

# The Friendship Garden: A Co-Designed Digital Intervention to Promote Healthier Social Connections Among Youth

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**Abstract**—The mental health impacts of adolescent social media use are complex, with evidence linking use to increased anxiety, depression, loneliness, and self-harm, while also offering opportunities for connection among isolated youth. A central sociotechnical challenge presented is youth loneliness: online platforms may support well-being when they strengthen meaningful relationships, but may be detrimental when they displace in-person interaction. This work addresses this challenge through the co-design of a digital intervention aimed at promoting face-to-face social engagement among adolescents. Building on a youth-generated concept developed during a hackathon, we apply systems analysis and user-centered design processes—including goal definition, alternative generation and evaluation, and iterative prototyping—to translate an early-stage idea into a minimum viable system. A targeted review of prior digital and behavioral interventions informs the design, grounding it in behavioral activation, self-determination theory, and social support theory, and identifying key behavioral targets for sustaining friendships: initiation, follow-through, and relationship deepening. These insights guide the development of core system features centered on a “friendship garden” metaphor, in which peer connections are represented as entities that grow through shared, in-person activities. The prototype is iteratively refined through wireframing and feedback from a Youth Advisory Board (YAB) and is designed to support intentional interaction, shared accountability, and sustained relationship maintenance. Ongoing work includes a feasibility and user experience study with adolescents (target n=10) to evaluate usability, engagement, and potential for reducing loneliness. This work contributes a theoretically grounded, co-designed digital intervention and provides design insights for promoting offline social connection through technology.

**Keywords**—digital intervention, loneliness, mental health, social network, co-design.

## I. INTRODUCTION

The conventional narrative frames social media as the cause of youth loneliness - that screens have replaced friends. However, the problem is more specific. Young people are not lacking access to social platforms; rather, they lack platforms that support what friendship requires. Forming a close friendship

demands over 200 hours of shared time and activity [1], yet the applications that dominate daily screen time are designed around feeds, likes, and passive consumption; mechanisms that substitute the feeling of connection for its substance. The result is a generation that is more digitally connected yet more socially isolated: nearly 65% of U.S. college students report feeling lonely [2], and the Surgeon General has classified loneliness as a public health epidemic on par with smoking [3].

Existing mental health applications largely target symptom reduction through cognitive behavioral therapy modules, mood tracking, or mindfulness exercises. Few address the social behaviors that sustain real-world friendships: initiation, follow-through, and deepening [1]. Prior work shows that shared time and structured activities, rather than messaging volume, predict relationship closeness, and that in-person interactions reduce loneliness in ways that digital substitutes do not [1]. At the same time, persuasive design literature cautions against reward-based engagement mechanisms that may undermine intrinsic motivation [4]. Collectively, these findings motivate a design approach grounded in intentional interaction and reflective feedback rather than competitive gamification.

This paper presents the design and development of a behavior-informed social connection application that reframes the smartphone from a tool for passive consumption into one that supports active relationship maintenance. The project originated from a winning concept developed by undergraduate and high school students during a youth “hackathon” at the University of Virginia, which proposed a digital intervention to deepen friendship connections and reduce loneliness among young adults (ages 18-22). A student-led engineering design team subsequently adopted the concept and applied a structured process to translate the early-stage idea into an interactive minimum viable product (MVP). This process included stakeholder analysis, user persona development, iterative prototyping, usability heuristic evaluation, and AI-

