P-ISSN: 0119-3058
E-ISSN: 2945-4093

The Vector: International Journal of Emerging Science, Technology and Management
Volume 34, Issue 1, January - December 2025

GRIT: A Developmental Study of a Gamified Fitness Application Integrating AI Technologies

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ABSTRACT

Physical inactivity has become a major public health concern in modern society. As digital entertainment and mobile technologies continue to encourage a more sedentary lifestyle, many people find it challenging to integrate adequate physical exercise into their busy daily schedules. Over time, physical inactivity has resulted in poor physical health. Addressing such issues calls for innovative approaches to make exercise more enjoyable and accessible. Hence, this study aimed to develop GRIT, a fitness application that integrates AI technologies and is primarily designed to provide personalized recommendations, gamification, progress monitoring, and image processing for pose detection, offering AI-supported features to support home-based fitness activities. The application was developed using the Rapid Application Development (RAD) Model, and its quality was evaluated using the ISO/IEC 25010 software quality model, focusing on functionality, performance, compatibility, usability, dependability, and maintainability. Functionality scored the highest. The application has these key functionalities: gamification elements, such as points, levels, badges, streaks, daily goals, and progress bars; personalized recommendation that tailors fitness activities to individual preferences, body data, and progress history, ensuring; progress tracking that monitors steps, muscle level, and other health metrics; and authentication requirement to ensure secure login and cloud synchronization. The results of the study confirm GRIT's potential as a high-quality, innovative fitness tool. Overall, this study contributes to the field of fitness application development by demonstrating how to integrate and evaluate AI-driven personalization, gamification systematically, and pose detection using the ISO/IEC 25010 software quality framework.

Keywords: *gamification, pose detection, personalized recommendation system, rapid application development*

INTRODUCTION

In this digital age, physical inactivity has emerged as a significant public health concern, driven by increasingly inactive lifestyles linked to digital entertainment and mobile technologies. This lack of physical exercise may

contribute to cardiovascular diseases, obesity, mental disorders, and other health problems. Addressing such concern requires more than awareness – it calls for innovative, engaging solutions.

Mobile computing has enabled the development of smartphone applications that make physical routines more enjoyable, accessible, and adaptable. Among these are fitness applications, which are cost-effective, time-saving, and convenient, helping people stay active and enjoy a healthy life (Sakitha et al., 2020). Despite the growing number of fitness applications, however, many users stop using them. While an association between fitness applications and motivation for physical activity and exercise has been found, the theoretical foundation underlying fitness apps' features for sustaining exercise routines remains unclear (Southcott & Jooste, 2023).

Given the growing concern about physical inactivity, motivating people is essential. One of the new solutions is gamification, which integrates game-like elements to make physical activities more entertaining and promote regular participation. Gamification, or the use of game-design elements in non-game contexts, has become a powerful tool in mobile applications by enhancing engagement, motivation, and loyalty, as evidenced by Duolingo, Nike+ Run Club, and mHealth solutions (Oliveira et al., 2024). Koivisto and Hamari (2019) also noted that health, along with education and crowdsourcing, remains a common domain for gamification, with points, badges, and leaderboards serving as the predominant implementation methods.

Another challenge faced with mobile applications is the overwhelming volume of information, which complicates decision-making. To address it, a recommendation system is an important tool that provides users with suggestions by filtering out useful content using information filtering methods (Alyari & Navimipour, 2018). Arruejo and Arruejo (2025) integrated a recommender agent in their developed application, offering similar items for users to view and providing visitors with he best options to select from. In fitness applications, recommendations involve a personalized set of workouts.

Besides personalized recommendations, image processing technology enhances the fitness experience, particularly for individuals who want to exercise but have busy schedules or lack technical understanding or professional guidance, making it difficult for them to go to the gym. Fitness applications can monitor user movement, help propose suitable exercise routines, and monitor fitness sessions. According to Tong et al. (2022), including user preferences in a physical activity mobile application improves usability and engagement.

