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Development of a Concentration-Enhancing Scheduling Application to Support Independent Living for Individuals with Developmental Disabilities

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Abstract: Individuals with developmental disabilities face difficulties in independent living and communication due to limited cognitive abilities, requiring support from caregivers such as parents. Caregivers also experience significant burden in assisting with minor tasks like concentration and time management for executing schedules. Therefore, IT technology support is needed to aid the independent living of individuals with developmental disabilities. This paper implements a concentration-enhancing scheduling application using a simple visual interface with a combined scheduler and timer system. The aim is to assist in supporting the independent living of individuals with developmental disabilities through this application.

Keywords: Kotlin app, scheduler app, timer, developmental disability support

1. Introduction

Individuals with developmental disabilities experience many difficulties in forming social relationships and communication [1], necessitating caregiver support. Assistance is required even for minor tasks such as time management and scheduling daily activities in the lives of individuals with developmental disabilities [2]. For this reason, IT technology support is needed to assist in the daily lives of individuals with developmental disabilities [3].

This paper implements a concentration-enhancing scheduling application to support independent living [4] for individuals with developmental disabilities. An intuitive user interface and visual elements were actively utilized to enhance understanding. This allows individuals with developmental disabilities to easily manage their schedules independently. The application was designed considering cognitive abilities such as limited attention span, social cognition, and executive function of individuals with developmental disabilities [5-6]. It is expected to help establish daily routines and improve self-management skills, as well as contribute to reducing caregiver burden [7].

2. Background

The autonomous community integration of individuals with developmental disabilities is crucial for social inclusion and enhancement of individual quality of life [8]. However, many individuals with developmental disabilities experience difficulties in managing daily activities. In response, the National Institute of Special Education's National Center for Lifelong Education Promotion for the Disabled has recently developed a lifelong education curriculum for individuals with developmental disabilities [9]. This curriculum encompasses educational

content on developing independent living skills and time management, among other areas. Within the time management domain, individuals receive instruction on organizing daily routines by hour and creating schedules with the objective of appropriate time management.

Concurrently, the daily life management of individuals with developmental disabilities is predominantly carried out by parents or caregivers, resulting in substantial physical and psychological burdens. Research indicates that approximately 52% of caregivers for individuals with developmental disabilities report experiencing depression and stress [10]. This not only leads to a deterioration in the caregivers' quality of life but may also impact the long-term quality of care provided to individuals with developmental disabilities.

In this context, the necessity for support systems utilizing Information Technology (IT) has emerged. While manual creation of daily schedules is beneficial, this study aims to support independent living for individuals with developmental disabilities through IT by developing an application that allows for schedule creation on frequently used smartphones, incorporating notification systems and timer functions to enhance focus on specific tasks. This approach not only promotes the independence of individuals with developmental disabilities but also contributes to alleviating the burden on parents and caregivers.

Existing applications for supporting individuals with developmental disabilities have primarily been useful for communication assistance but often require a high degree of caregiver intervention. There are limited applications that can be used independently without caregiver involvement [11]. Additionally, while scheduling applications such as Visual Schedule Planner [12] utilize visual elements to display schedules, their complex interfaces often necessitate continuous caregiver intervention. This consequently demands more time and energy from caregivers, exacerbating their burden.

To address these issues, this study implements an application that integrates scheduler and timer functions, utilizing a simplified interface and visual elements, taking into account the cognitive abilities of individuals with developmental disabilities [5-6]. The aim is to enhance the independence of individuals with developmental disabilities while minimizing parental and caregiver intervention, thereby reducing their burden. Ultimately, this application is expected to contribute to improving the independent living skills of individuals with developmental disabilities and enhancing the quality of life of their caregivers.

3. System Architecture

Figure 1 illustrates the modular structure of the concentration-enhancing scheduling application. This application was developed using Kotlin [13], a cross-platform general-purpose programming language developed by JetBrains.

