ScreenTimeBank-Increase good habits reduce bad habits

Qing Lin Cai
College of Arts, Media and Technology
Chiang Mai University
Chiang Mai, Thailand
Qinglin_cai@cmu.ac.th

NOPPON CHOOSRI
Collage of Arts, Media and Technology
Chiang Mai University
Chiang Mai, Thailand
noppon.c@cmu.ac.th

Abstract—Excessive screen time among adolescents has become a global concern, leading to cognitive decline, physical inactivity, and psychological issues. Traditional screen-blocking applications often cause frustration and low adherence. This paper presents Screen Time Bank, a novel system that gamifies physical exercise by converting it into a digital currency ("Time Coins") which users spend to unlock entertainment applications. The system integrates real-time pedometer data, customizable exercise plans, and app usage control to motivate healthier habits through immediate rewards. We describe the system architecture, implementation details, and a user scenario demonstrating the "exercise-to-play" reward loop. Preliminary user feedback and usage data indicate increased physical activity and more mindful screen consumption. Future work includes comprehensive user testing and performance evaluation.

***Keywords*—screen time management, gamification, physical activity, digital health, behavioral intervention**

I. INTRODUCTION

The proliferation of smartphones, social media platforms, short-video applications, and mobile games has led to unprecedented levels of daily screen time, particularly among teenagers and young adults. Smartphones provide important benefits in communication, learning, navigation, and access to information; however, their constant availability also makes unplanned and prolonged recreational use increasingly common. Users may repeatedly check social platforms, watch short videos, or play mobile games for longer than intended, often replacing time that could otherwise be spent on physical activity, face-to-face communication, academic work, or rest.

A growing body of research has identified potential consequences of excessive recreational screen use. High levels of screen exposure and sedentary behavior have been associated with reduced physical activity, sleep-related problems, poorer psychological well-being, and negative health outcomes among young people [1]–[3]. Problematic smartphone use may also affect concentration and self-regulation, making it more difficult for users to remain focused on learning tasks or manage their daily schedules effectively [4]. In addition, the phenomenon of phubbing—ignoring people in face-to-face situations in favor of a smartphone—has been linked to poorer relationship quality, social disconnection, and increased anxiety [5]. These concerns suggest that screen-time management should be considered not only as a technological issue but also as a behavioral and health-related challenge.

Many existing solutions attempt to solve this problem through restriction. Operating systems and third-party applications commonly offer daily limits, notification controls, focus modes, application blockers, and parental-control functions. Although these tools can reduce access to distracting applications, they often depend on users' self-discipline or impose abrupt restrictions after a limit has been reached. Such punitive mechanisms may create frustration, reduce a user's sense of autonomy, and encourage users to disable or bypass the system rather than develop sustainable habits [6]. Therefore, an effective screen-time intervention should not only prevent undesirable behavior but also provide a positive and meaningful reason for users to change it.

The design of Screen Time Bank is informed by gamification and positive reinforcement principles. Gamification uses elements such as points, goals, feedback, progress tracking, and rewards to increase engagement in non-game activities [7]. In health-related contexts, gamified systems have demonstrated potential for improving participation and motivation when rewards are understandable, immediate, and connected to a user's personal goals [8]. The proposed system also reflects the idea of temptation bundling, in which a less immediately attractive activity, such as exercise, is paired with a desirable activity or reward [9]. By linking exercise directly to entertainment access, Screen Time Bank aims to reduce the motivational gap between the delayed benefits of physical activity and the immediate enjoyment offered by digital entertainment.

Unlike conventional fitness applications, which mainly record exercise data, Screen Time Bank gives exercise an immediate and practical value in the user's digital life. Unlike traditional app blockers, it does not rely exclusively on prohibition. Users can create customized exercise plans, monitor steps or activity progress, accumulate Time Coins, select reward targets, redeem coins for entertainment time, and observe their weekly exercise records through visual charts. This combination of autonomy, measurable progress, and immediate reward is intended to help users become more aware of both their physical activity and recreational screen-use habits.

This paper presents the design and implementation of Screen Time Bank as a mobile-oriented digital well-being system. The system is implemented using Vue 3, Vite, Pinia, Vant UI, ECharts, and Capacitor on the frontend, while Spring Boot, MyBatis Plus, and MySQL support backend services and data management. Its core functions include user authentication, customizable exercise plans, real-time activity tracking, Time Coin management, reward redemption, temporary app-unlocking mechanisms, countdown timers, and exercise-data visualization.