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Understanding AI's role in fitness applications is crucial to understanding how advanced technologies enhance user experience, performance, and interaction. Ali et al. (2023) conducted a study on AI's revolutionary role in healthcare, enhancing diagnosis, treatment, consultation, and monitoring of health with machine learning, IoT, algorithms, and robotics. Another enhancement to the user experience in fitness applications is the use of more sophisticated AI technologies, such as pose estimation and correction tools. There are several pose estimation models (PEMs) that automatically locate key body landmarks. These are: a) MediaPipe that detects 33 landmarks; b) BlazePose that detects 33 landmarks; c) MoveNet that detects 17 landmarks; d) OpenPose that detects 18 landmarks; e) HRNet that detects 17 landmarks; and f) AlphaPose that detects 17 landmarks (Roggio, 2024).

While there is an increasing availability of fitness applications, some users still face difficulties sustaining long-term engagement, receiving personalized recommendations, and effective monitoring, which may lead to reduced motivation, improper workout execution, and limited progress, particularly for people who want to exercise at home without equipment or professional guidance. Despite the growing number of fitness applications, few developmental studies have demonstrated how to integrate gamification, AI-based personalization, and pose detection into a single system and evaluate it using a standardized software quality model.

This study addresses this gap by developing GRIT, a fitness application that integrates multiple AI-driven features and systematically evaluates its quality using ISO/IEC 25010. Ultimately, GRIT was designed to provide tailored workout plans, progress tracking, and posture monitoring using image processing technology. By combining personalization, gamified motivation, and intelligent monitoring, GRIT promises to be a comprehensive solution that enhances user satisfaction, supports home-based workouts, and promotes health and wellness through a sustained commitment to an active lifestyle.

Objectives of the Study

This study aimed to develop GRIT, a gamified fitness application integrating AI technologies. Specifically, it sought to: (1) Identify the functional and user requirements of the GRIT application; (2) Design and construct the GRIT application using personalization features and image recognition; and (3) evaluate the quality of the developed application, in terms of functionality, performance, compatibility, usability, reliability, and maintainability based on the ISO/IEC 25010 software quality model.

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METHODOLOGY

Research Design. This study employed developmental research. Specifically, the Rapid Application Development (RAD) Model was used to develop the GRIT application. The stages in this method include requirements planning, user design, construction, and cutover (Pratama et al., 2023). As a developmental study, the primary focus was on system design and quality evaluation rather than measuring behavioral or health outcomes.

Requirements Planning. This phase for developing the GRIT fitness application served as the foundation for project success by outlining essential needs and priorities, similar to traditional project scoping (Widodo et al., 2024). This stage involves gathering detailed insights from potential users, including fitness trainers and enthusiasts, to understand their expectations, challenges, and requirements for tracking and scheduling exercise, and complementing this with a review of existing literature on fitness apps to identify best practices and technical considerations.

User Design. This phase encompasses system development and design activities, including learning content creation, user interface development, and research instrument design (Latifah et al., 2023). This stage focuses on building an intuitive, user-friendly interface that simplifies logging, tracking, and workout performance, ensuring accessibility and ease of use for diverse users.

Construction. This phase focuses on efficiently building the software components based on established requirements and designs, with the development team adding functionality, design, and user interface through a quick, iterative process to prepare the system for testing and release (Harianja et al., 2024). During this stage, the application is transformed into a fully operational system by coding and integrating key elements, including the user interface, database, AI features, and workout-tracking tools, while verifying each component for proper functionality. The researchers employed Flutter (Dart) for a clean, minimalistic design, Firebase for real-time data storage and workout records, and Google ML Kit's Pose Detection to guide users in maintaining correct exercise form.

Cutover. The system was implemented for a small group of people, including fitness enthusiasts and an IT expert, for live testing. All system features in this phase were thoroughly tested for functionality, performance, compatibility, usability, reliability, and maintainability.

P-ISSN: 0119-3058
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Participants of the Study. This study involved a total of ten (10) participants who evaluated the developed application, which included IT professionals and fitness enthusiasts/end-users. The participants served as evaluators of the application's quality characteristics rather than as subjects of behavioral intervention. The evaluation involved a limited number of IT experts and fitness enthusiasts, which is appropriate for initial quality assessment but may limit generalizability.

