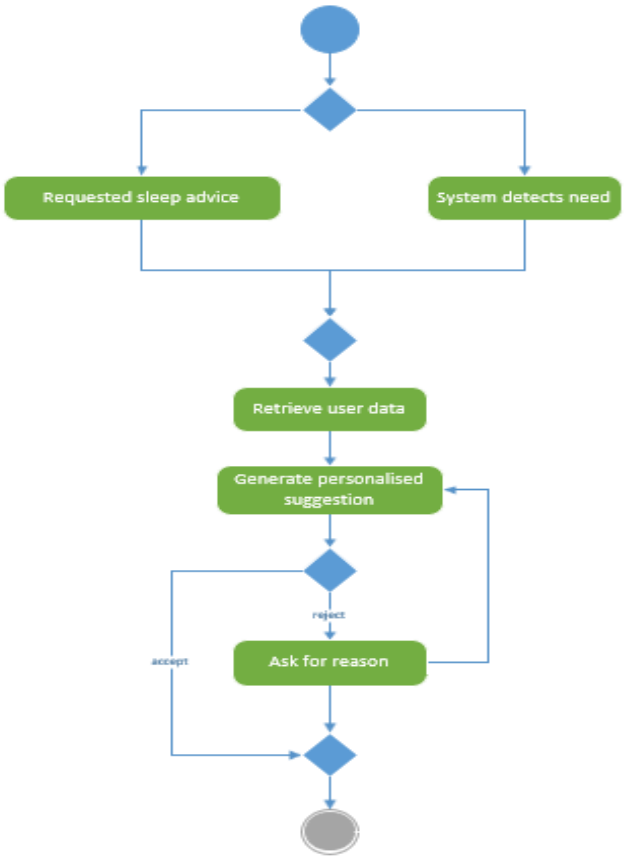
Step Counting Activity Diagram:



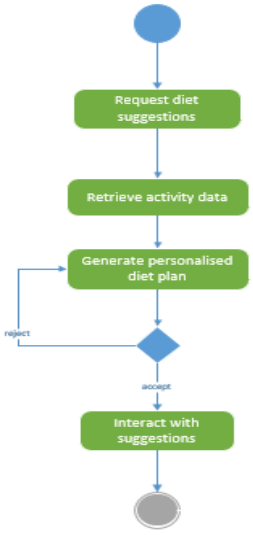
Suggestions For Personalized Diagram:



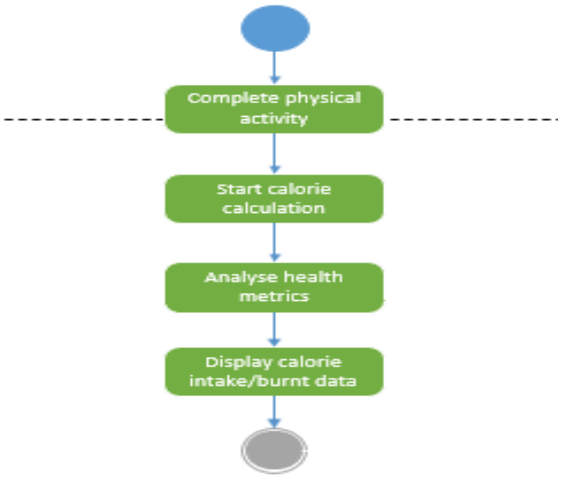
Recommend Sleeping Schedule:



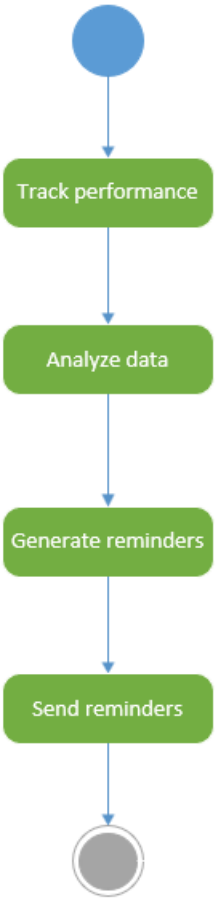
Diet suggestion:



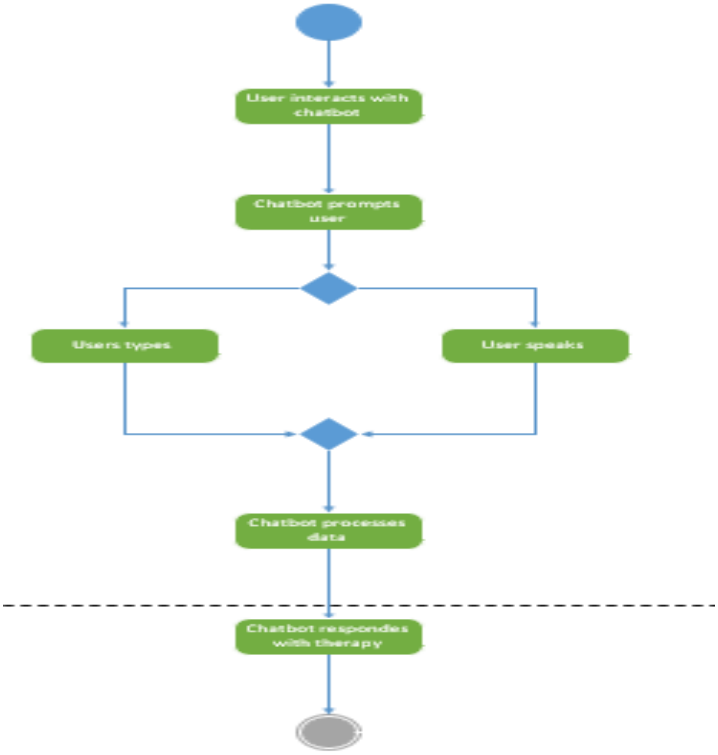
Calories Count:



Daily Reminder for Wellness Activities:



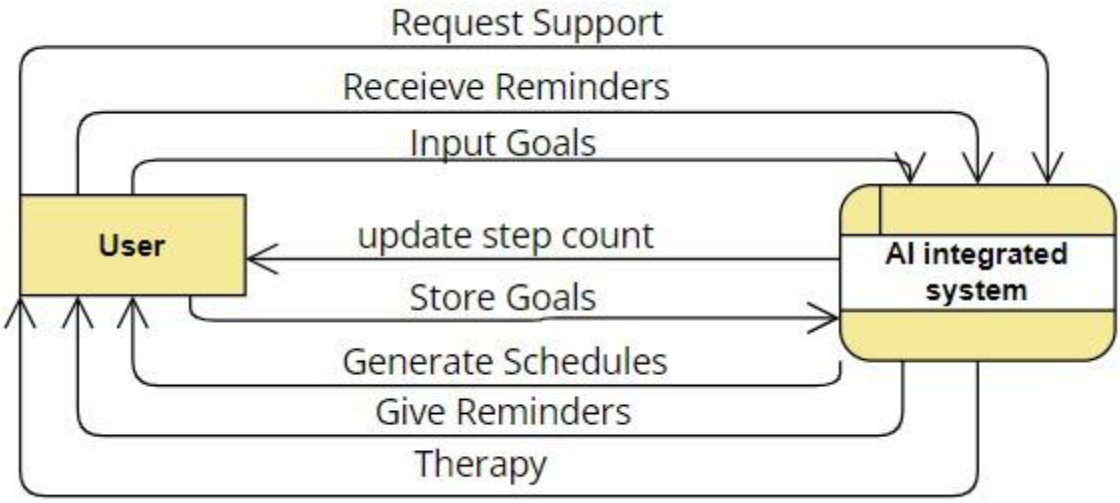
Integration of Chatbot for Mental Well-being Support:



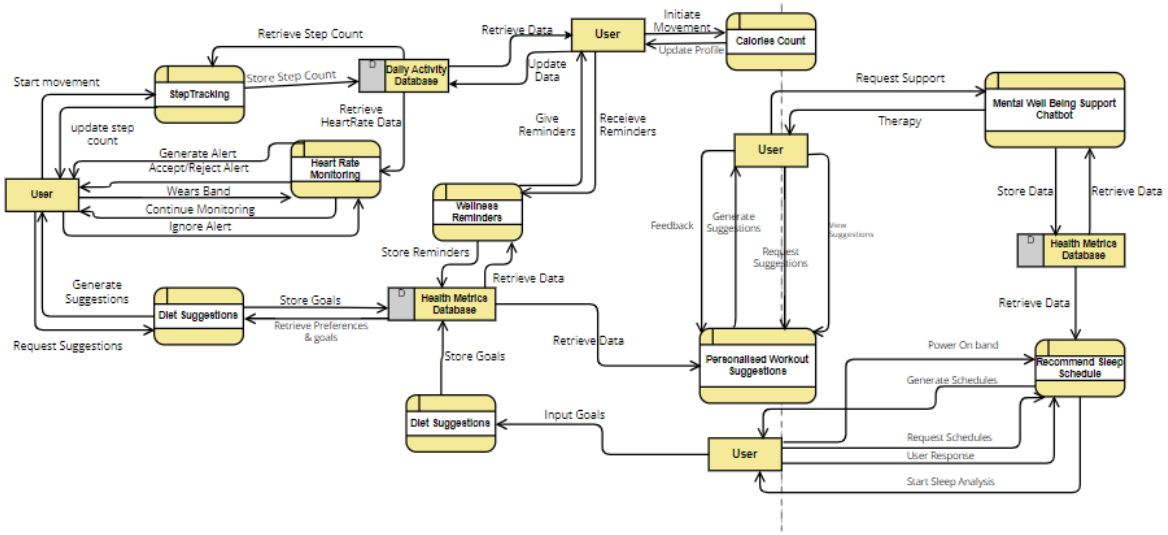
User Preferences and Goal Management:

Data Flow Diagram

Context Diagram:

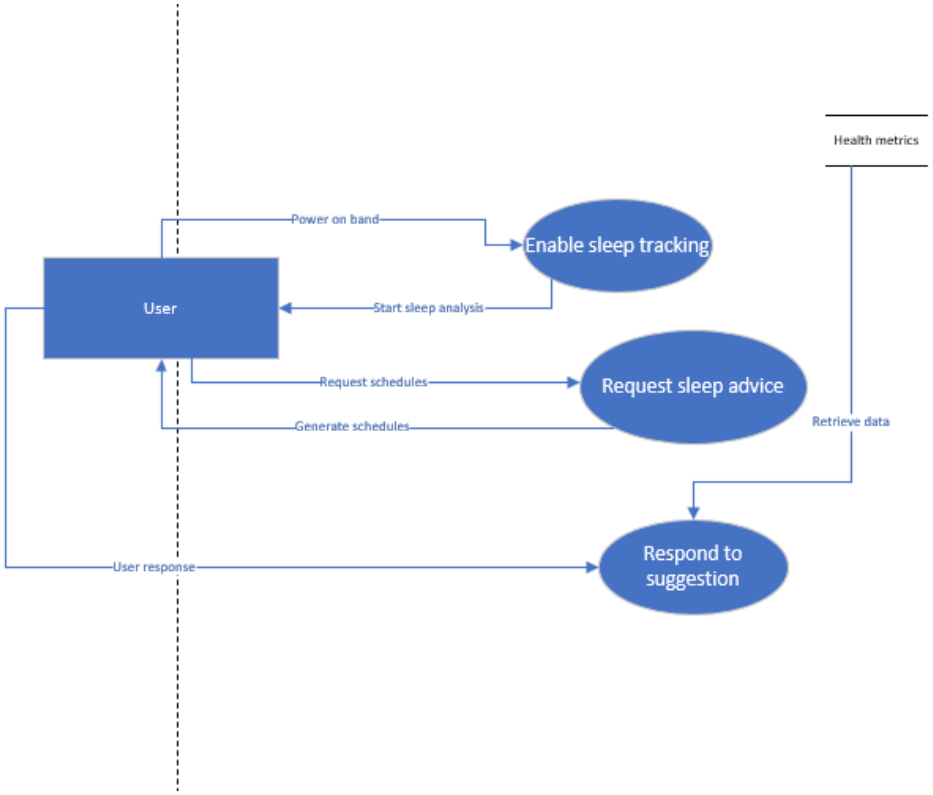


Level 0

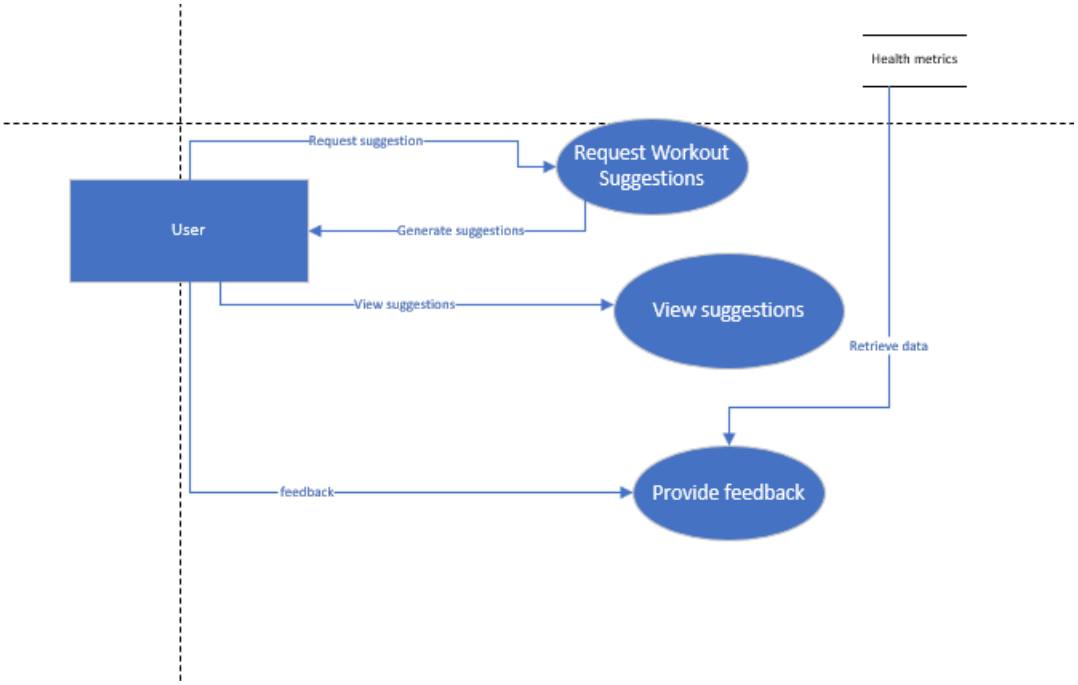


Level 1

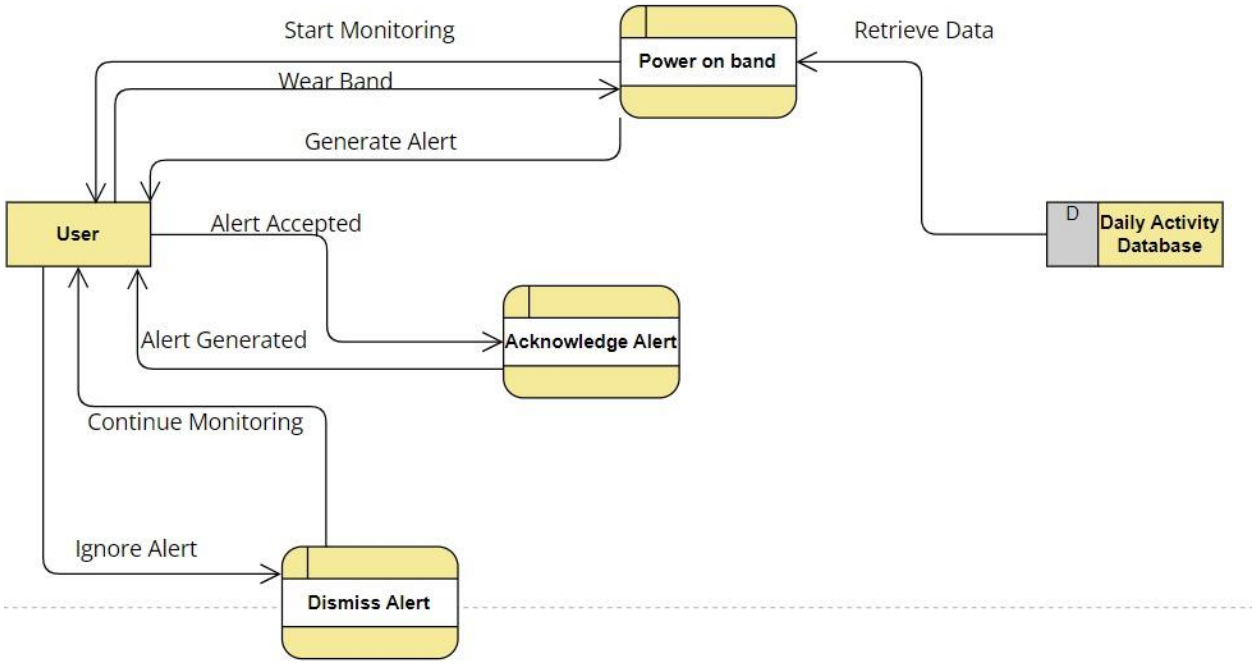
FR4



FR3



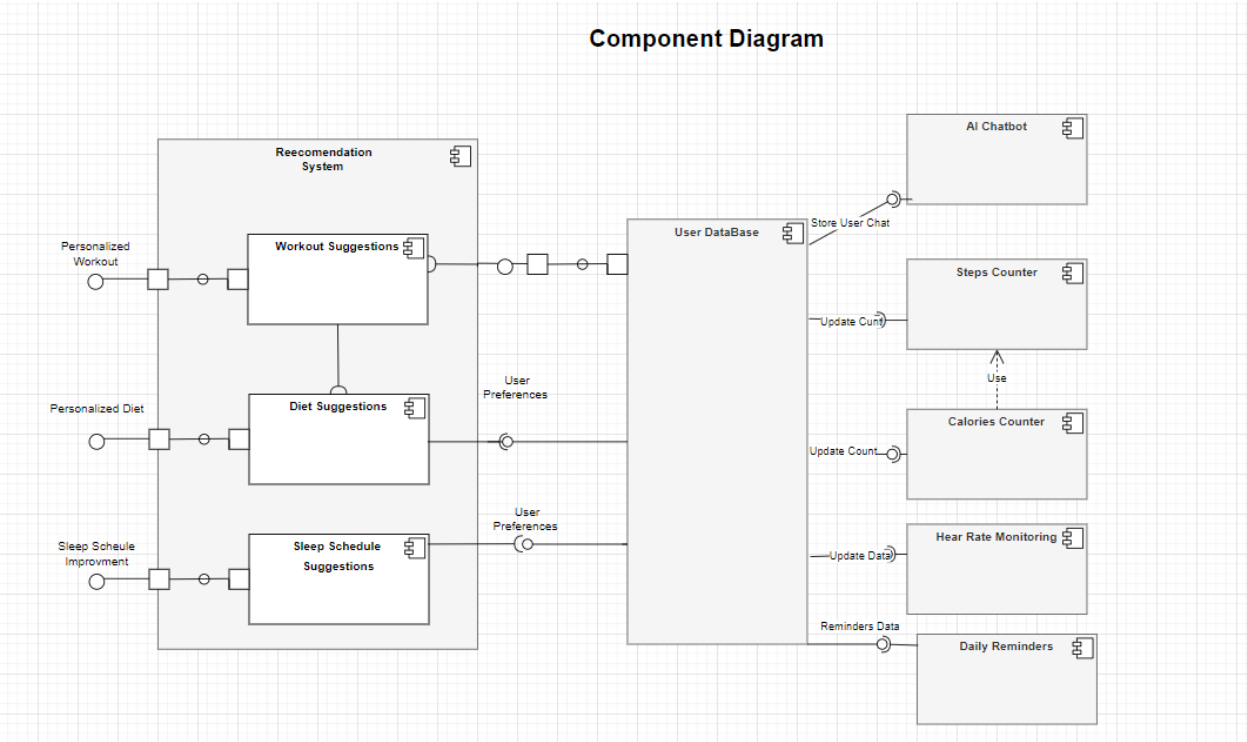
FR1


Start Monitoring
Power on band
Retrieve Data
Wear Band
Generate Alert
User
Alert Accepted
D
Daily Activity Database
Acknowledge Alert
Alert Generated
Continue Monitoring
Ignore Alert
Dismiss Alert