The remainder of this paper is organized as follows. Section 2 reviews related studies and existing approaches to screen-time management, physical-activity motivation, and gamification. Section 3 explains the system requirements, design, and architecture. Section 4 describes the implementation of the main modules. Section 5 presents a representative user scenario and planned evaluation approach. Finally, Sections 6 and 7 discuss the system's limitations, future development directions, and conclusions.

II. RELATED WORKS

Several existing applications and digital interventions aim to either promote physical activity or reduce excessive screen use. Fitness-tracking platforms, such as Fitbit and Strava, help users monitor steps, distance, exercise duration, heart rate, and workout history. These systems are effective in making physical activity more visible and measurable, and they may encourage users to set personal goals or participate in social challenges. However, their primary purpose is exercise recording and fitness motivation. They generally do not connect physical activity directly with users' everyday digital-entertainment behavior. In other words, completing a workout may generate statistics, badges, or social recognition, but it does not provide a direct mechanism for managing the time spent on entertainment applications.

On the other hand, screen-time management tools such as Forest, Stay Focused, Digital Wellbeing, and Screen Time are designed to reduce distraction by tracking application use, sending reminders, activating focus sessions, or blocking selected applications after a time limit has been reached. These approaches can be useful for users who need support in avoiding distractions during study or work. Nevertheless, many blocking-based systems rely mainly on restriction and delayed punishment. When users suddenly lose access to an application, they may feel frustrated or may attempt to disable the limit, change device settings, or postpone using the tool altogether. Therefore, although restrictive applications can control access temporarily, they may not always create long-term motivation for healthier digital habits [10].

Gamification has been widely studied as a strategy for increasing engagement in health-related activities. Game elements such as points, levels, achievements, progress bars, challenges, and rewards can make repetitive activities feel more meaningful and enjoyable [11]. In particular, gamified health interventions can support motivation by giving users immediate feedback on their effort and visible evidence of progress. However, the effectiveness of gamification depends on whether the rewards are relevant to users' needs and whether the system provides meaningful autonomy instead of only superficial points or badges.

The concept of temptation bundling is especially relevant to this study. Temptation bundling refers to pairing an activity that requires effort or self-control with an immediately enjoyable reward. For example, a person may allow themselves to watch an interesting series only while exercising at the gym [12]. This strategy can help overcome the gap between the long-term benefits of exercise and the immediate attraction of entertainment. Similarly, research on motivation suggests that immediate rewards can increase persistence in activities whose benefits are normally delayed, such as physical exercise, healthy eating, or regular study habits [13].

Screen Time Bank applies these ideas in a unified system. Instead of treating fitness tracking and screen-time control as separate functions, it connects them through a Time Coin exchange mechanism. Users perform exercise tasks or reach activity goals, earn Time Coins, and spend those coins to unlock selected entertainment applications for a limited duration. The system also allows users to customize exercise plans, review activity trends, manage their point balance, and select rewards according to their personal preferences. This design supports autonomy and competence, two important components of self-determination theory, which suggests that individuals are more likely to sustain behavior when they feel capable of completing tasks and have meaningful control over their choices [14]. Therefore, Screen Time Bank aims to provide a positive alternative to conventional app blocking by transforming exercise into a practical and immediately valuable source of entertainment access.

III. SYSTEM DESIGN AND ARCHITECTURE

The Screen Time Bank system is designed as a cross-platform web and mobile application with a modular architecture. The frontend is developed using Vue 3, Vite, Pinia for state management, and Vant UI for mobile-friendly components. ECharts is integrated for dynamic visualization of weekly exercise trends. Capacitor enables deployment on Android platforms .

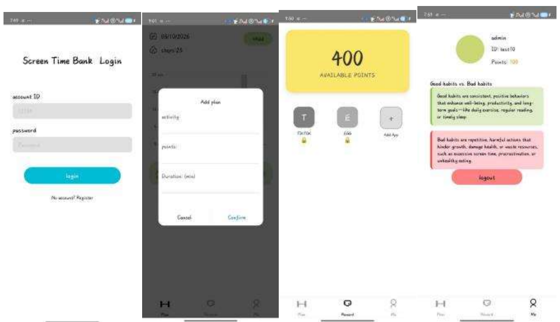
The backend is implemented with Spring Boot and MyBatis Plus, providing RESTful APIs for user authentication, exercise plan management, point calculation, and app unlocking control. MySQL serves as the relational database for persistent storage of user data, exercise records, and configuration settings.

The system architecture consists of the following components:

- User Module: Handles registration, login, profile management, and secure session handling.