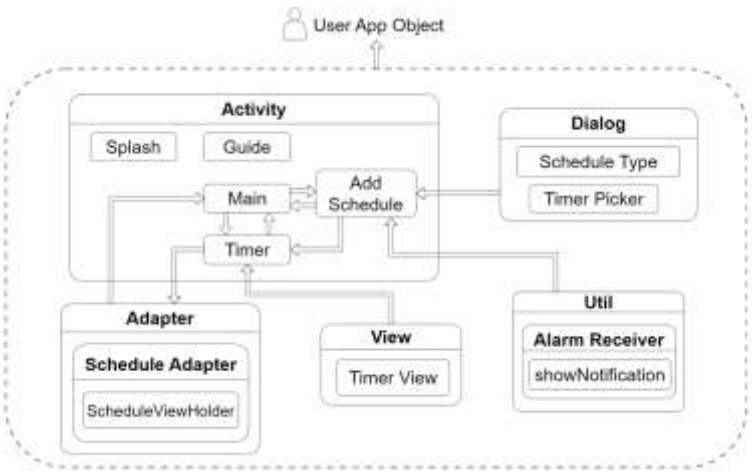

Fig. 1: Module Configuration Diagram

The system configuration of the application developed in this study was designed considering the cognitive characteristics of individuals with developmental disabilities, such as deficits in language and executive functions [14], as well as user-friendliness. It aimed to address the limitations of existing schedule management applications, particularly the complexity arising from the separation of alarm and timer functions. To this end, the system implements an innovative interface that integrates alarm and timer functionality.

Through the schedule addition feature, users can simultaneously set the schedule name, execution time, and allocated timer duration within a single interface. This deviates from the conventional separated UI structure, instead embedding the timer within the schedule. This integrated approach allows users with developmental disabilities to manage their schedules efficiently without navigating complex steps.

A local notification system was implemented to align with the execution times of set schedules, serving to remind users of their appointments. Specifically, local push notifications were designed to provide users with immediate access to the details of the relevant schedule. The screen accessed through these notifications allows for instant activation of pre-set timers, enabling continuous support from the commencement to the conclusion of each scheduled task.

The core feature of this research is the comprehensive schedule management functionality through a single process. It is structured to reduce the burden on users with developmental disabilities of having to configure multiple functions individually, allowing them to utilize both alarm and timer functions with a single schedule registration. This significantly reduces UI complexity, consequently alleviating the cognitive load on users.

The application's database was constructed using the Room library, an Object-Relational Mapping ORM (Object-Relational Mapping) library. This feature facilitates code maintenance by mapping database tables to objects, enabling object-oriented data handling. The Room library was selected for its inherent support of asynchronous processing, which helps maintain the application's performance and responsiveness.