AI INTEGRATED FITNESS BAND

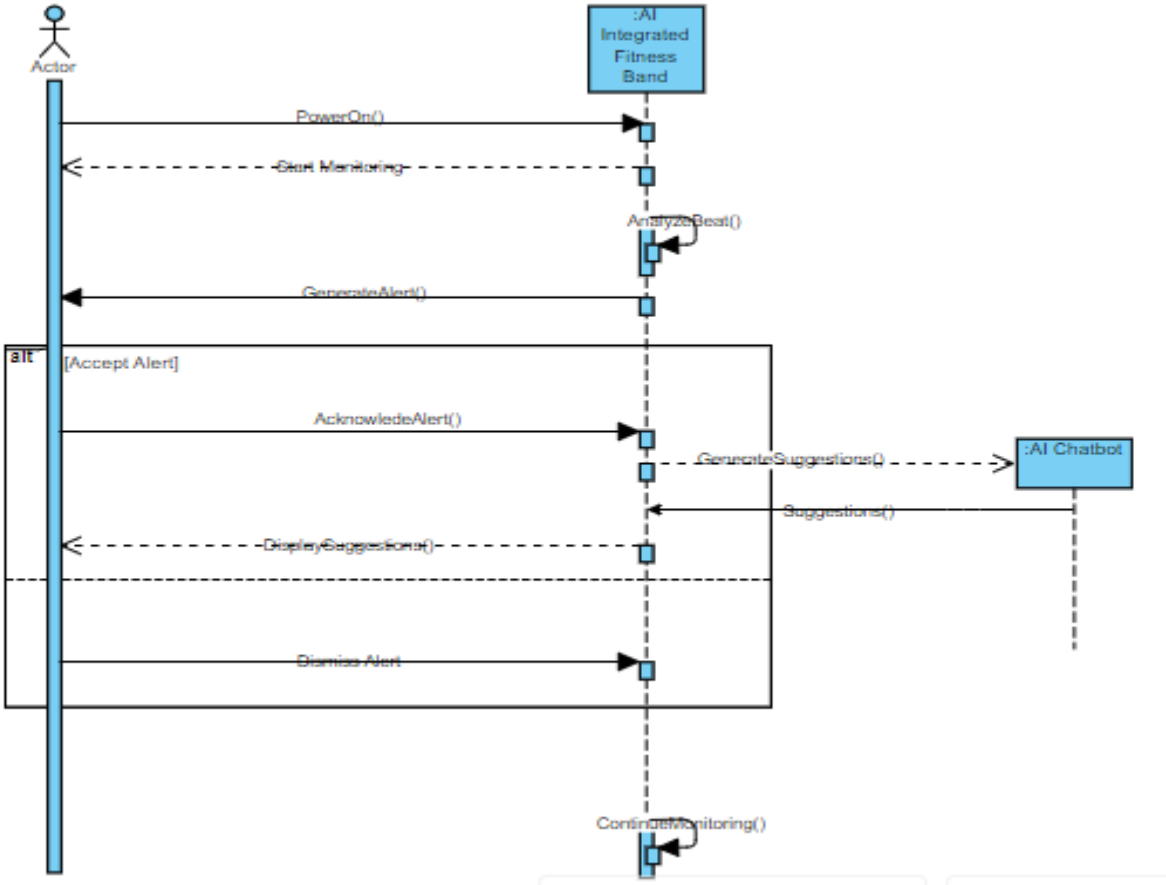
Project Phase III

Component Diagram

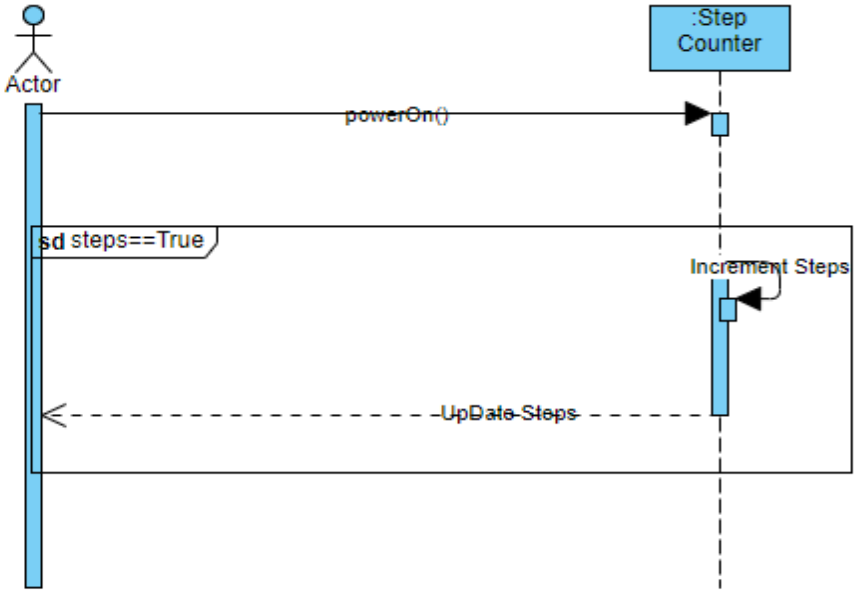


Sequence Diagram

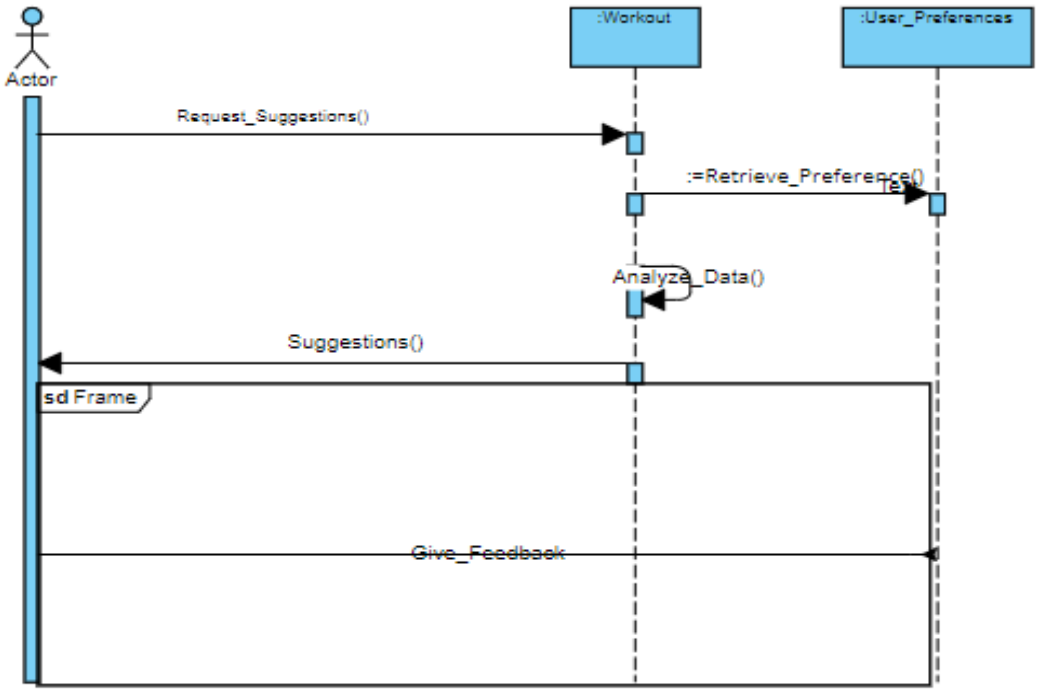
FR1



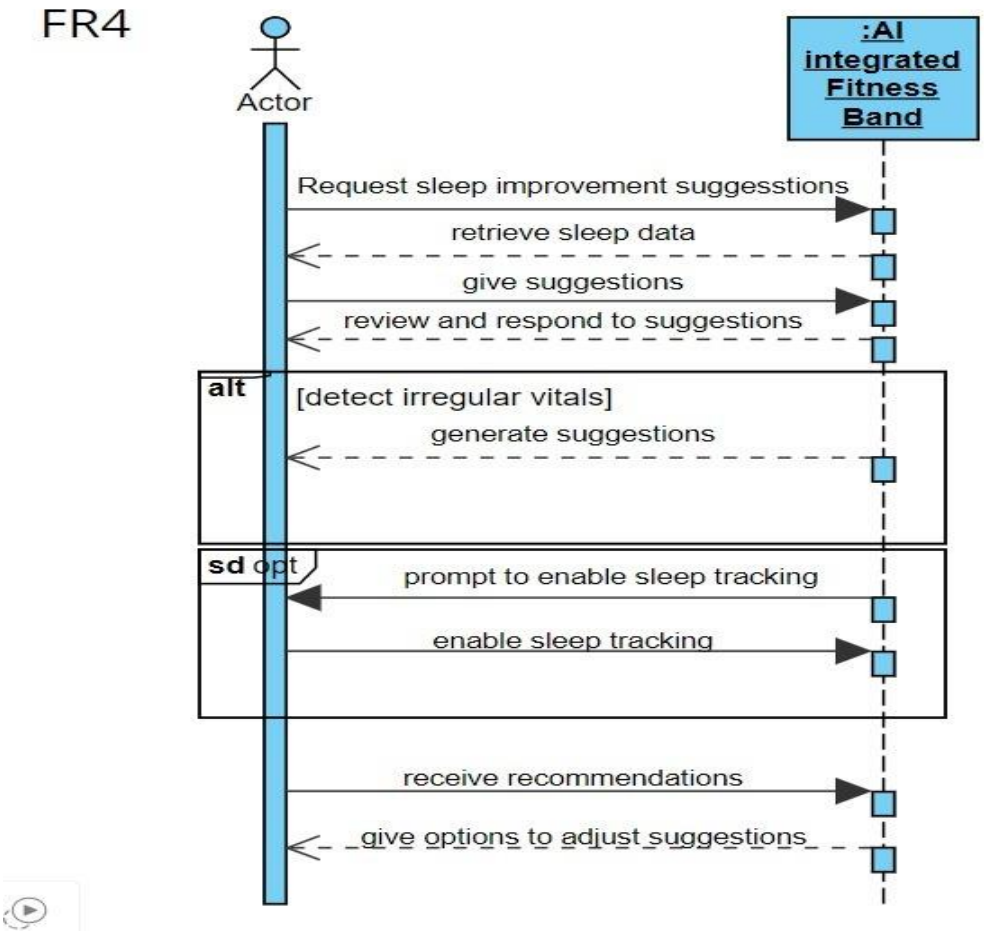
FR2


Actor
:Step Counter
powerOn()
sd steps==True
Increment Steps
UpDate Steps

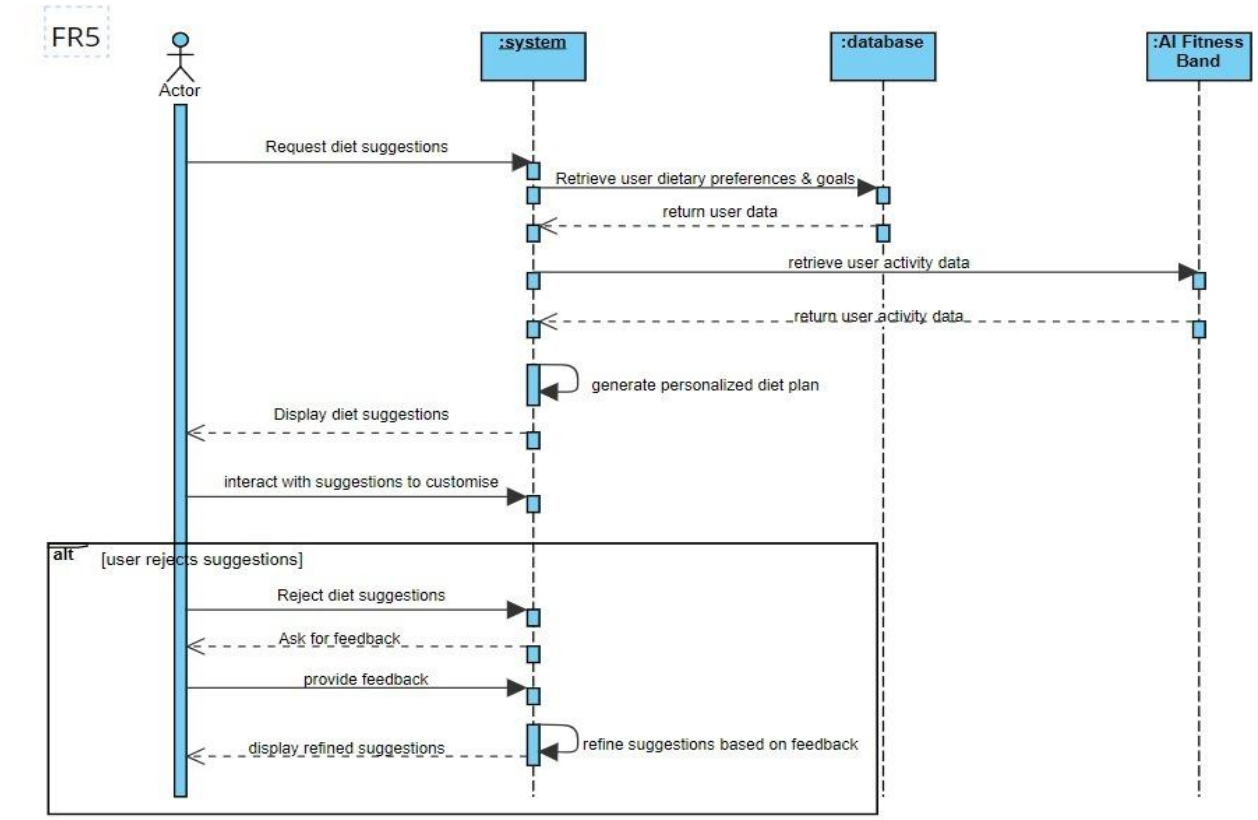
FR3


Actor
:Workout
:User_Preferances
Request_Suggestions()
:=Retrieve_Preference()