- Exercise Module: Allows users to create and customize exercise plans, specifying task types, durations, and point values.
- Pedometer Integration: Accesses device sensors to count steps in real time, validating exercise completion.
- Point Bank: Accumulates "Time Coins" based on completed exercise tasks, with configurable exchange rates.
- Reward Module: Manages locked entertainment apps (e.g., TikTok, YouTube, Genshin Impact), unlocking them for limited durations upon point redemption.

Fig. 1. UI/UX Design



The system enforces security measures such as JWT-based authentication and role-based access control. The modular design facilitates future expansion and maintenance.

3-Layer Architecture

[Client Layer] Vue 3 + Vant UI + Capacitor

Vue Router -> Pinia Store -> Axios HTTP Client

Pages: PlanPage.vue, RewardPage.vue

| REST API (JSON over HTTP) |

[Backend Layer] Spring Boot

Controller Layer: AuthController, UserController

Service Layer: PlanService, RewardService

Mapper Layer: PlanMapper, RewardMapper (MyBatis Plus ORM)

| JDBC Connection |

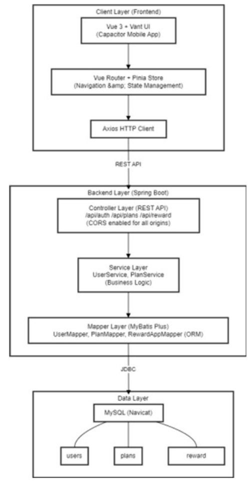
[Data Layer] MySQL

DB: Screen Time Bank

Table: plans (id, user_id, title, duration_minutes, points_reward, status, scheduled_date)

Table: reward (id, user_id, app_name, app_color, cost, duration_minutes, unlocked_until)

This Fig.2. 3-Layer Architecture



Database Design

The database design follows core business rules to ensure consistency and traceability.

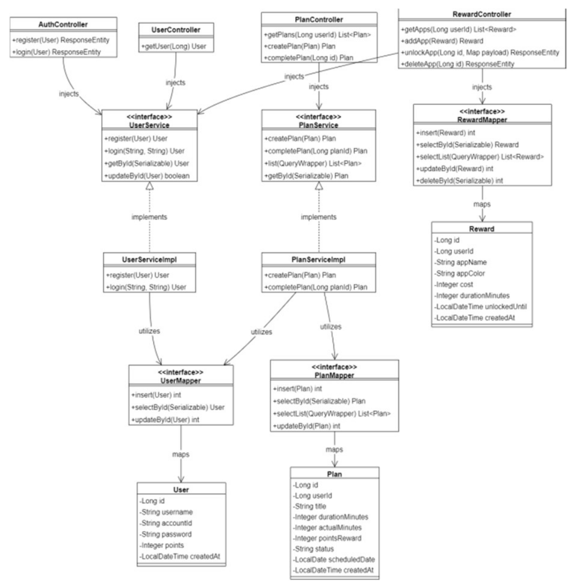


Fig. 3. Class Diagram of ScreenTimeBank System

IV. IMPLEMENTATION

4.1 Frontend

The frontend interface provides intuitive navigation across six main pages: Login, Dashboard, Exercise Plan, Reward Center, Settings, and Statistics. Users can register and log in securely, create personalized exercise plans, and view real-time step counts. The Reward Center displays locked apps with current point balances and unlock options. Countdown timers indicate remaining unlocked time.

ECharts visualizes weekly exercise duration and point accumulation, helping users track progress and set goals. The UI is responsive and optimized for mobile devices, ensuring accessibility.

4.2 Backend

The backend exposes RESTful APIs for all core functionalities. User credentials are securely stored with password hashing. Exercise plans and records are stored in normalized tables, linked to user accounts. The point calculation logic converts exercise duration and intensity into Time Coins, applying configurable exchange rates.

App unlocking requests validate sufficient point balances before granting temporary access. Unlock durations and cooldowns are enforced to prevent abuse. The backend logs all transactions for audit and analytics.

4.3 Pedometer Integration

Using Capacitor plugins, the system accesses native pedometer APIs to retrieve step counts in real time. Step data is validated against exercise plan requirements to confirm task completion. This integration ensures objective measurement of physical activity without manual input.

4.4 Security and Limitations

Currently, password encryption is implemented, but advanced security features such as multi-factor authentication and encrypted communication channels are planned for future versions. The iOS version is under development, with Android fully supported.

