SOEN6841: Software Project Management

Winter 2025

PROBLEM IDENTIFICATION

FOR

AI-DRIVEN HEALTH MONITORING APP

Date of Submission: February 02, 2025

Submitted to:

JOUMANA DARGHAM

Team Information

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1. Problem Identification

Title: AI-Driven Mobile App for Personalized Health Monitoring

Objective:

AI-Driven Mobile App for Personalized Health Monitoring is an intelligent health monitoring app that provides real-time, comprehensive health tracking using state-of-the-art artificial intelligence and wearable technology. It tracks physical health (heart rate, temperature, exercise) and mental health (stress, fatigue) via smartwatch sensors. Yet, it's important to note that mental health awareness of conditions comes from voice and facial analysis.

This project will incorporate machine learning in the following ways:

Random Forest will be used to detect the type of exercise, **Support Vector Machines (SVM)** will be used for heart disease acquisition detection and assessment and heart disease risk assessment, and **Convolutional Neural Network (CNN)** will be used for emotion and fatigue detection. When this application provides users with a true assessment of their health, they can be preventative in lifestyle changes by no longer ignoring symptoms or truths.

Content:

Problem/Opportunity Statement:

Chronic conditions are increasing, and a senior population wants to take a proactive approach to any diagnosis relative to health management. Assessment and better devices should be more integrated and technologically advanced. However, wearable technology that would facilitate such things is not as prevalent as it should be. The assessment, therefore, comes from fallible blood pressure readings from seldom-frequented doctor's offices or pharmacy chains and an inability to get accurate, 24-hour blood pressure readings when someone complains at their semi-annual or annual check-up. In addition, the blood pressure measurements that do exist are more worn as pedometers and heart rate monitors with no medical oversight than supported by the artificial intelligence (AI) technology needed to provide accurate, comprehensive diagnosis.

The core problem this project addresses is the absence of an intelligent, integrated health monitoring solution that combines both physiological and behavioral data for a holistic view of

an individual's health. The system aims to overcome the limitations of current technologies by utilizing AI-driven models capable of analyzing data from smartwatches and mobile applications. This includes monitoring vital signs such as heart rate, body temperature, and step count, as well as detecting psychological states like stress and fatigue through speech and facial recognition analysis.

The goal is to create a robust, dependable, and efficient health monitoring system that not only collects data but also processes it intelligently to provide timely health assessments and actionable advice. By incorporating machine learning algorithms like Random Forest for activity recognition, Support Vector Machines (SVM) for cardiovascular risk assessment, and Convolutional Neural Networks (CNN) for mood and fatigue detection, the system seeks to deliver high accuracy in health evaluations. This comprehensive approach empowers users to actively manage their health, make informed decisions, and adopt preventive measures, ultimately contributing to improved health outcomes and quality of life.

Project Scope:

In-Scope:

- Development of AI models for health predictions.
- Secure API integration with wearable devices.
- UI/UX design for user-friendly experience.
- Compliance with medical regulations (HIPAA, GDPR).
- Mobile application development (Android & iOS).

Out-of-Scope:

- Direct medical consultation or prescriptions.
- Hardware manufacturing (third-party wearable integration only).
- Diagnosis of complex medical conditions without human oversight.

Significance in Healthcare Domain:

Early Detection & Prevention: AI-driven analytics can identify potential health risks before they become critical, reducing hospital admissions and emergency cases.

Personalized Health Insights: AI models can provide recommendations tailored to an individual's lifestyle, medical history, and daily activities.

Reduced Healthcare Costs: By preventing major illnesses and reducing doctor visits through self-monitoring, individuals can significantly lower healthcare expenses.

Improved Accessibility: The app ensures continuous health monitoring for individuals in remote or underserved areas who have limited access to medical facilities.

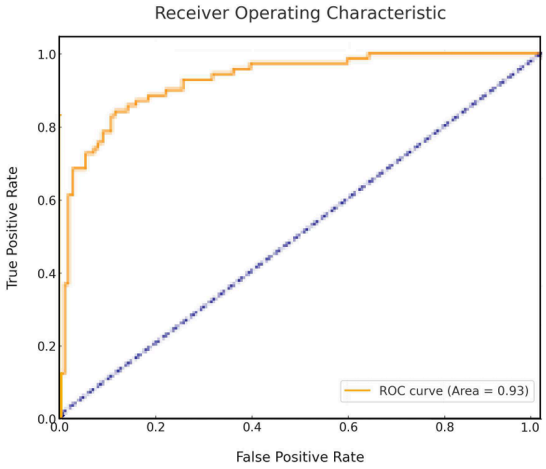

Fig 1: ROC Curve Analysis for the SVM Model

The figure related to ROC Curve Analysis for the SVM Model, showing an **AUC (Area Under the Curve) of 93%**, which indicates excellent model performance in distinguishing between different cardiovascular risk levels. This suggests that the model is highly effective at predicting heart health risks, making it a valuable tool for early detection of potential cardiovascular conditions.