Analyze_Data()
Suggestions()
sd Frame
Give_Feedback

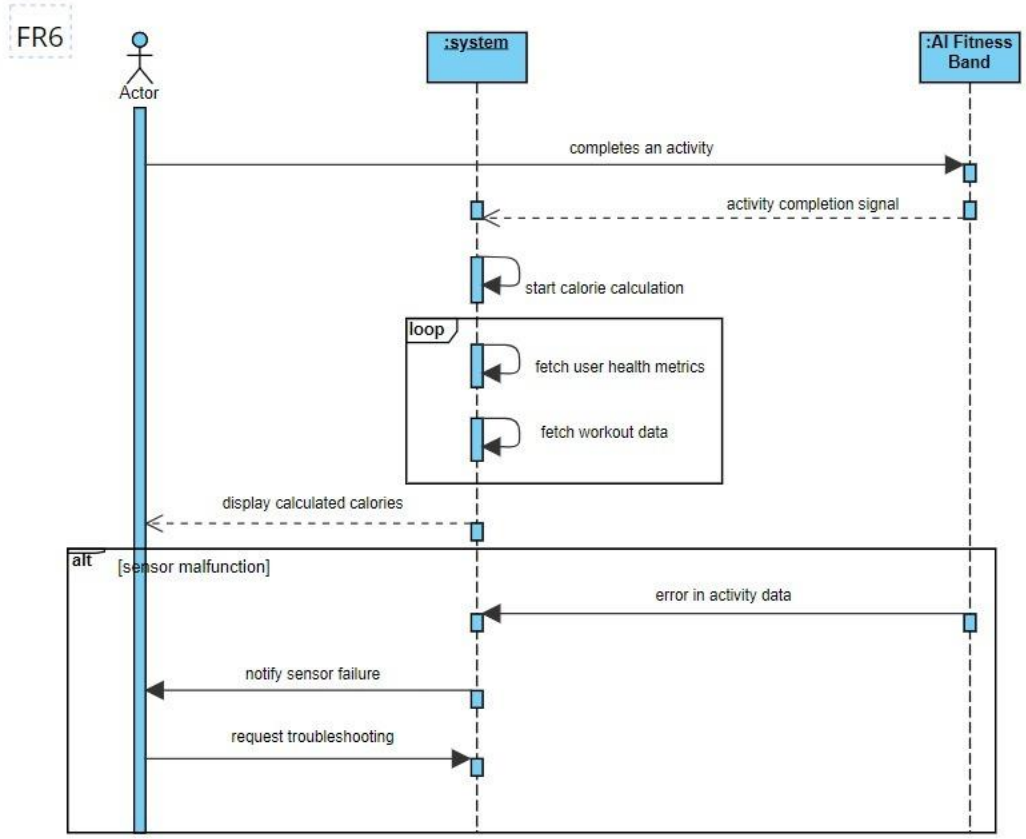
FR4


FR4
Actor
:AI integrated Fitness Band
Request sleep improvement suggesstions
retrieve sleep data
give suggestions
review and respond to suggestions
alt
[detect irregular vitals]
generate suggestions
sd opt
prompt to enable sleep tracking
enable sleep tracking
receive recommendations
give options to adjust suggestions

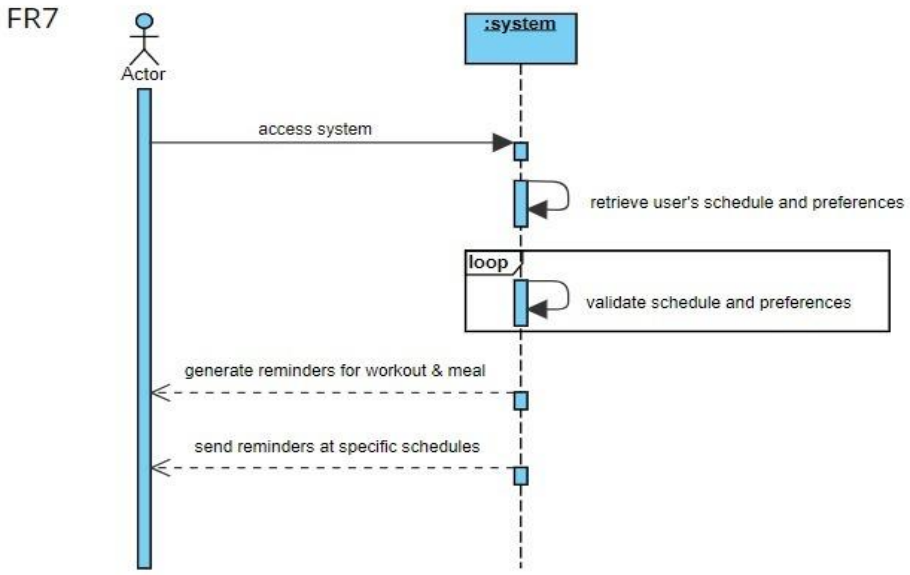
FR5


FR5
Actor
:system
:database
:AI Fitness Band
Request diet suggestions
Retrieve user dietary preferences & goals
return user data
retrieve user activity data
return user activity data
generate personalized diet plan
Display diet suggestions
interact with suggestions to customise
alt
[user rejects suggestions]
Reject diet suggestions
Ask for feedback
provide feedback
display refined suggestions
refine suggestions based on feedback