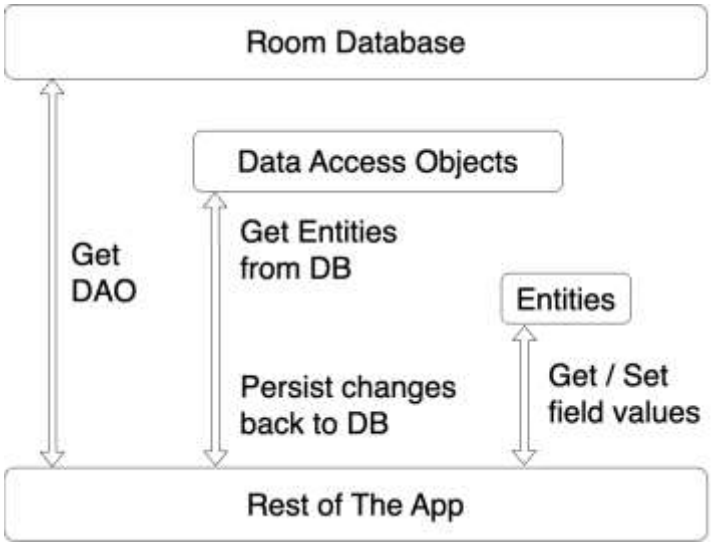

Fig. 2: Structure of the Room Library

When storing data using the Room library, objects need to be defined as entities. Each entity corresponds to a table in the associated Room database, and each instance represents a row of data in that table. The table is named "Schedule." Figure 3 shows the Entity code that sets the attributes corresponding to the data columns saved when adding a schedule.

```
@Entity(tableName = "schedules")
data class Schedule(
    @PrimaryKey(autoGenerate = true)
    val id: Int = 0,
    val name: String,
    val hours: Int,
    val minutes: Int,
    val seconds: Int,
    val startTime: String,
    val endTime: String,
    val musicPath: String? = null,
    val type: Int
): Serializable
```

Fig. 3: Entity Configuration Code

The local push notification feature provides users with schedule-related information even when the application is not in use or is running in the background, thereby helping them effectively utilize the timer function. Notification channels are required for devices running Android 8.0 or later, allowing the configuration of the notification's importance and characteristics.

There are two primary methods for delivering information to users: local notifications and push notifications. This application employs local notifications instead of push notifications, ensuring that it can function without an active internet connection. As the application is designed specifically for individuals with developmental disabilities, it was developed to be usable anytime and anywhere without requiring an internet connection. Local notifications are generated within the application, whereas push notifications are created on a server. Consequently, the use of local notifications allows the application to operate smoothly without an internet connection.

The application retrieves the schedule name from the Intent and searches the database for the corresponding schedule using the getScheduleByName function. Notifications are then displayed to the user through the showNotification method, and the setNextAlarm function is used to trigger the alarm at the same time the next day. Figure 10 illustrates the structure of the AlarmReceiver class, which sets up the alarm and displays the notification when the alarm is triggered.

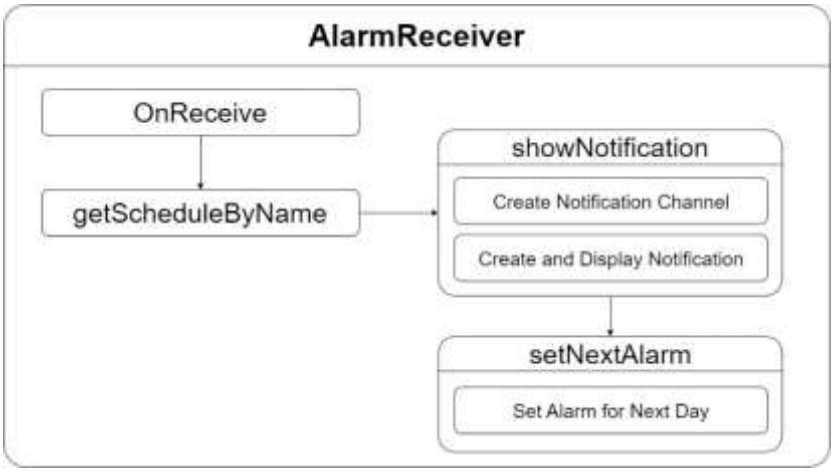

Fig. 4: Structure of the AlarmReceiver

4. System Implementation and Result

Figure 5 illustrates the UI configuration of the focus-enhancing scheduling application. After the Splash screen is displayed, the main screen showing the schedule list appears. A schedule list is generated according to the number of schedules created, and additional schedules can be created using the "Add Schedule" button on the main screen. By clicking on a created list, the timer function can be used.