The findings highlight the feasibility of AI-driven mobile health applications in providing real-time, highly accurate personalized health monitoring.

Stakeholder Analysis

Stakeholder	*Role & Impact*	*Interest & Concerns*
Individual Users	Primary beneficiaries using the app for health tracking and recommendations.	Accuracy of AI predictions, ease of use, data privacy, and integration with wearable devices.
Healthcare Professionals	Doctors and specialists who can use the app's insights for improved patient care.	Reliability of AI-generated recommendations, data sharing compliance, and reducing misdiagnosis.
Hospitals & Clinics	Institutions that can integrate the app for remote patient monitoring.	Integration with existing systems, regulatory compliance, and potential cost savings.
Insurance Company	Firms that may use the app for policy adjustments based on health metrics.	Risk assessment, fraud prevention, and customer engagement through incentives for healthy habits.
Regulatory Bodies	Government agencies ensure data security and compliance with health regulations.	Data privacy, ethical AI use, and adherence to medical standards (e.g., HIPAA, GDPR).
Tech Companies & Developers	Developers building the AI algorithms and infrastructure for the app.	Scalability, AI model accuracy, security, and ongoing maintenance.

Relevance to Software Solution:

How the Problem Can Be Addressed through Software Development?

The health monitoring challenges identified in this project are comprehensively addressed through the development of an advanced software solution that integrates artificial intelligence (AI) with wearable technology. The Smart Health Monitoring App (SHMA) leverages software to bridge the gap between raw physiological data collection and actionable health insights, ensuring real-time, accurate, and personalized health monitoring.

At the core of the solution is a **React Native mobile application** that provides a user-friendly interface for individuals to interact with their health data. This app seamlessly communicates with a Google Pixel Watch, which collects real-time physiological metrics such as heart rate, body temperature, and physical activity levels. The mobile application is designed not only to display this data but also to process it through sophisticated AI algorithms, transforming raw information into meaningful health insights.

The software incorporates multiple machine learning models tailored to different health parameters:

- Random Forest algorithms are used for activity recognition, classifying user activities like walking, running, or sitting with an accuracy of 98%.
- Support Vector Machines (SVM) assess cardiovascular risk by analyzing physiological data patterns, achieving an accuracy of 86% and an AUC (Area Under the Curve) of 93%.
- Convolutional Neural Networks (CNN) handle mood detection through speech analysis and facial fatigue recognition, with accuracies of 97% and 93%, respectively.

The scope of the software solution extends beyond simple data visualization. It integrates behavioral health monitoring by analyzing speech for stress detection and facial expressions for fatigue recognition. These AI-driven insights allow for proactive health management, providing personalized recommendations and early warnings about potential health issues. Furthermore, the app is designed for scalability and adaptability, capable of integrating with additional

wearable devices and expanding its monitoring capabilities to cover more complex health metrics in the future.

The backend infrastructure, powered by **Node.JS**, ensures efficient data processing and secure communication between the smartwatch and the mobile app. The software architecture is built to handle real-time data streams, ensuring continuous monitoring without compromising performance. Additionally, the use of Figma for front-end design ensures an intuitive user experience, making complex health data easily accessible and understandable for users.

The SHMA shows how software development can transform wearable health technology into a comprehensive, intelligent health management system. It addresses the limitations of traditional health monitoring methods by providing a scalable, user-centric, and AI-powered solution that empowers individuals to take control of their health proactively.

Initial Thoughts on Scope

- ➔ **Core Features:**
  - ◆ AI-driven analysis of vital signs (heart rate, blood pressure, oxygen levels, etc.).
  - ◆ Personalized health insights and recommendations.
  - ◆ Real-time alerts for potential health issues.
  - ◆ Secure data storage and encryption.
  - ◆ Integration with wearable devices.
- ➔ **Advanced Features:**
  - ◆ Chatbot-powered health guidance.
  - ◆ Integration with telemedicine platforms.
  - ◆ Predictive analytics for disease prevention.
  - ◆ Gamification for user engagement.
- ➔ **Target Users:**
  - ◆ Individuals with chronic conditions.
  - ◆ Fitness enthusiasts and wellness-conscious users.
  - ◆ Elderly individuals who require regular health monitoring.

