Personalized Exercise Programs for Smart Fitness Systems : Scenario Design and Logic Development

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ABSTRACT

Introduction : As demand for personalized fitness grows, AI-driven systems are evolving to optimize workouts, tailor training, and improve outcomes. However, the current smart fitness systems rely on static approaches, lacking real-time feedback and personalized adjustments. This study proposes a data-driven framework that integrates data analysis, exercise recommendation algorithms, and a feedback system to enhance workout accuracy and improve the user experience in smart fitness systems.

Method : This study designed a scenario for personalized workout programs using user profiling, incorporating age, gender, height, and weight. A fitness level assessment, considering experience, fitness test levels, and workout tendencies, was developed to refine recommendations. Workouts were categorized by types, stages, difficulty levels, locations, and equipment options.

Result : Based on workout goals, fitness levels, and total workout sessions, recommended workout splits and muscle group-specific logic were developed. Additionally, a logic system was implemented to provide information on repetitions, sets, movement count, and rest time for each workout program. To ensure varied and balanced training, exercises targeting specific muscle groups were randomly assigned according to the workout split. A feedback system was designed using workout performance data, including:
1. Basic feedback - duration, difficulty, and progress.
2. Physiological feedback - heart rate and energy expenditure.
3. Goal-specific feedback - muscle targets and stimulation.
4. Optimal feedback timing - logic for when and how feedback is given.

Conclusion : To validate effectiveness, a comparative evaluation is needed, assessing performance improvements, user satisfaction, and recommendation precision. Given the limitations of rule-based systems, enhancements should leverage user data, AI-driven personalization, and real-time feedback integration.

PURPOSE

- This study aims to develop a personalized workout program scenario by integrating data-driven algorithms and a feedback system.
- The goal is to overcome the static limitations of existing smart fitness systems and achieve user-centered optimization of exercise routines.

INTRODUCTION

- While interest in digital healthcare continues to grow, most current exercise programs remain video-based and content-centric, offering standardized routines that fail to accommodate individual differences.
- These systems typically lack real-time adaptability and do not account for user-specific factors such as age, sex, fitness level, and exercise preferences.
- Consequently, users may experience decreased engagement and difficulty maintaining long-term adherence.
- To address these limitations, this study proposes a data-driven framework that integrates user profiling, algorithmic exercise recommendations, and multidimensional feedback systems.
- Leveraging advances in AI and wearable technologies, the framework enables adaptive exercise planning and real-time feedback to enhance the precision of prescriptions and user satisfaction in smart fitness environments.

METHOD

- To provide personalized exercise programs, the development scope was designed in three key areas (Figure 1).

User Information Collection Tools
- Develop user questionnaire
- Design a fitness level classification system based on physical fitness indicators

Exercise Movement Database Construction
- Design of exercise movement database
- Implement detailed categorization and motion database coding
- Perform code mapping for streamlined use

Feedback System
- Analyze user performance results
- Develop motion-specific feedback questions

Figure 1. Three key components for personalized program development

●User Information Collection Tools

- Structure of the Questionnaire
  To support the development of personalized exercise programs, a structured questionnaire consisting of 9 key items was created (Table 1).

Category	Key Items
Fitness goal splitting	• Method for segmenting fitness goals
Exercise frequency and duration	• Exercise frequency • Goal period (in weeks)
Physical readiness levels	• Exercise experience • Perceived difficulty • Fitness level
Exercise location and tools	• Workout location • Available equipment
Exercise plan adjustment cycle	• Progressive change and plan updates