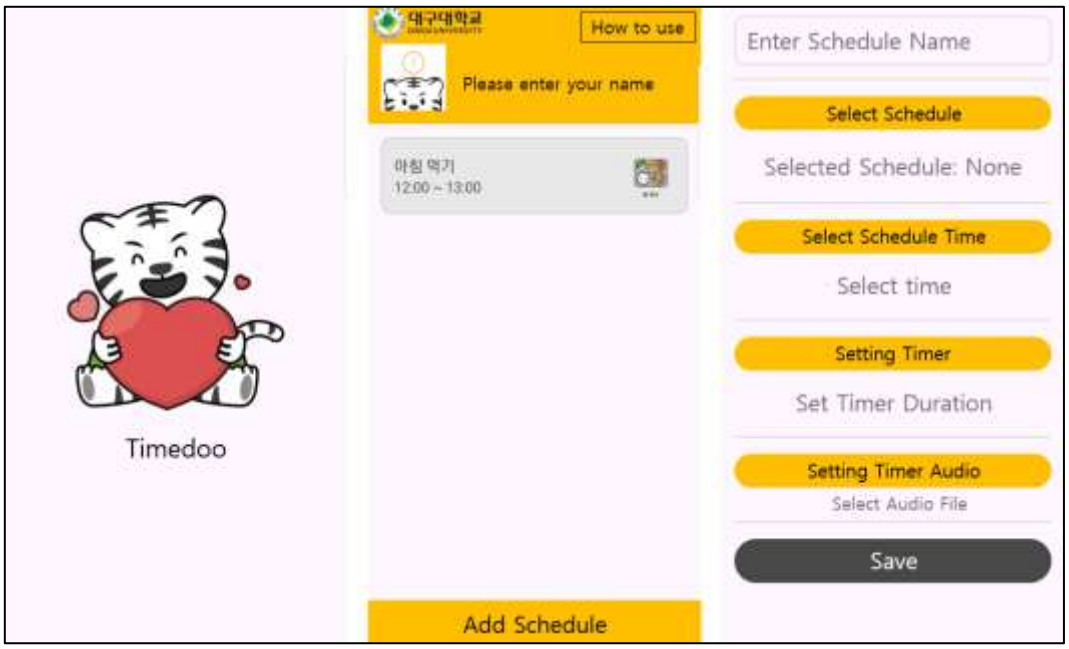

Fig. 5: Application Screen Composition

Users can enter the name of the schedule they want to create and select an image related to the schedule through the "Select Schedule" button, as shown in Figure 6. This feature helps users intuitively recognize the schedule from the main screen. To enhance the intuitive use of the focus-enhancing scheduling application for individuals with developmental disabilities, visual aids were provided using KAAC (Korean Augmentative and Alternative Communication: AAC) symbol images [15].

AAC (Augmentative and Alternative Communication) refers to methods that supplement or replace speech to provide communication opportunities and improve communication abilities for individuals with speech and language impairments [16]. While existing alarm lists do not display images, using AAC images allows for more intuitive understanding of the scheduled events. These images were obtained from the Korean AAC Symbol Search System, which uses about 10,000 symbols from the Korean AAC Basic Symbol System [17].

As a result, individuals with developmental disabilities can easily recognize schedules through visual cues, making this application more effective for them.

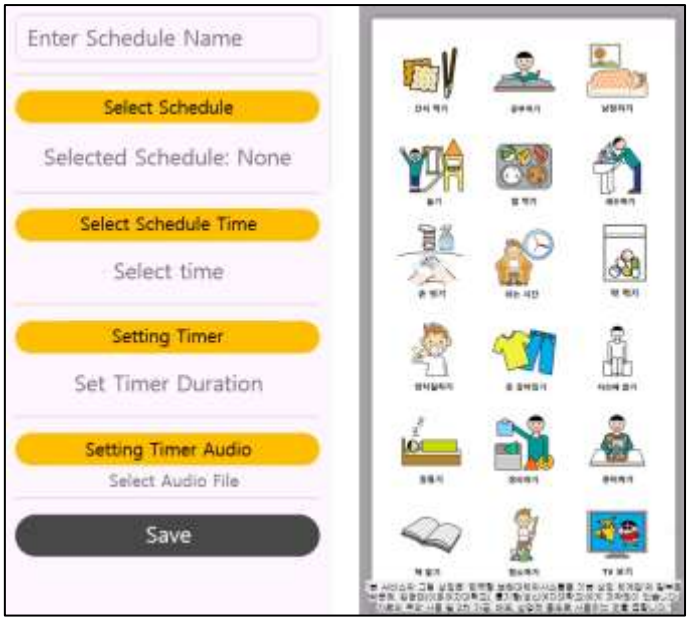

Fig. 6: Use of AAC Image

Figure 7 shows the user interface for setting the schedule time. A drag-and-drop clock model interface was used by default for time selection. This design allows users to set the time intuitively, providing visual enjoyment, promoting clock recognition, and stimulating curiosity to engage attention.