Flow Chart:

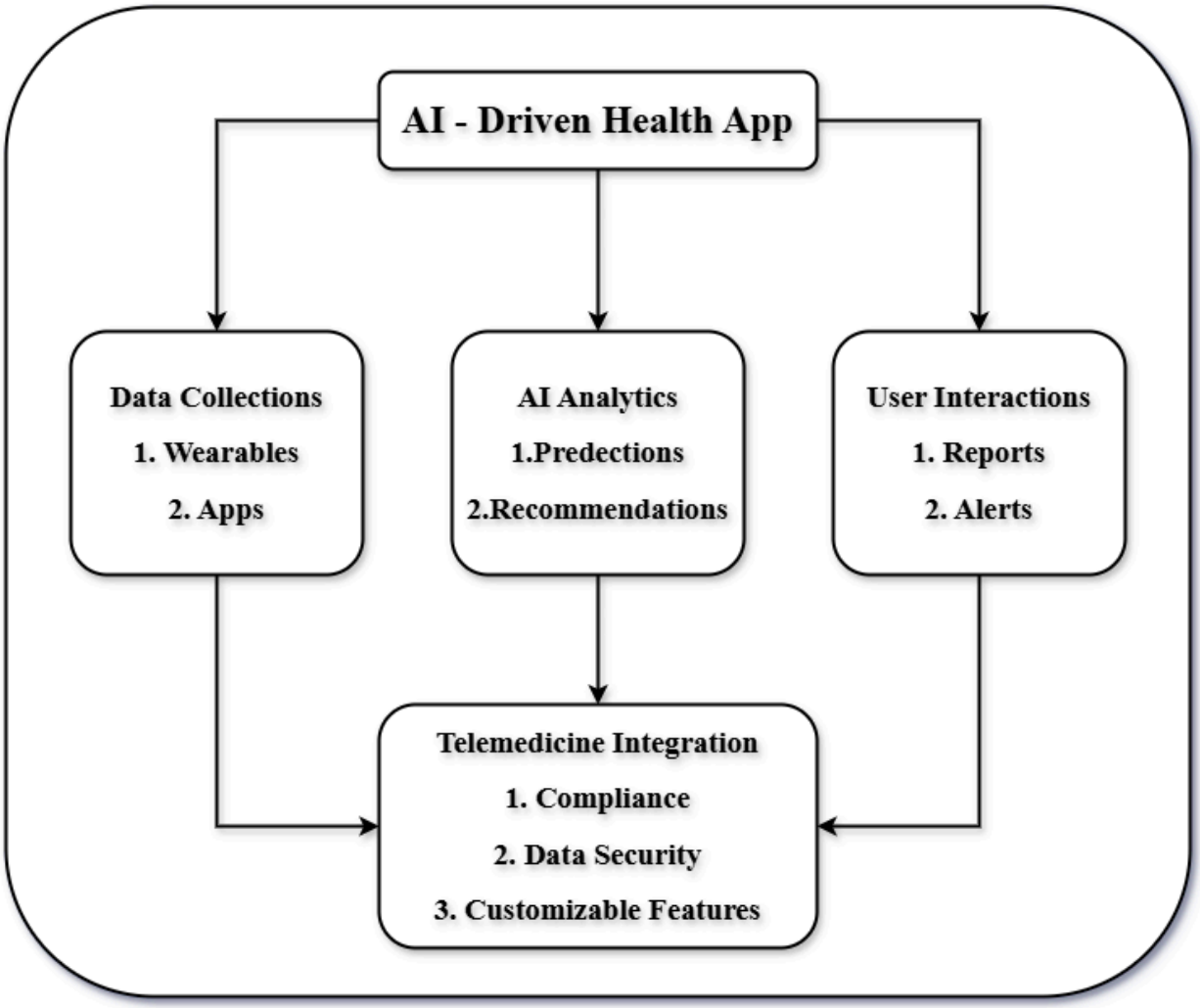

Fig 2: Flow Chart for AI - Driven Health App

Project Charter:

The AI-Driven Health Monitoring App project aims to develop a cutting-edge software solution that leverages artificial intelligence to analyze health data, provide personalized recommendations, and alert users to potential health concerns. This application will integrate with wearable devices, allowing users to monitor their health in real time while ensuring data privacy and compliance with regulations such as HIPAA and GDPR. The project will cater to individual users, healthcare providers, and regulatory bodies, addressing their needs through

secure data storage, AI-driven analytics, and an emergency alert system. Key deliverables include a fully functional mobile app, AI-powered insights engine, and secure cloud-based storage. The project will follow a structured timeline, starting with research and planning (Month 1), UI/UX design and prototyping (Month 2), AI model development and testing (Months 3-4), integration with wearables and backend development (Month 5), beta testing and feedback (Month 6), and final deployment (Month 7). Potential risks include data security concerns, AI accuracy and bias, and user adoption challenges, which will be mitigated through robust encryption, continuous model training, and an intuitive user experience. Success will be measured by high user adoption rates, regulatory compliance, seamless wearable integration, and accurate AI-driven health insights, ensuring that users receive timely and actionable health alerts to improve their well-being.

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MARKET ANALYSIS

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2. Market Analysis

Objective

The primary goal of this market analysis is to evaluate the potential of an AI-driven health monitoring app by identifying key user segments, analyzing competitors, and highlighting the unique value proposition of the application.

This report aims to:

- Identify the target audience based on demographics, health concerns, and technology adoption trends.
- Analyze competing products to assess strengths, weaknesses, and market gaps.
- Define the unique selling points (USPs) that distinguish this app in terms of functionality and business value.
- Evaluate market trends to assess the long-term sustainability and future growth of the product.
- Address regulatory concerns related to data security and privacy in health monitoring applications.

Market Size and Growth

The global digital health market is expanding rapidly, driven by advancements in AI, wearable technology, and telehealth solutions:

- The global digital health market was valued at $96.5 billion in 2020 and is projected to reach $220 billion by 2026, growing at a CAGR of 14.8%.
- The wearable health technology segment is forecasted to surpass $70 billion by 2026, highlighting strong demand for AI-powered monitoring solutions.
- 72% of consumers express interest in AI-driven health monitoring for personalized tracking and early disease detection.
- 80% of healthcare providers plan to integrate AI-based monitoring systems to improve patient care and operational efficiency.

The demand for real-time, AI-driven health monitoring continues to rise, with a growing preference for proactive healthcare management over reactive treatment approaches.

Target Audience Identification

Primary Target Audience

The primary target audience consists of individuals who benefit from continuous health monitoring and AI-driven insights, including:

1. **Health-conscious individuals** : Users who actively track vital signs, stress levels, and fitness progress to maintain a healthy lifestyle.
2. **Patients with chronic illnesses:** Individuals managing conditions such as cardiovascular diseases, diabetes, hypertension, or respiratory issues require continuous monitoring to manage their health effectively.
3. **Elderly individuals:** Many older adults face age-related health concerns, including mobility limitations, heart conditions, and cognitive decline. Remote health tracking allows them to live independently while staying connected to caregivers and healthcare providers.
4. **Fitness enthusiasts and athletes:** This group prioritizes optimizing their physical performance and recovery through data-driven insights. Those focused on workout optimization, heart rate variability, recovery monitoring, and stress management.
5. **Healthcare professionals and caregivers:** Doctors, nurses, and caregivers who use AI-generated health insights for remote patient monitoring and early intervention.

Demographic Characteristics:

- **Age:** 25-65 years (health-conscious users, fitness enthusiasts, and patients), 65+ years (elderly users needing remote monitoring).
- **Gender:** All genders.
- Location: Primarily urban and suburban regions with access to smart devices and health technology.
- **Income level:** Middle to high income (willingness to invest in health technology).
- **Education level:** College-educated professionals, fitness enthusiasts, and health conscious individuals with basic to advanced knowledge of technology.

Psychographic Characteristics:

- **Health-focused mindset:** Users actively seek wellness solutions and preventive healthcare measures.
- **Tech-savvy:** Comfortable with using smart devices and AI-driven solutions.
- **Proactive and self-reliant:** Prefer taking control of their health and tracking metrics for personal insights.
- **Trust in data-driven insights:** Willing to rely on AI-generated recommendations for health improvement.

Secondary Target Audience

The secondary target audience expands the market reach of the AI-Driven Health Monitoring App, catering to a diverse group of users with varying health and wellness needs.