## Prototype Overview

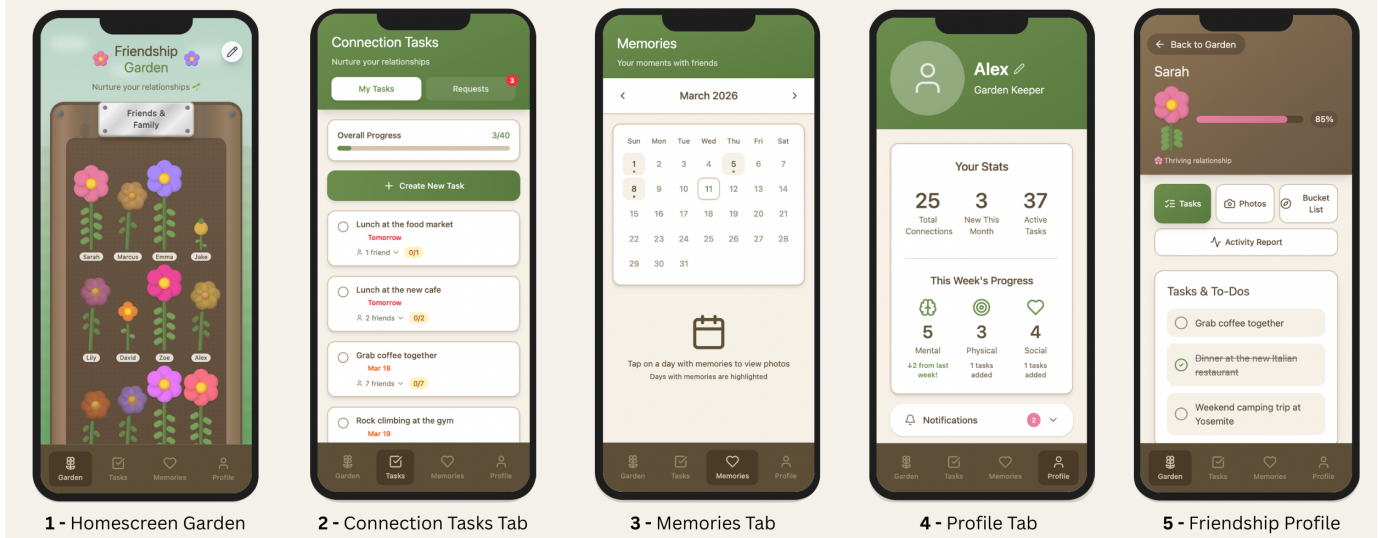


Fig. 1. Key screens of the Friendship Garden prototype. The garden view (1) represents peer relationships as flowers, with height encoding connection strength. The Tasks tab (2) scaffolds social behavior through date-organized activity planning. The Memories tab (3) supports reflection via a calendar-based interaction log. The Profile tab (4) aggregates user statistics and weekly progress. The Friendship Profile (5) provides relationship-specific tasks, photos, and a shared bucket list.

assisted design and implementation. Work was conducted in collaboration with an interdisciplinary group of psychology students and a Youth Advisory Board to ensure alignment with behavioral theory and target user needs.

The resulting prototype centers on a “friendship garden,” a visual metaphor in which peer connections are represented as growing elements that strengthen through shared, in-person activities (Fig. 1). Core features include personalized task lists tied to individual friendships, AI-driven activity recommendations informed by relationship context, structured reflection prompts triggered upon task completion, and a shared memory interface for revisiting past interactions. Relationship strength is conveyed through ambient visual feedback that reflects connection health over time, enabling users to maintain awareness of how their friendships evolve. Rather than relying on competitive mechanics, leaderboards, or extrinsic reward systems, the design follows reflective design principles, emphasizing awareness and intentionality over gamification [5].

This work demonstrates how a structured co-design process can translate an early-stage concept into a deployable digital intervention by integrating behavioral science, human-centered design, and rapid prototyping. It further provides a model for interdisciplinary collaboration across psychology and software engineering in the design of prosocial technologies. The resulting prototype is positioned for future user experience and feasibility studies with adolescents to assess usability, engagement, and potential impacts on loneliness and social well-being.

## II. BACKGROUND

A major concern in adolescent development is pervasive loneliness. Loneliness arises from a discrepancy between de-

sired and perceived social connection [6], and is exacerbated by factors such as difficulty initiating interpersonal relationships, fear of rejection, and low self-esteem [7]. Addressing adolescent mental health therefore requires fostering social interactions that build and sustain positive relationships. During adolescence, these connections are primarily formed through peer friendships, where individuals actively explore identity and seek validation [8]. Positive peer relationships are characterized by emotional closeness, reciprocity, and consistency over time [9], [10], and are supported by core interpersonal mechanisms such as self-disclosure, perceived responsiveness, and mutual engagement [11], [12]. These processes enable individuals to feel understood, valued, and socially connected, thereby fostering a sense of belonging [13]. Given adolescents’ heightened sensitivity to social feedback and reliance on peer evaluation [14], the presence—or absence—of these mechanisms has a pronounced impact on well-being.

These processes increasingly occur not only offline but also through digital platforms such as social media [15]. While such environments expand opportunities for connection, they often fall short in supporting the mechanisms required for meaningful interaction. For example, self-disclosure may be replaced by curated self-presentation, perceived responsiveness reduced to passive signals such as “likes,” and reciprocity weakened through asymmetric engagement. As a result, many platforms emphasize superficial interaction and social comparison rather than sustained, meaningful connection [16]. This gap highlights an opportunity for digital interventions that prioritize the quality, rather than the quantity, of social relationships.