Research Instrument. The researchers used the ISO 25010 evaluation tool to assess the quality of the developed application, focusing on six (6) criteria. These criteria served as a reference point for concluding the application's overall quality, strengths, and areas for improvement.

Data Gathering Procedure. Research data were collected through surveys, interviews, and observations.

Data Analysis. The quantitative data collected from this study were analyzed using the Mean.

RESULTS AND DISCUSSION

This part presents, analyzes, and interprets the study's findings on the utilization of AI technologies to develop a fitness application.

1. User Requirements

The personalized recommendation feature is integrated in GRIT to tailor content or information to the users' preferences and history. This requirement is consistent with what Fu et al. (2022) stated: that personalized recommendation systems utilize historical relationship data between items and users to construct interest models in an environment characterized by information overload, thereby enabling the discovery and recommendation of information that interests users.

The GRIT application is embedded with gamification elements such as challenges and goals. This aligns with the work of Song and Yao (2022) on gamified fitness applications for smartwatches, which found that users favored features such as overview, goals, challenges, and achievements.

These requirements guided the developers in designing the application's architecture, ensuring that user engagement, personalization, and data security were prioritized.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

Table 1
Application's user requirements

Requirement	Description	Scenario
User Authentication	GRIT has a secure login system that stores and syncs user's personalized data and workout history in the cloud.	A user logs in to GRIT on a new device and accesses their previous achievements, settings, and stats.
Personalized Recommendation	The application suggests workouts or fitness activities based on user preferences, body data (e.g., BMI), and progress history.	A user is trying to work out for the first time. The application will automatically suggest beginner exercises.
Gamification Elements	GRIT integrated game-like features such as points, levels, badges, streaks, daily goals, and progress bars to boost user motivation, engagement, and consistency.	A user completes daily challenges to earn points, unlocks badges for milestones, and advances to next levels.
Progress Tracking	GRIT monitors steps, muscle level, and other health metrics to help users track their fitness journey.	The user checks his/her weekly stats to see improvements and changes in estimated muscle level.

2. The GRIT Application

The GRIT's main functionalities are presented in the next set of figures.

User Authentication

Figure 1 shows the Login and Signup pages for existing and new users, respectively.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

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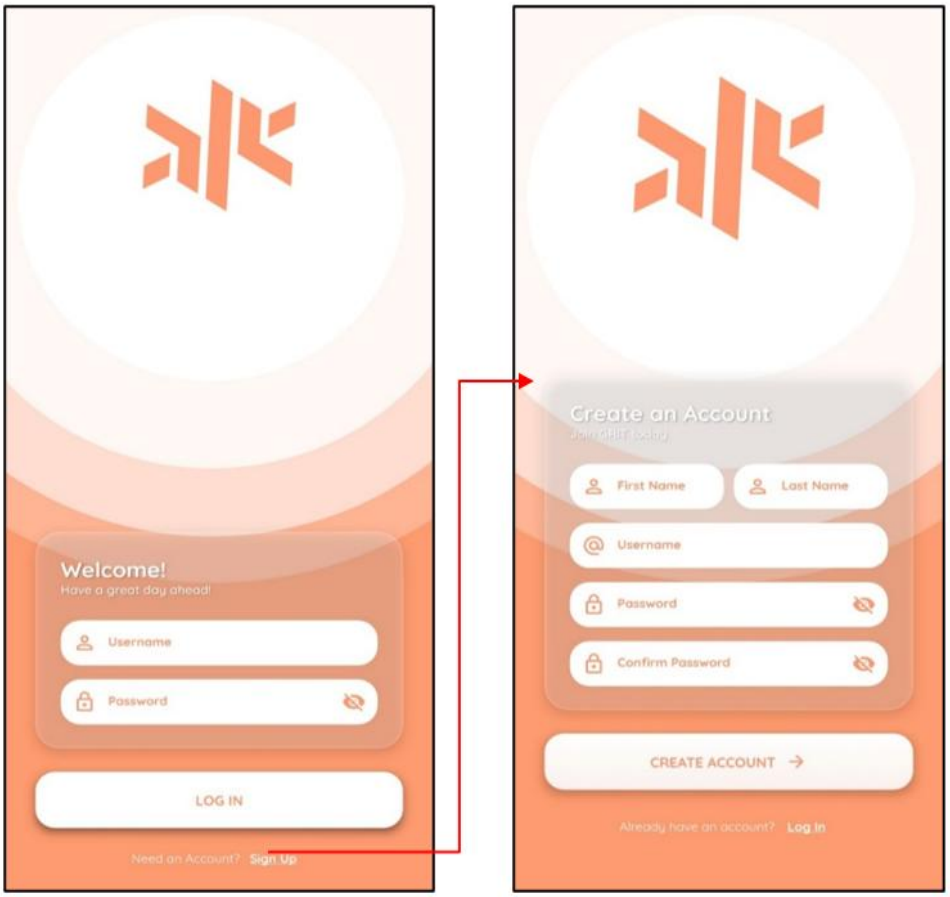