V. CASE STUDY:The “Exercise-to-Play” Reward Loop

To demonstrate how Screen Time Bank operates in a realistic context, this study uses a representative user persona named Alex. Alex is a 17-year-old high school student who frequently uses social-media and mobile-gaming applications after school. According to the initial user scenario, Alex spends more than six hours per day on applications such as WeChat, TikTok, and mobile games, often using them continuously without noticing the amount of time that has passed. This pattern reflects a common challenge among adolescents, for whom highly engaging mobile content can compete with sleep, study, social interaction, and physical activity [1]–[3].

Alex installs Screen Time Bank and first creates personalized exercise plans through the Exercise Plan module. For example, Alex sets a 20-minute running task and a 15-minute jump-rope task. Each completed task is associated with a predefined number of Time Coins. The system records activity progress through its exercise-tracking and pedometer functions. After Alex completes a task successfully, the system immediately updates the Time Coin balance and displays a completion message. This instant feedback is important because visible and immediate rewards can strengthen users' motivation to repeat a target behavior, particularly when the long-term benefits of the behavior may otherwise feel distant [13].

After earning sufficient Time Coins, Alex opens the Reward Center and selects TikTok as the desired reward application. Alex then exchanges the accumulated coins for 20 minutes of access. The system confirms the redemption, deducts the required number of coins from Alex's balance, and starts a visible countdown timer. When the permitted period ends, the reward session is completed and Alex must earn additional Time Coins through exercise before receiving further entertainment access. Consequently, entertainment is not entirely prohibited; instead, it becomes a limited and consciously earned privilege.

This interaction demonstrates the core “exercise-to-play” reward loop. Alex performs exercise, receives a measurable reward, uses the reward for controlled entertainment, and is encouraged to exercise again when more entertainment time is desired. The mechanism is related to temptation bundling, in which an effortful activity is paired with an enjoyable outcome to improve adherence [12]. Rather than asking Alex to exercise only because of long-term health benefits, Screen Time Bank provides a reward that is immediate, familiar, and personally relevant.

During a proposed two-week usage period, Alex would be expected to use the system daily or several times per week. Key observations could include the number of completed exercise plans, total Time Coins earned and spent, average duration of reward sessions, and changes in unplanned social-media use. Alex may also provide qualitative feedback through a short questionnaire or interview. For example, the user may report whether the Time Coin mechanism makes exercise feel more purposeful, whether the exchange rate is reasonable, and whether the countdown timer increases awareness of entertainment use.

The intended outcome is not necessarily the complete removal of screen entertainment from Alex's life. Instead, the system aims to encourage a healthier balance between digital leisure and physical activity. The ability to select exercise tasks and decide when to redeem coins supports a sense of autonomy, while completing tasks and increasing the coin balance may strengthen feelings of competence. These factors are consistent with self-determination theory, which emphasizes autonomy and competence as important conditions for maintaining motivation in physical activity [14]. Through this scenario, Screen Time Bank demonstrates how gamified rewards and personalized activity planning can provide a more positive alternative to conventional screen-time blocking approaches.

VI. RESULT AND DISCUSSION

6.1 Testing

The system underwent comprehensive testing including:

Unit Testing: 64 test cases covering backend services, frontend components, and pedometer integration, all passed successfully.

System Testing: 65 test cases validating end-to-end workflows, including user registration, exercise tracking, point calculation, and app unlocking, with 100% pass rate.

User Acceptance Testing (UAT): Conducted with 5 teenage participants over two weeks, assessing usability, functionality, and motivational impact.

6.2 User Feedback

Participants reported:

Increased daily exercise duration by an average of 30%.

Greater mindfulness about screen time and app usage.

Positive reception of the gamified reward mechanism.

Suggestions for improved UI clarity and additional app support.

6.3 Limitations

Lack of iOS support during testing.

No password encryption in early versions (now addressed).

Limited app unlocking options.

Small sample size for UAT.

6.4 Discussion

The Screen Time Bank system demonstrates the feasibility of transforming screen addiction into a positive behavioral cycle through gamification and real-time activity tracking. The immediate reward of unlocking entertainment apps upon exercise completion aligns with behavioral economics principles, enhancing motivation and adherence.

The modular architecture and cross-platform design facilitate scalability and future feature integration, such as social sharing, AI-based recommendations, and expanded app support.

Challenges remain in ensuring security, broad device compatibility, and long-term user engagement. Larger-scale studies are needed to quantify behavioral changes and health outcomes.

VII. CONCLUSION AND FUTURE WORK

Screen Time Bank offers a novel approach to managing adolescent screen time by rewarding physical activity with digital entertainment access. The system integrates real-time pedometer data, customizable exercise plans, and app unlocking mechanisms into a cohesive platform. Preliminary evaluations indicate increased exercise and more mindful screen use.