Although relatively few digital mental health interventions

directly target loneliness, existing systems suggest promising approaches. For example, Noneliness, a gamified intervention designed to foster campus connections, demonstrated reductions in loneliness through features supporting both direct communication and engagement-driven participation [17]. Similarly, habit-tracking applications, such as Strava, increase engagement and consistency through goal-setting and social accountability, which may enhance motivation and support repeated social behavior over time [18], [19]. Prior work also shows that the frequency of social interaction during adolescence, which requires planning and consistency, is associated with psychosocial development in adulthood [20]. Collectively, these findings suggest that integrating goal-directed and behavior-shaping features with mechanisms that support social interaction may provide an effective pathway for fostering stronger, more meaningful connections.

### III. DIGITAL INTERVENTION CONCEPT

The proposed intervention is grounded in behavioral principles that support the formation and maintenance of meaningful social connections, with a particular emphasis on facilitating time spent together. To operationalize this, the system structures user behavior using goal-directed principles, promoting specific, personalized social actions that direct attention, increase effort, and improve follow-through by reducing ambiguity and clarifying desired behaviors [21]. In practice, this translates abstract intentions (e.g., “spend more time with friends”) into concrete, actionable tasks within the application.

The design further supports sustained engagement through lightweight reinforcement mechanisms, such as the friendship garden, which provide continuous visual feedback tied to user behavior. These features draw on principles of operant conditioning, where contingent feedback reinforces desired actions and increases the likelihood of repetition. Prior work suggests that systems providing immediate, action-contingent feedback can reinforce target behaviors and promote sustained engagement over time [4].

By integrating task scaffolding, feedback, and reinforcement within a unified interface, the system is designed to reduce barriers to social coordination and promote repeated, intentional in-person interactions. In doing so, the intervention targets the behavioral processes underlying the development and maintenance of social connection.

### IV. DESIGN AND DEVELOPMENT PROCESS

The design and development of this mobile intervention followed an interdisciplinary approach involving an engineering design team, a psychology team, and a Youth Advisory Board (YAB) consisting of five adolescents. The initial concept, developed by the psychology team, was extended using a systems analysis framework [22]. This framework includes the following stages: goal definition, criteria establishment for evaluating alternatives, alternative generation, ranking, iteration, and implementation, providing a structured approach for translating early-stage concepts into deployable systems.

To define system goals, the design team conducted stakeholder and contextual analyses, resulting in six user personas representing key barriers to social connection: access, initiation, follow-through, depth, life transitions, and community contribution. In parallel, the psychology team collected input from the YAB to guide the design team’s development of a hierarchical task analysis (HTA) [23], decomposing the primary user goal—engaging with the intervention—into actionable tasks. Based on this HTA, evaluation criteria for design alternatives were established, including aesthetics, content and functionality, feature set, and personalization.

Guided by these criteria, three high-fidelity prototypes were developed using Figma and Figma Make and evaluated with the YAB. Feedback from these sessions was used to assess and rank the alternatives. Following selection of a single design for further development, the team entered an iterative implementation phase.

A continuous integration and deployment workflow supported this process, with AI-assisted code changes committed to version-controlled repositories and deployed iteratively. This enabled rapid feedback cycles across the design and psychology teams. Additional YAB sessions were conducted during this phase to refine functionality and interface design based on user input. The resulting system is an interactive prototype prepared for subsequent user testing and back-end integration.

#### A. Implementation Pipeline

The development process followed a structured, task-driven pipeline. An HTA was first constructed to decompose the primary system objective into discrete user actions. Based on this analysis, low-fidelity wireframes were developed in Figma to define core layouts and navigation flows prior to visual design. These wireframes were subsequently transformed into high-fidelity mockups using Figma Make. Implementation was then refined using AI-assisted coding tools, including Claude Code, to address feature gaps, improve functionality, and integrate back-end components. This process enabled a small student-led development team to produce an interactive prototype within a single academic year.

The resulting system is a React-based mobile application. The front end operates on preloaded mock data, allowing full demonstration of functionality without requiring an active server. The primary live integration is an AI-driven activity recommendation module, which generates real-time suggestions via the Anthropic Claude API.