Figure 1
User Login/Signup

To create a new account, users provide their first name, last name, username, and a secure password containing uppercase and lowercase letters, numbers, and special characters. Once the account is successfully created, the user is redirected to the Login page, which asks for user credentials.

Personalized Recommendation

After creating a new account, users complete a Pre-Assessment survey that evaluates their fitness level – beginner, intermediate, or advanced, as depicted in Figure 2.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

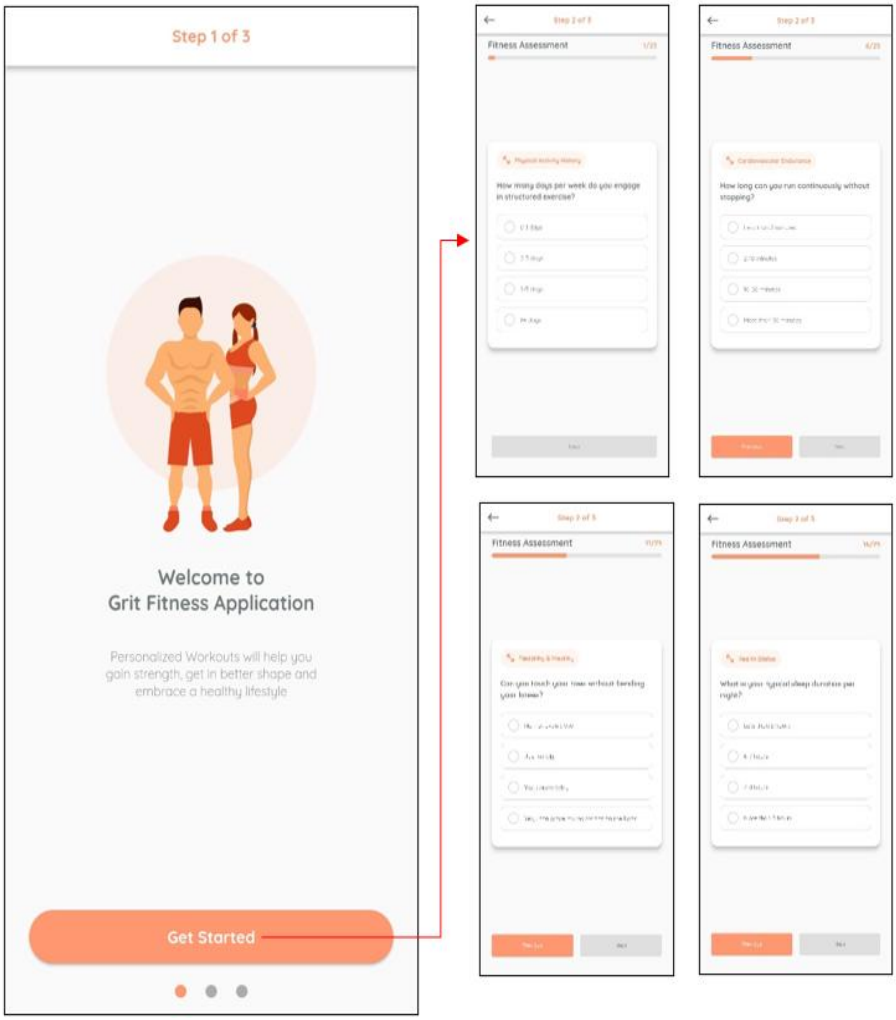

Figure 2
Pre-Assessment

The users' pre-assessment is based on five (5) areas: physical activity history, cardiovascular endurance, flexibility and mobility, health status, and gym experience. Using this information, GRIT generates personalized recommendations and assigns a workout plan tailored to the users' current condition, ensuring a safe and effective start to their fitness journey. A sample workout plan is shown in Figure 3.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