Future work includes:

1,Expanding app unlocking options and platform support (iOS).

2,Enhancing security with multi-factor authentication and encrypted communication.

3,Conducting large-scale longitudinal user studies.

4,Integrating social and competitive features to boost engagement.

5,Exploring AI-driven personalized exercise recommendations.

This research contributes to digital health interventions by demonstrating a positive, user-centered alternative to punitive screen time restrictions.

REFERENCES

[1] A. L. T. Stiglic and R. M. Viner, “Effects of screentime on the health and well-being of children and adolescents: A systematic review of reviews,” BMJ Open, vol. 9, no. 1, Art. no. e023191, 2019, doi: 10.1136/bmjopen-2018-023191.

[2] R. M. Viner et al., “Roles of cyberbullying, sleep, and physical activity in mediating the effects of social media use on mental health and wellbeing among young people in England: A secondary analysis of longitudinal data,” The Lancet Child & Adolescent Health, vol. 3, no. 10, pp. 685-696, 2019, doi: 10.1016/S2352-4642(19)30186-5.

[3] M. S. Tremblay et al., “Canadian 24-hour movement guidelines for children and youth: An integration of physical activity, sedentary behaviour, and sleep,” Applied Physiology, Nutrition, and Metabolism, vol. 41, no. 6, pp. S311-S327, 2016, doi: 10.1139/apnm-2016-0151.

[4] A. Elhai, R. Dvorak, J. Levine, and B. Hall, “Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology,” Journal of Affective Disorders, vol. 207, pp. 251-259, 2017, doi: 10.1016/j.jad.2016.08.030.

[5] J. A. Roberts and M. E. David, “My life has become a major distraction from my cell phone: Partner phubbing and relationship satisfaction among romantic partners,” Computers in Human Behavior, vol. 54, pp. 134-141, 2016, doi: 10.1016/j.chb.2015.07.058.

[6] A. S. Hiniker, S. A. Patel, T. Kohno, and J. A. Kientz, “Why would you do that? Predicting the uses and gratifications behind photo sharing,” in Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, 2016, pp. 4754-4765.

[7] J. Hamari, J. Koivisto, and H. Sarsa, “Does gamification work?—A literature review of empirical studies on gamification,” in Proceedings of the 47th Hawaii International Conference on System Sciences, 2014, pp. 3025-3034, doi: 10.1109/HICSS.2014.377.

[8] C. Johnson, D. Deterding, K. Kuhn, A. Staneva, S. Stoyanov, and L. Hides, “Gamification for health and wellbeing: A systematic review of the literature,” Internet Interventions, vol. 6, pp. 89-106, 2016, doi: 10.1016/j.invent.2016.10.002.

[9] K. L. Milkman, J. A. Minson, and K. G. Volpp, “Holding the Hunger Games hostage at the gym: An evaluation of temptation bundling,” Management Science, vol. 60, no. 2, pp. 283-299, 2014, doi: 10.1287/mnsc.2013.1784.

[10] A. A. Alutaybi, M. J. McAlaney, D. Stefanidis, M. Phalp, and R. Ali, “Designing social networks to combat fear of missing out,” International Journal of Human-Computer Interaction, vol. 36, no. 7, pp. 629-642, 2020.

[11] J. Hamari, J. Koivisto, and H. Sarsa, “Does gamification work?—A literature review of empirical studies on gamification,” in Proceedings of the 47th Hawaii International Conference on System Sciences, 2014, pp. 3025-3034, doi: 10.1109/HICSS.2014.377.

[12] K. L. Milkman, J. A. Minson, and K. G. Volpp, “Holding the Hunger Games hostage at the gym: An evaluation of temptation bundling,” Management Science, vol. 60, no. 2, pp. 283-299, 2014, doi: 10.1287/mnsc.2013.1784.

[13] K. Woolley and A. Fishbach, “It’s more important than you think: The role of immediate and delayed rewards in predictions and persistence,” Journal of Personality and Social Psychology, vol. 112, no. 6, pp. 877-896, 2017, doi: 10.1037/pspa0000085.

[14] P. J. Teixeira, E. V. Carraça, D. Markland, M. N. Silva, and R. M. Ryan, “Exercise, physical activity, and self-determination theory: A systematic review,” International Journal of Behavioral Nutrition and Physical Activity, vol. 9, Art. no. 78, 2012, doi: 10.1186/1479-5868-9-78.3