The clock model interface allows users to set the time easily through drag-and-drop, making it user-friendly for a diverse group, including individuals with developmental disabilities. Users can effortlessly move the hour and minute hands to set the desired time, thereby enhancing convenience.

In addition to the clock model interface, an interface allowing time input via the keyboard was also implemented. Users can freely switch between the two interfaces using the keyboard and clock-shaped buttons located in the bottom left corner of the time selection interface. By providing both the clock model interface and the keyboard input interface for schedule time settings, the user interface supports users in setting time efficiently according to their needs and preferences.

Fig. 7: Selection of Start and End Times for Schedule

Figure 8 depicts the timer-setting functionality. The timer in the focus-enhancing scheduling application is one of the core features designed to help users focus during the

scheduled time, allowing a maximum timer setting of 23 hours, 59 minutes, and 59 seconds. This enables the timer to be set for any time of the day.

The timer setting is designed with an intuitive drag-and-drop interface, making it easy for users to adjust the time. The interface provides visual feedback, allowing clear confirmation of the set time.

Additionally, the timer sound selection feature enables users to select their preferred sound from the smartphone's built-in files. Upon the first launch of the application, file access permission must be granted on the mobile device. This sound selection feature offers customization, aiding individuals with developmental disabilities in managing their time more efficiently in various environments. Setting a familiar sound as the timer alarm can produce positive effects on focus improvement. Once the schedule setup is complete, the schedule will be displayed on the main screen by pressing the save button.

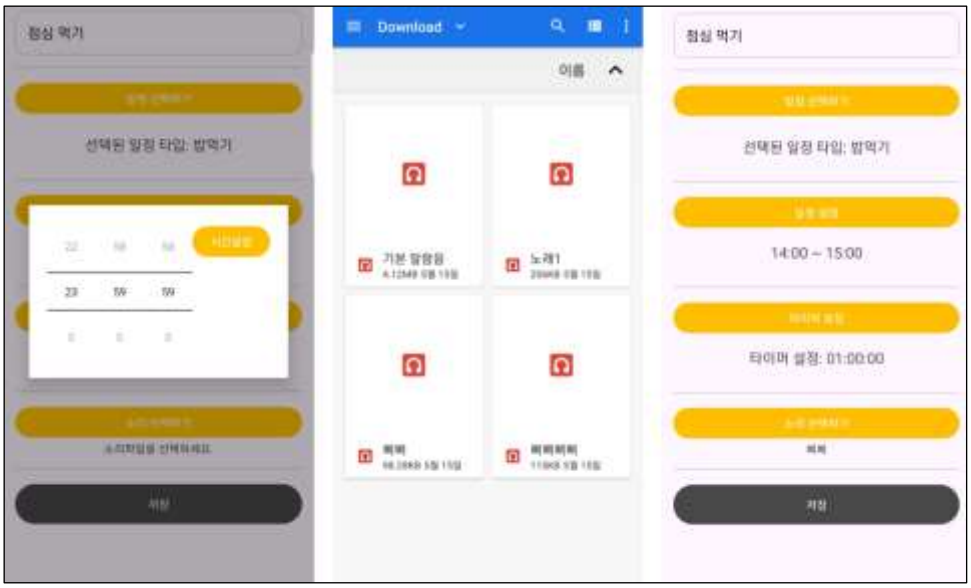

Fig. 8: Timer Settings

Figure 9 illustrates the interface for using key features designed to help users focus during the schedule. This interface simultaneously displays the schedule content and the timer time, with a circular graphic used to provide visual feedback on the timer. As the timer operates, the circle gradually shrinks counterclockwise, visually representing the passage of time. This aids users in easily recognizing time progression while adding visual interest.