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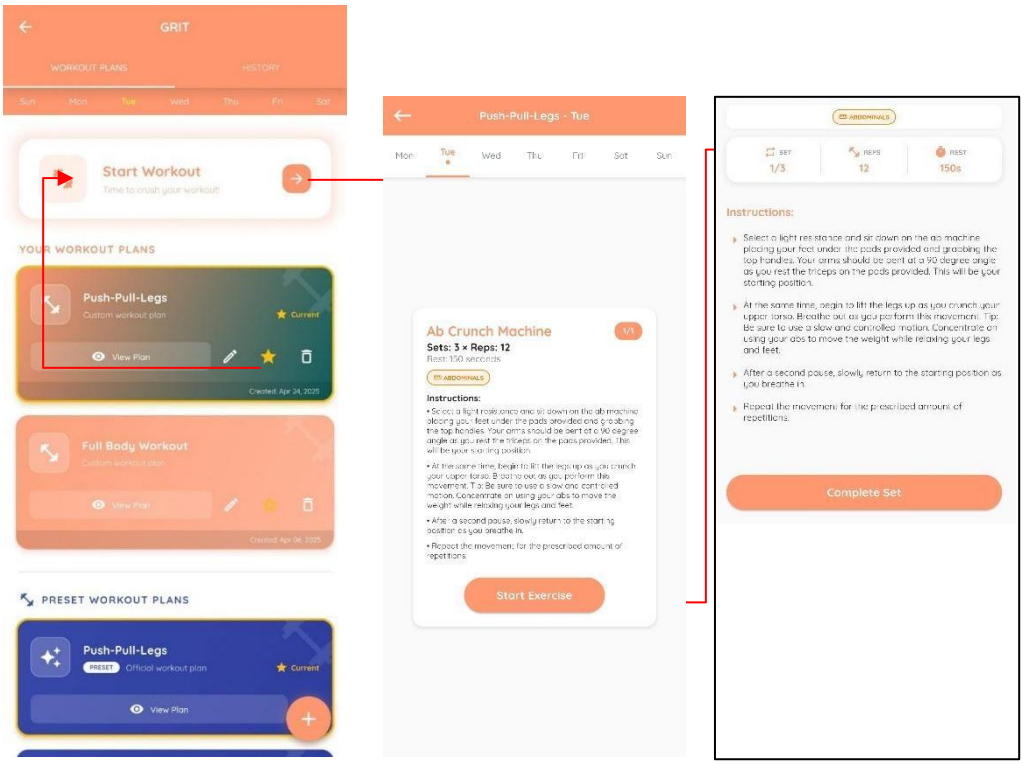

Figure 3
Workout Plans

Gamification Elements

Users can set and complete daily challenges, as displayed in Figure 4. The earned points, badges, and milestones are reflected in Figure 5.