### V. SYSTEM DESIGN

#### A. Design Space Exploration

Four high-fidelity design alternatives were developed and evaluated with the Youth Advisory Board (YAB) to explore different approaches to interaction design, navigation, and the representation of social relationships. Across all designs, core functionality remained consistent, including friendship tracking through the Friendship Garden, task generation and completion, activity reflection, and profile customization.

Through this process, several key design decisions emerged. First, participants consistently preferred a garden representation in which relationships are presented as a collection of discrete elements, rather than as part of an immersive, navigable scene, citing greater clarity and ease of use. Second, distributing functionality across multiple screens was favored over a single-screen experience, as it reduced cognitive load and improved usability. Third, participants valued opportunities for interface customization (e.g., selecting different visual themes such as garden, city, or beach), which increased engagement and a sense of ownership. Finally, persistent bottom navigation tabs were preferred over a centralized home screen, as they enable consistent, always-available access to functionality across screens.

The final design reflects these preferences, incorporating a garden representation of relationships as a collection of discrete elements, multi-screen organization, customizable themes, and persistent bottom navigation tabs.

### *B. Selected Design: Friendship Garden*

Based on structured feedback from the YAB, the third alternative (Fig. 1) was selected for further development. This design employs an organic growth metaphor, representing friendships as entities that evolve through sustained interaction over time, with an intuitive user interface.

1) *Garden View and Relationship Visualization*: The main screen represents the user's social network as a garden, where each friend is visualized as a flower. Flower height encodes relationship strength on a normalized 0–100 scale, providing an ambient visual representation of connection health without exposing explicit numerical values. This design supports quick assessment of which relationships are thriving versus those requiring attention. Friends are organized into user-identified categories (e.g., Friends & Family or Work Connections), and selecting a flower opens a detailed, one-on-one relationship view.

This representation was informed by YAB feedback, which indicated a preference for visual growth metaphors over numerical indicators, as explicit metrics were perceived as discouraging during periods of low interaction. The detailed view includes a relationship strength indicator, qualitative status labels (e.g., THRIVING, GROWING, NEEDS ATTENTION), and four functional tabs: Tasks, Photos, Bucket List, and Activity Report.

2) *Connection Tasks*: The Tasks interface serves as the primary behavior-change mechanism within the system. Tasks are organized into four temporal categories—Today, Tomorrow, Upcoming, and No Date—with color-coded indicators to convey urgency. Each task is associated with one or more friends, and expandable task cards provide visibility of all participants for group activities.

Users can create tasks by selecting users to invite, specifying a date, and optionally designating group participation. A built-in request system enables users to send activity invitations, monitor responses, and issue reminders to contacts who have not replied.

Upon task completion, the system prompts user reflection, including a five-point enjoyment rating, required written input, and optional photo capture. This feature was refined based on YAB feedback, which emphasized the importance of system generated prompts and optional media sharing to reduce user burden.

3) *Memories and Calendar System*: The Memories interface presents a calendar-based view of past interactions. Dates containing recorded memories are indicated with visual markers, and selecting a date reveals a gallery of associated entries, including photos, captions, locations, tagged contacts, and timestamps. Individual entries can be expanded for detailed viewing. This feature was consistently rated as highly valuable during YAB evaluations, highlighting the importance of reflection and recall in reinforcing social connections.

4) *Profile and Personalization*: The Profile interface aggregates user-specific information, including activity metrics, weekly progress, recent interactions, notifications, and system settings. Personalization features include avatar customization and interface theming (Fig. 2). Summary statistics (e.g., total connections, new connections, active tasks) are presented using neutral, non-evaluative language to avoid negative user perceptions.

Each friend profile includes personalized activity recommendations generated through real-time calls to the Anthropic Claude API. These recommendations leverage contextual information about the relationship to suggest relevant, actionable activities. This functionality operationalizes goal-setting principles by translating abstract social intentions into concrete behavioral prompts. It also reflects consistent YAB feedback expressing a preference for guided suggestions over fully user-driven planning.

Privacy and safety controls include configurable location sharing, connection visibility, recommendation preferences, and user blocking/reporting mechanisms. These features were incorporated in response to concerns raised by YAB participants regarding data privacy and safety, particularly for younger users.