Table 1. Key components of the 9-item questionnaire

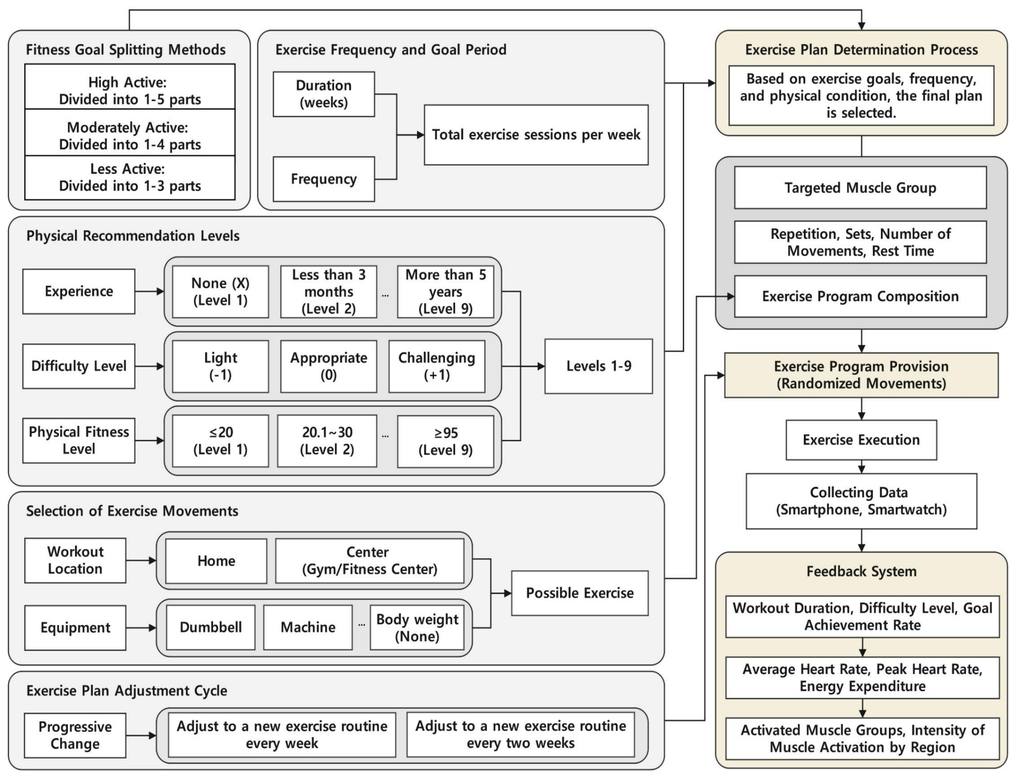
●Exercise Movement Database Construction

- Movement Classification
  Exercise movements were categorized based on five attributes:
  exercise type (n = 210), difficulty level (n = 9), target body region (n = 9), location (n = 2), and equipment used (n = 14).
- Encoding
  Each exercise movement in the database was assigned a unique identifier code using a structured format. The coding system followed a standardized scheme, such as:
  Exercise Type – Exercise Name – Difficulty Level – Target Body Region – Location – Equipment Used.

●Feedback System

- Development of a Personalized Feedback Logic
  A personalized feedback logic was developed based on users' exercise data, with examples of visualized feedback outputs provided.
- Timing of Feedback Delivery
  Feedback is delivered immediately after each exercise session, at the midpoint (50%) and completion (100%) of the goal period, as well as on a monthly basis.
- Feedback Components:
  1) Physiological indicators
  2) Motivational messages based on goal achievement status
  3) User-reported exercise satisfaction

RESULTS



●Program Logic Development

- Application of FITT Framework
  Frequency, sets, repetitions, and rest intervals were structured based on the FITT framework (Frequency, Intensity, Time, Type) to ensure individualized and effective programming.
- Exercise Split by Body Region
  Exercises were grouped by target body regions with similar training objectives to establish body-part-specific training guidelines.
- Preferred Exercise Cycle
  The update cycle for the exercise program was determined according to user preferences regarding preferred progressive change.

CONCLUSION

- To evaluate the effectiveness of the system, a comparative analysis should be conducted focusing on performance improvements, user satisfaction, and the accuracy of exercise recommendations.
- Given the inherent limitations of rule-based systems, future enhancements should incorporate user-generated data, personalized AI algorithms, and real-time feedback integration to optimize individual outcomes.