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E-ISSN: 2945-4093

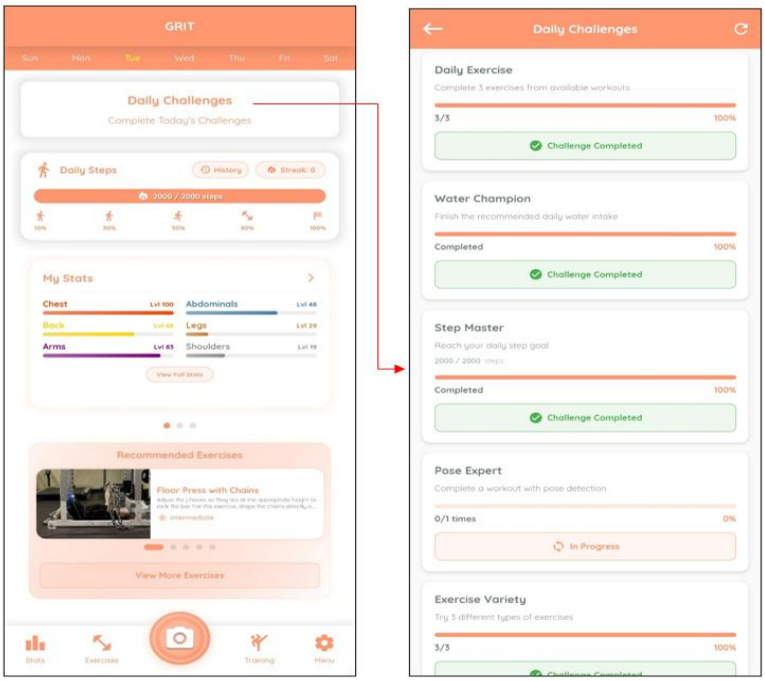

Figure 4
Daily Challenges

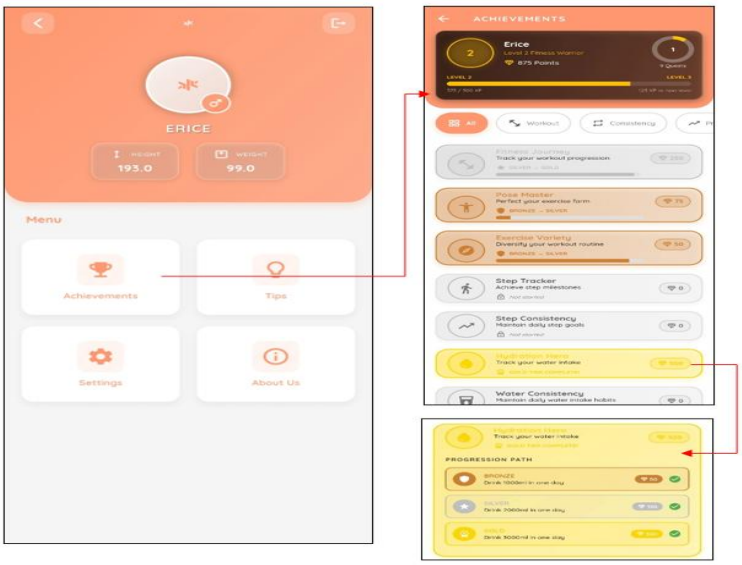

Figure 5
Achievements

P-ISSN: 0119-3058
E-ISSN: 2945-4093

The Vector: International Journal of Emerging Science, Technology and Management
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As seen in Fig. 2.4, challenges include: (1) Daily Exercise – competing a set of exercises; (2) Water Champion – finishing the recommended daily water intake; (3) Daily Steps– reaching daily step goal; (4) Pose Expert – completing a workout with pose detection; (5) Exercise Variety – trying out different types of exercises. The “Achievements” section allows users to view the badges and milestones they have earned, their progression path, and their current overall level.

Figure 6 below shows the application’s “Pose Expert” challenge that integrates pose detection.