1. **Corporate Employees and Remote Workers:** Many professionals lead sedentary lifestyles, which can contribute to stress, poor posture, and other health concerns. AI-driven health monitoring can help track stress levels, encourage movement, and provide personalized wellness tips to maintain a healthy work-life balance.
2. **Students and Young Adults:** With increasing academic pressure and irregular sleep patterns, students can benefit from real-time health insights. The app can monitor stress, fatigue, and sleep quality, offering tailored recommendations to enhance mental and physical well-being.
3. **Parents and Family Caregivers:** Parents who want to monitor the health of their children or aging family members can use the app to track vitals, sleep patterns, and stress levels. AI-driven alerts help ensure the well-being of loved ones by providing timely notifications of potential health risks.
4. **Insurance and Healthcare Providers:** Insurance companies and healthcare organizations can integrate AI-driven health tracking to assess risk, personalize health plans, and improve preventive care strategies for their customers.
5. **Wellness and Lifestyle Enthusiasts:** Individuals who prioritize mindfulness, stress management, and holistic wellness can benefit from AI-powered insights into their physical and emotional health. The app can provide guided meditation, breathing exercises, and customized wellness plans.

Demographic Characteristics (Secondary Target Audience):

- Age: 18-60 years (students, corporate employees, caregivers, and wellness enthusiasts).
- Gender: All genders
- Location: Primarily urban and suburban areas with access to digital health tools and wearable technology.
- Income Level: Middle-income to high-income individuals who prioritize health and wellness.
- Education Level: High school to postgraduate level, including working professionals and students familiar with digital applications.

Psychographic Characteristics (Secondary Target Audience):

- Work-life balance seekers: Employees and students looking for tools to manage stress, monitor health, and improve productivity.
- Health-conscious caregivers: Parents and family members dedicated to monitoring the well-being of their loved ones.
- Technology adopters: Individuals comfortable using AI-powered health apps, wearables, and digital health tracking tools.
- Preventive health advocates: Users who prefer early detection of health issues and believe in data-driven decision-making.
- Wellness-oriented individuals: People committed to maintaining a healthy lifestyle through mindfulness, fitness, and personalized health tracking.

Competitor Analysis

Identification and Analysis of Competitors offering Similar Solutions

Several companies provide AI-driven health monitoring solutions. Key competitors include:

Apple Health & Apple Watch

- Real-time heart rate tracking
- ECG, Oxygen saturation monitoring
- Fitness insights.
- Deep integration with Apple's ecosystem.

Fitbit by Google

- Provides continuous heart rate monitoring
- Sleep tracking, and stress management features.
- AI-driven health recommendations.

Samsung Health & Galaxy Watch

- Heart rate monitoring
- ECG analysis
- SpO2 tracking.
- Focuses on a holistic health approach with fitness tracking.

Garmin Smartwatches

- Targets fitness enthusiasts and athletes with detailed physiological insights.
- Advanced AI-powered performance analytics.

WHOOP Strap

- Subscription-based wearable that tracks strain, recovery, and sleep.
- Uses AI models for personalized coaching.

Competitor SWOT(Strengths-Weakness-Opportunities-Threats) Analysis

Competitor	Strengths	Weaknesses	Opportunities	Threats
Apple Watch	High accuracy, deep iOS integration.	Limited compatibility with non-Apple devices.	Expansion into AI diagnostics.	High cost, competition from Samsung & Google.
Fitbit (Google)	Affordable, AIdriven insights.	Subscription needed for premium features.	AI-driven stress & sleep tracking.	Google may shift focus away from wearables.
Samsung Galaxy Watch	Strong fitness tracking, wide device compatibility.	ECG accuracy is lower than Apple.	Expansion into medical-grade AI monitoring.	Competing against Apple's ecosystem.
Garmin Smartwatches	Advanced performance analytics, long battery life.	Less user friendly for casual users.	AI-powered recovery tracking expansion.	Premium pricing limits accessibility.
WHOOP Strap	Focus on recovery & stress tracking.	Requires subscription.	Expansion in high performance training.	Subscription fatigue among users.

Feature Comparison Matrix

Feature	AI-Driven Health Monitoring App	Apple Watch	Fitbit	Samsung Watch	Garmin	WHOOP
AI-powered stress analysis	Yes	No	Yes	Yes	No	Yes
Real-time cardiovascular risk prediction	Yes	Yes	No	Yes	Yes	No
Mood and fatigue detection via facial recognition	Yes	No	No	No	No	No
Personalized health coaching	Yes	Yes	Yes	Yes	Yes	Yes
Smartwatch integration	Yes	Yes	Yes	Yes	Yes	Yes
Subscription required	No	No	Yes	No	No	Yes

Business Values

Unique Selling Points (USPs)

1. AI-Powered Stress and Fatigue Detection

The AI-Driven Health Monitoring App leverages speech analysis and facial recognition technology to assess users' emotional well-being. By continuously monitoring stress levels and fatigue, the app provides actionable insights and personalized mental health recommendations. This feature differentiates it from competitors, which primarily focus on physical health metrics without integrating psychological well-being assessments.