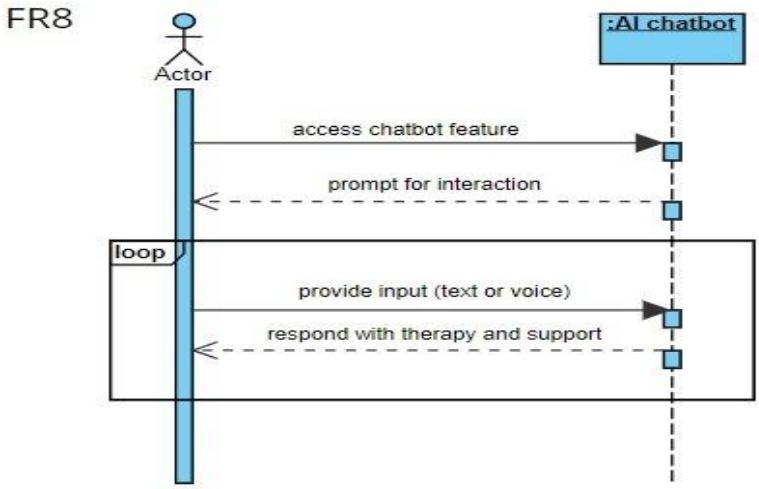
FR6


FR6
Actor
:system
:AI Fitness Band
completes an activity
activity completion signal
start calorie calculation
loop
fetch user health metrics
fetch workout data
display calculated calories
alt
[sensor malfunction]
error in activity data
notify sensor failure
request troubleshooting

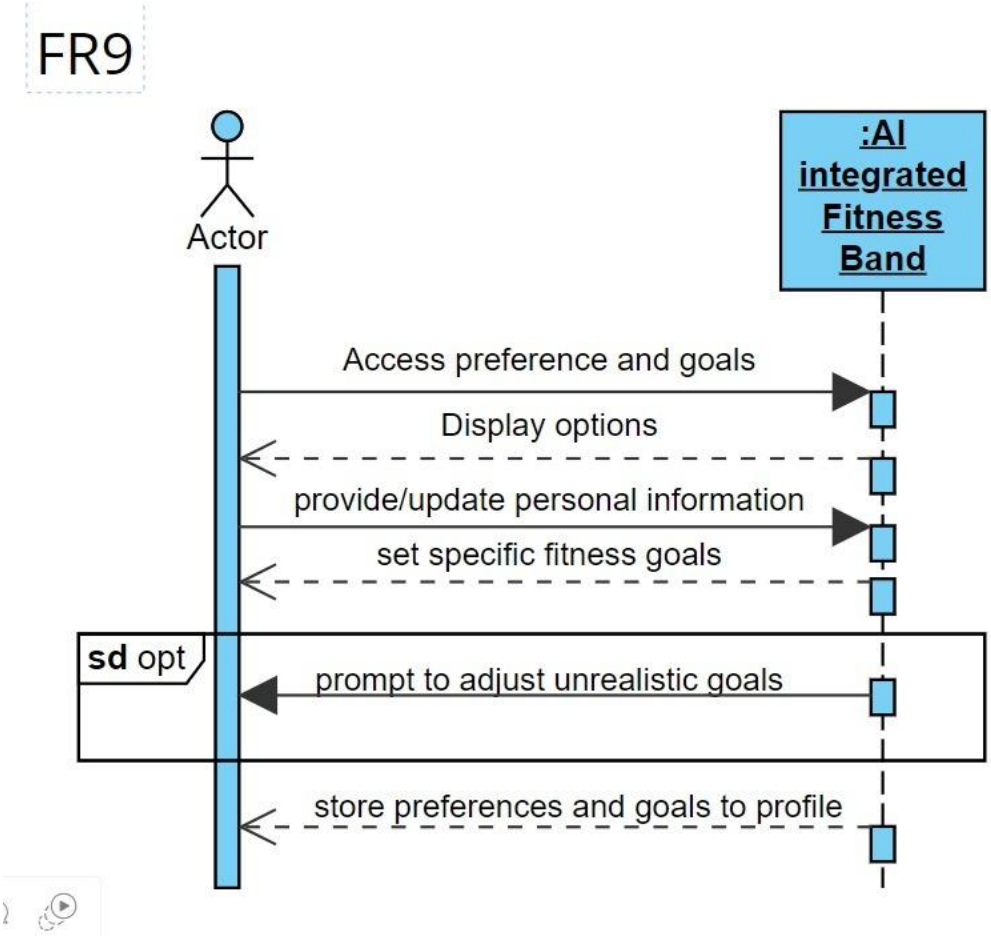
FR7


FR7
Actor
:system
access system
retrieve user's schedule and preferences
loop
validate schedule and preferences
generate reminders for workout & meal
send reminders at specific schedules