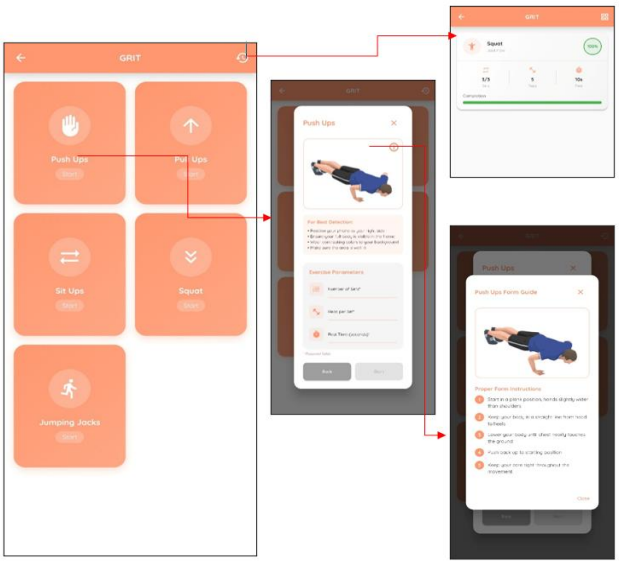

Figure 6
Exercise with Pose Detection

As shown in the figure, users must choose one exercise and set the number of sets, reps, and rest time. Once started, users must ensure that their device camera can capture their entire body. The application uses AI to scan the user’s posture and stops counting reps and sets if the posture is incorrect. Specifically, it uses the BlazePose algorithm to detect major body points, such as limbs and joints. Users receive visual cues of their posture via image processing and pose estimation and can adjust their posture until accuracy is achieved. This feature of GRIT is similar to that of an application developed by Costales, Callejo-Arruejo, and Rafanan (2023), which uses the embedded camera for real-time detection.

The integration of AI-based pose detection positions GRIT as a self-guided fitness tool that provides real-time corrective feedback, addressing common challenges of improper exercise posture in home-based workouts.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

Progress Tracking

Users can track their daily step history, muscle stats, BMI, water intake, and other progress. Samples of such tracking are shown in the next figures.

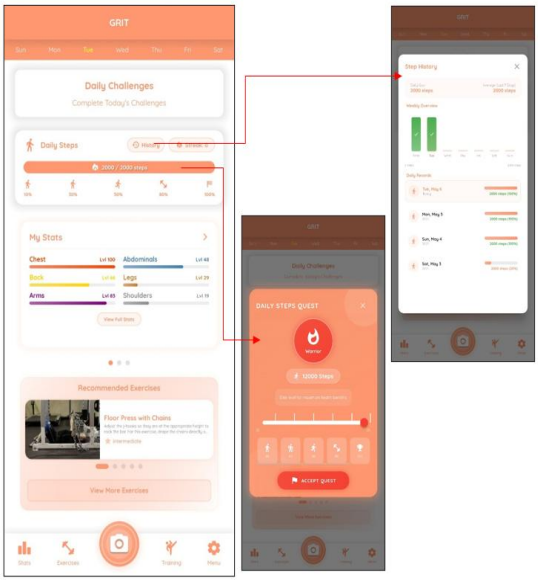

Figure 7
Daily Steps History

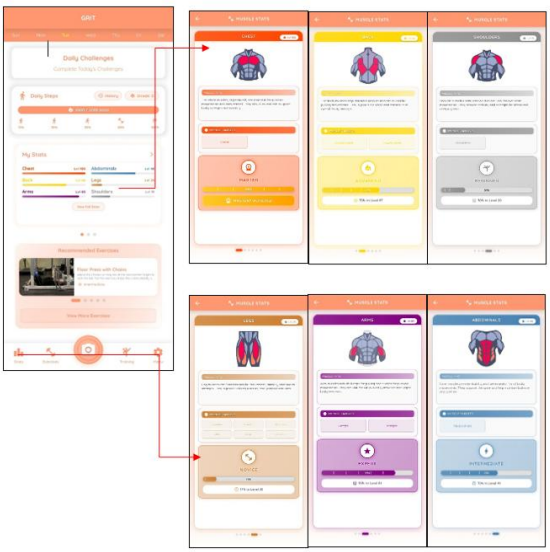

Figure 8
Muscle Stats

P-ISSN: 0119-3058
E-ISSN: 2945-4093

The Vector: International Journal of Emerging Science, Technology and Management
Volume 34, Issue 1, January - December 2025

The "Daily Steps History" section shows the user's current steps, the day's step target, and a graphical progress bar to help the user see their activity levels. Users can also view an expanded view that displays their step history and movement patterns over time, enabling more insight into their physical activity levels.

As shown in Fig. 2.8, users can obtain detailed information on a selected muscle group, including smaller muscles that make up the area, and which exercises target these muscles. The users' current level of progression for each chosen muscle group is indicated, enabling them to track their development and focus on muscle groups that require more attention.

Collectively, these features demonstrate how GRIT integrates motivation, personalization, and intelligent monitoring into a unified fitness application.

3. The Quality of the Developed Application

Table 2 presents the evaluation results of the GRIT application by IT experts and fitness enthusiasts.