### *C. Youth Advisory Board Feedback and Design Response*

Feedback from YAB sessions directly informed key design decisions in the final prototype. The engineering and psychology teams met with the YAB a total of five times over the course of the project: three sessions in Fall 2025 during the initial design phase, and two sessions in Spring 2026 during prototyping. Feedback consistently favored growth-based visual representations over purely numerical progress indicators, leading to the adoption of flower height as the primary mechanism for conveying relationship strength. Recommendations to limit task volume (e.g., two to three tasks per contact) informed the design of a focused, date-organized task interface. Additionally, the inclusion of mandatory, system generated reflection prompts and optional photo uploads reflects feedback emphasizing that post-activity engagement should remain intentional yet low-effort.

# Thematic Overview



Fig. 2. Three high-fidelity design alternatives evaluated with the Youth Advisory Board: Friendship Garden (1), Social Skyline (2), and Tropical Oasis (3). All prototypes provided equivalent functionality but differed in their visual metaphors for representing relationships.

Several YAB-suggested features were not incorporated in the current iteration. Such feedback included interest in more expressive personalization options, including companion characters, and expanded theme capabilities; however, the current system supports only a limited set of visual themes. The calendar component functions as a retrospective log of interactions but does not yet integrate with personal scheduling or shared availability, constraining its utility for planning. In-app messaging was intentionally excluded due to privacy and safety considerations for minor users, requiring coordination through external platforms. Additional features—such as group meetup facilitation for forming new connections and QR code-based friend verification—remain under consideration for future development. These limitations and planned extensions are discussed further in Section VI.

## VI. IMPLICATIONS AND FUTURE WORK

The proposed intervention operationalizes its goal of reducing adolescent loneliness by structuring the social interaction lifecycle—planning, follow-through, and reflection—within a single system. Relationship health is conveyed through ambient visual representations (e.g., growth-based metaphors), enabling users to quickly assess the state of their social connections without reliance on explicit metrics. By linking identified relationships to scheduled activities, the system translates abstract social intentions into concrete commitments, reducing coordination friction. The integration of a memory archive further reinforces these interactions by organizing shared experiences over time, supporting reflection and sustained engagement.

Despite these strengths, several limitations remain. The calendar component functions primarily as a retrospective log and does not yet integrate with personal schedules or shared

availability, limiting its utility for planning and coordination. The absence of in-app messaging reflects a deliberate design choice to avoid redundancy with existing communication platforms; however, it also fragments the interaction flow by requiring users to coordinate activities externally. Personalization features are also limited; while multiple visual themes are available, participants expressed a desire for more expressive customization options, including companion elements and adjustable interface components that support a stronger sense of ownership and identity.

Evaluation of the system remains preliminary. Future work should include a feasibility and user experience study combining quantitative measures with qualitative methods (e.g., interviews and focus groups) to assess usability, engagement, and alignment with user needs. Additional evaluation is needed to compare visual design approaches and determine which interaction metaphors are most effective for adolescents. Longitudinal studies will be required to assess potential impacts on loneliness, perceived social support, and in-person interaction frequency.

The co-design process, while informative, was limited to a small Youth Advisory Board. Expanding future engagement to include a more diverse set of adolescents across age, gender identity, and socioeconomic backgrounds will strengthen both the design process and the generalizability of findings.

Future development will focus on transitioning the prototype to iOS and Android platforms, including platform-specific adaptation, app store compliance, and the implementation of robust privacy and consent mechanisms for minor users. A small-scale feasibility study (target  $n=10$ ) will provide initial evidence on usability and acceptability.

## VII. CONCLUSION

This work presents the translation of a youth-generated concept into a functional digital intervention aimed at strengthening real-world friendships and reducing loneliness among young adults. Rather than reinforcing online interaction, the system is designed to support in-person social engagement by structuring planning, follow-through, and reflection within a unified interface.

Through a systems-based, iterative co-design process involving interdisciplinary collaboration and Youth Advisory Board input, the resulting prototype integrates visual relationship feedback, task-based activity planning, reflective memory capture, and AI-supported recommendations. Together, these features aim to reduce logistical barriers and promote sustained, meaningful social interaction.

This work responds to a broader shift in which increasing time spent on digital platforms has been associated with declines in face-to-face interaction, despite evidence that in-person relationships are strongly linked to improved well-being and life satisfaction. By reframing the role of the smartphone—from a medium of passive consumption to a tool for facilitating real-world connection—the proposed system aims to support not only the quality but also the longevity of social relationships.

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