2. Advanced Cardiovascular Risk Analysis

Using machine learning models such as Support Vector Machines (SVM), the app analyzes heart rate patterns, oxygen saturation, and other biometric data to detect early signs of cardiovascular risk. By identifying anomalies that may indicate heart disease or irregularities, the app enables timely medical intervention and promotes preventive healthcare strategies.

3. Integrated AI Coaching

The app provides real-time, AI-driven health coaching tailored to users' biometric data, lifestyle habits, and activity levels. AI-powered recommendations guide users in exercise, nutrition, and mental well-being, dynamically adapting based on progress to ensure relevant and effective guidance.

4. Seamless Wearable and Mobile App Integration

Designed for compatibility with various wearable devices, including smartwatches and fitness trackers, the app allows users to sync real-time health data effortlessly. This enhances the accuracy and accessibility of health insights, ensuring continuous monitoring without manual data entry.

5. No Subscription Model

Unlike many competitors that require ongoing subscriptions, this app offers premium features with a one-time purchase. Users can access all essential health monitoring tools without

recurring fees, making it a cost-effective and widely accessible solution without compromising on advanced features.

6. Comprehensive Sleep Analysis

Sleep quality plays a crucial role in overall well-being, and this app provides detailed sleep tracking with AI-driven insights. Users receive personalized recommendations to improve sleep patterns based on movement, heart rate, and oxygen levels during rest. This feature helps users establish better sleep hygiene and reduce long-term health risks associated with poor sleep.

7. Nutrition and Hydration Tracking

The app integrates dietary monitoring and hydration tracking, helping users maintain optimal nutrition. AI-powered analysis assesses user habits, physical activity levels, and health goals, providing customized dietary recommendations to support overall well-being.

8. Mental Health Monitoring

Beyond traditional health tracking, the app incorporates guided mindfulness exercises, stress management techniques, and mental well-being analytics. Users have access to breathing exercises, meditation sessions, and cognitive behavioral therapy (CBT)-based tools to enhance mental resilience and emotional stability.

9. Emergency Alert System

For users at risk of medical emergencies, the app features a real-time emergency alert system that notifies caregivers or emergency contacts in case of abnormal vital signs. This is particularly beneficial for elderly users and individuals with chronic health conditions, ensuring timely response and improved safety.

10. Cloud-Based Data Access

Users can securely store and access their health records across multiple devices via cloud-based storage. This ensures continuous access to historical health data, enabling better progress tracking and informed medical decision-making while complying with data security regulations (HIPAA, GDPR).

Articulation of Value Proposition for Potential User

The AI-Driven Health Monitoring App offers a personalized, data-driven, and proactive approach to health management, catering to a wide range of users from health-conscious individuals to patients with chronic conditions and professionals seeking wellness solutions.

1. **Real-Time Health Insights:** The app continuously monitors vital signs, stress levels, sleep patterns, and physical activity, providing users with instant feedback and actionable recommendations to improve their well-being.
2. **AI-Powered Predictive Analysis:** Through machine learning algorithms, the app detects early signs of health issues, allowing users to take preventive action before conditions worsen.
3. **Holistic Health Tracking:** Unlike traditional health tracking apps, this solution integrates physical, mental, and emotional well-being insights, helping users maintain balanced lifestyles.
4. **Seamless Integration with Wearables:** The app is compatible with smartwatches, fitness bands, and other digital health devices, ensuring easy data synchronization and real-time updates.
5. **User-Centric Customization:** AI-driven personalization adapts to individual preferences, suggesting tailored fitness, diet, and stress management plans based on lifestyle habits.
6. **Enhanced Safety and Emergency Alerts:** For elderly users and individuals with medical conditions, emergency notifications provide an added layer of security by alerting caregivers or healthcare providers in case of abnormalities.
7. **Data Privacy and Security Compliance:** Adhering to industry standards like GDPR and HIPAA, the app ensures user data remains secure, confidential, and used only for health optimization.
8. **Cost-Effective and Subscription-Free Model:** Unlike competitors that rely on expensive subscription models, this app provides premium health insights at an affordable one-time cost, making it accessible to a broader audience.

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