Characteristics	Mean Rating	Descriptive interpretation
Functionality	4.74	Excellent
Performance Efficiency	4.68	Excellent
Compatibility	4.53	Excellent
Usability	4.70	Excellent
Reliability	4.55	Excellent
Maintainability	4.62	Excellent

The table shows high scores for the application across the six (6) quality characteristics, corresponding to an "Excellent" descriptive rating. Functionality received the highest mean rating of 4.74, indicating that the application provides all required functions correctly and completely, meeting users' needs. Compatibility received the lowest rating of 4.53, but is still considered "Excellent." This suggests that the application integrates smoothly with other applications, platforms, or environments, but still has potential areas for minor improvement. Overall, the high evaluation scores confirm that the application meets technical standards and meets user expectations. While the results reflect strong technical quality, further studies are needed to examine user engagement, long-term adoption, and fitness outcomes.

P-ISSN: 0119-3058
E-ISSN: 2945-4093

CONCLUSIONS

The GRIT application's functionalities offer a comprehensive approach to fitness engagement. Through secure user authentication, GRIT ensures continuity of the fitness experience while protecting users' personal data. The application's personalized recommendation engine, which uses pre-assessment surveys, maximizes user metrics and history to provide tailored workout plans, reducing the barriers for beginners and enhancing progression for more advanced users. The integration of gamification elements, such as daily challenges, achievements, and AI-enabled pose detection, may facilitate users' motivation, consistency, and adherence to routines. Finally, the application's progress tracking empowers users to monitor their steps, muscle development, BMI, hydration, and other metrics, providing immediate feedback and meaningful insights into their fitness journey. The evaluation indicates that GRIT meets high software quality standards based on the ISO/IEC 25010 criteria. The 'Excellent' ratings in all six (6) quality characteristics. Overall, GRIT demonstrated a balance of security, personalization, engagement mechanisms, and technical reliability, as assessed by experts and users. Hence, this makes GRIT a promising fitness technology solution, equipped with a gamified, personalized, AI-enabled ecosystem. The conclusions, however, are limited to system development and quality evaluation and do not assess behavioral or health outcomes.

RECOMMENDATIONS

It is recommended that future versions of GRIT integrate social and community-based features such as leaderboards and group challenges to enhance user interaction. Additional compatibility testing across diverse devices and operating systems is encouraged. Future studies may evaluate user engagement, motivation, and fitness outcomes through experimental or longitudinal research designs. Also, integrating emerging technologies such as augmented reality and adaptive, AI-driven workout plans may further enhance the application's functionality and user experience.

ETHICAL STATEMENT

In accordance with the Data Privacy Act of 2012, the study was reviewed and approved by the Ethics Review Committee of the University of Northern Philippines. Accordingly, the researchers prioritized voluntary participation when recruiting research participants. Hence, each participant is given the right to decide whether to participate or decline the researchers' invitation. Additionally, they were informed of their right to withdraw from the study at any time if they felt

uncomfortable during the researchers' data collection. The researchers guarantee that each respondent's rights to anonymity and privacy are protected at all costs. Data collected from the participants were treated with the utmost confidentiality and used solely for the study, as agreed by the participants and the researchers.

ACKNOWLEDGEMENT

The researchers would like to convey their huge gratitude to the people who dedicated their time and shared their valuable knowledge, skills, and unconditional support for the success of this study. Special mention is accorded to the University President, Dr. Erwin F. Cadorna; the Vice President for Research and Extension, Dr. Fatima F. Rocamora; the Vice President for Academic Affairs, Dr. Rolando B. Navarro; the University Research and Development Office, headed by the Director, Dr. Edelyn A. Cadorna; the faculty and staff of the College of Communication and Information Technology; and the entire UNP Community. Above all, the greatest honor is accorded to Jehovah God for blessing them with wisdom, knowledge, strength, and opportunities, guiding them, and giving them hope in times of trials, allowing them to finish this undertaking successfully.

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P-ISSN: 0119-3058
E-ISSN: 2945-4093

The Vector: International Journal of Emerging Science, Technology and Management
Volume 34, Issue 1, January - December 2025

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