Users can pause the ongoing timer with the pause button, stop the timer completely with the reset button, or resume the timer using the start button. The reset button is particularly useful if something interrupts the schedule, offering flexibility to the user.

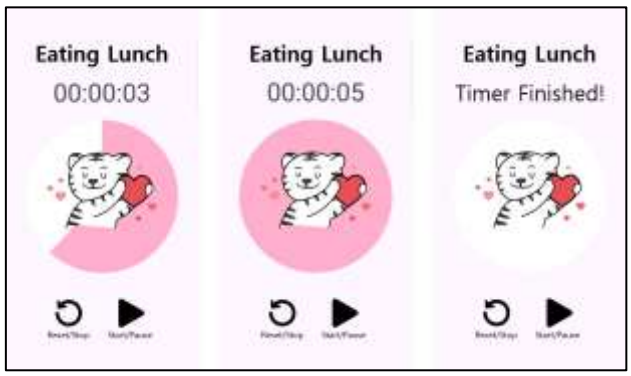

Fig. 9: Timer Interface

Even after the timer has finished, the alarm sound will continue to repeat until the user presses the stop button. This function helps maintain focus by continuously alerting the user until the scheduled task is completed. It is designed to support individuals with developmental disabilities in effectively using the timer and achieving their planned schedules.

There are two ways to use the timer. The first is to click on the schedule list in the main screen shown in Figure 6. The second is to activate the timer function via the local notification feature. Local notifications deliver messages generated within the application to the notification center, even when the application is closed or in the background. In this application, local notifications are implemented to display the schedule name with the default Android notification sound, as shown in Figure 10. By clicking the local notification, the timer function can be used immediately.

The local notification feature contributes to helping individuals with developmental disabilities remember their schedules and maintain focus, playing a crucial role in enhancing the application's functionality.

Fig. 10: Local Notification Screen

This application can be utilized as follows: After creating a schedule, the user can attend to other tasks until the designated time arrives. At that point, a local notification will alert the user that it is time to perform the scheduled task. By clicking on the local notification, the user is redirected to the timer screen. The timer can be started by pressing the play button, and if the task is completed, the user can stop the timer by pressing the stop button. For users with low concentration, such as individuals with developmental disabilities, the timer alarm will continue to sound indefinitely until the stop button is pressed after the task is completed. This feature is expected to enhance concentration and improve the ability to manage and complete scheduled tasks.

Fig. 11: Practical Use of the Application

5. Conclusion

In this study, a focus-enhancing scheduling application for individuals with developmental disabilities was developed using the Kotlin language. The application is designed to enable users to efficiently manage their schedules independently by incorporating an intuitive user interface and visual elements. The focus-enhancing scheduling application also integrates a

timer function to help users concentrate on the schedules they have created. Additionally, the timer function can be activated through the local notification feature.

Efforts to support the independent community living of individuals with developmental disabilities are crucial for their social integration and the enhancement of their quality of life. This application is expected to contribute to the establishment of daily routines and the improvement of self-management skills, potentially reducing the burden on caregivers. The application was developed by integrating the scheduler and timer functions into a simple interface that utilizes visual elements.

This system configuration is anticipated to effectively support the independent management of daily life for individuals with developmental disabilities. The organic integration of alarms and timers provides comprehensive support from schedule recognition to execution and completion. Furthermore, the intuitive and simplified interface is expected to enhance the autonomy of users with developmental disabilities while reducing the need for caregiver intervention.

Future research will involve evaluating the actual usability of this system to verify its effectiveness, followed by continuous improvements based on user feedback. It is expected that this will further enhance the quality of daily life for individuals with developmental disabilities, contributing to improved daily management skills and overall quality of life.

Acknowledgements

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