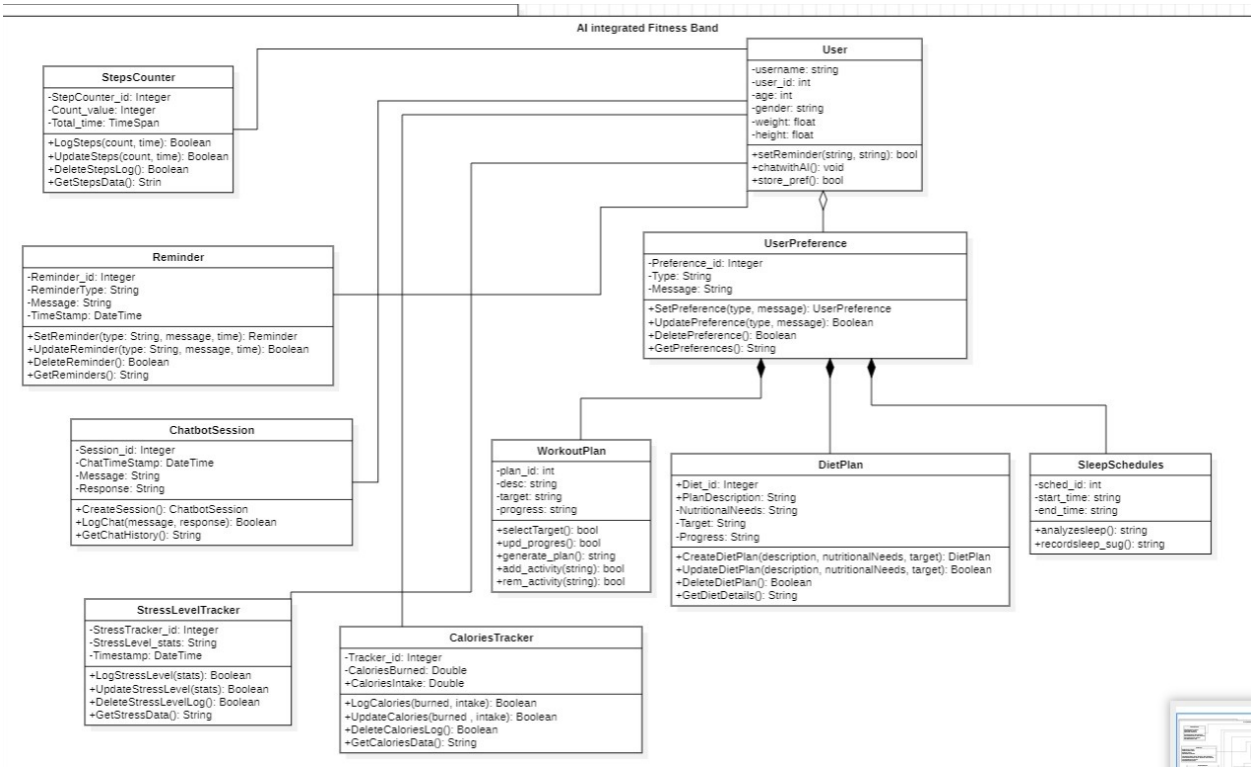
FR8


FR8
Actor
:AI chatbot
access chatbot feature
prompt for interaction
loop
provide input (text or voice)
respond with therapy and support

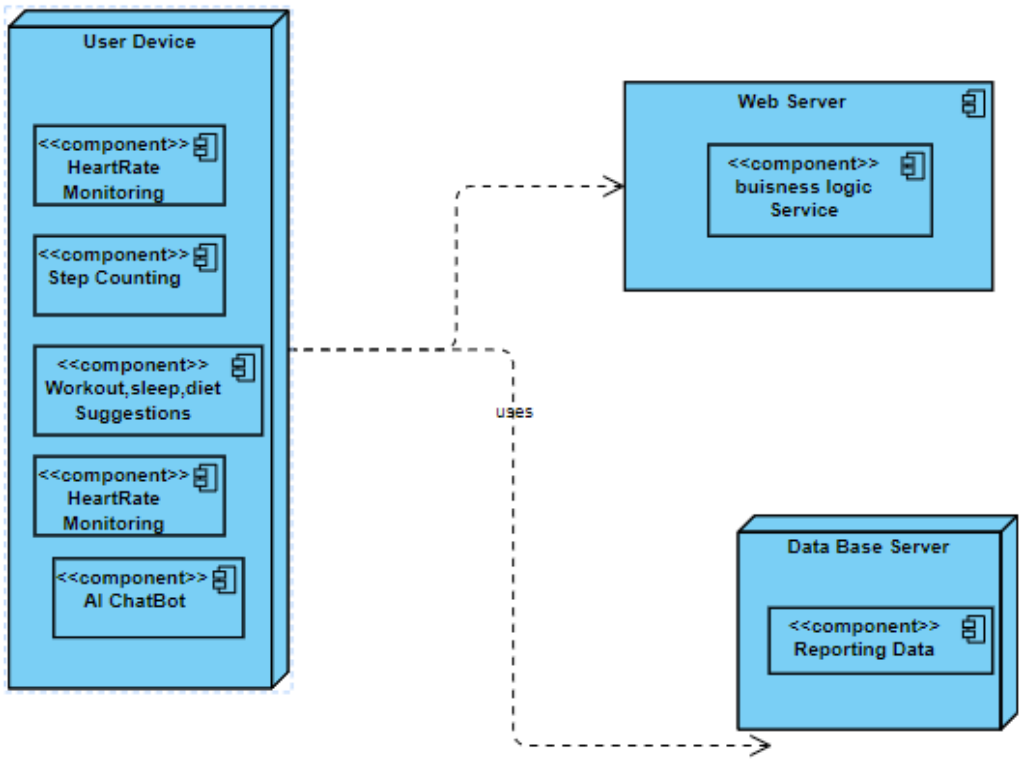
FR9


FR9
Actor
:AI integrated Fitness Band
Access preference and goals
Display options
provide/update personal information
set specific fitness goals
sd opt
prompt to adjust unrealistic goals
store preferences and goals to profile

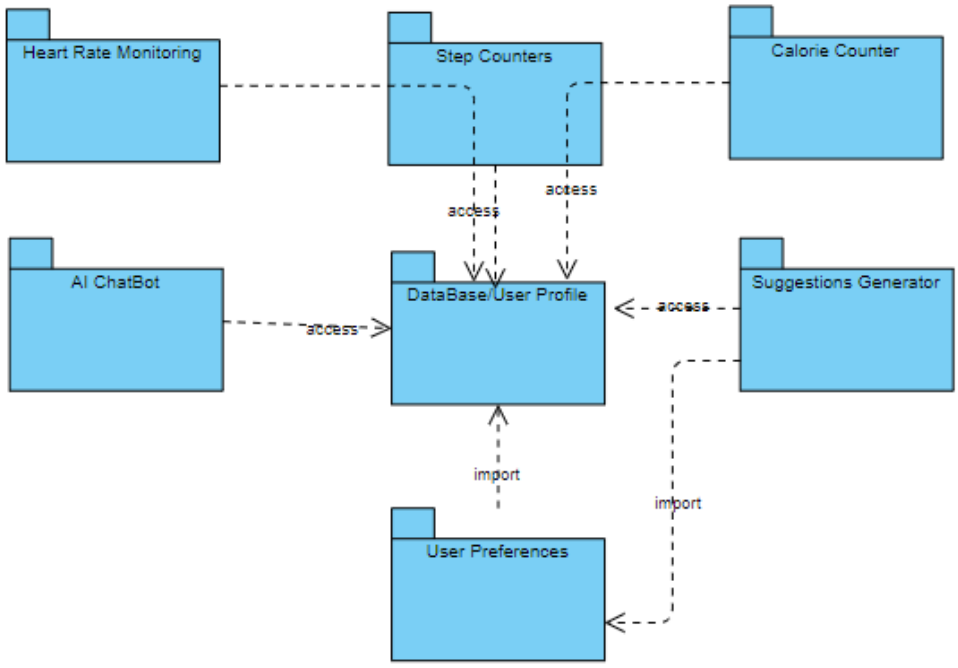
Class Diagram:



Deployment Diagram



Package Diagram



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