

Preference-Based Calendar and Planner User Interface Design

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Abstract

Our goal is to design interactive systems that are enjoyable to use, that do useful things and that enhance the lives of the people who use them. We want our interactive systems to be accessible, usable and engaging. In order to achieve this we believe that the design of such systems should be human-centred. That is, designers need to put people rather than technology at the centre of their design process. [1]

In this project, a user interface for a feature in the calendar is designed. The design process is step-by-step based on the first two chapters of the book "Designing Interactive Systems" by David Benyon.[1]

In this project, a user interface for a feature in the calendar is designed. In the first part, available similar calendars and planners in the market are analyzed, and a survey is taken to approve that users feel the same need for a preference-based feature in their calendars. The surveys and interviews are also used to determine exactly what can satisfy the users' needs regarding an Auto Planner feature in the calendar. Then tried to document requirements simultaneously with writing the personas and scenarios.

In the second part, the design idea of the final chosen feature described in the previous part is developed, and the first prototype is sketched. To have a selection among the design options, the choice that best satisfies the requirements based on Benyon's collection of 12 design principles is considered. Later, the design's usability is examined by walking through the four cognitive questions described by Benyon [1]. The feature is considered to be added to the Apple calendar. Therefore, the design should be compatible with the apple calendar and iOS user interface.

In the third part, an evaluation of the design is presented. First, a list of the problems or suggestions from the experts is provided. Based on that, some modifications are suggested to be done in the next design steps. After applying the adjustments, a digital prototype will be ready for an end-user test to evaluate the design from the users' and participants' perspectives. Eventually, after several cycles of design and evaluation, the final digital prototype is presented.

Keywords

User Interface Design, Interactive System, Prototype, Evaluation, Calendar, Preference-Based Planner

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1. Being Human-Centred

Designing interactive systems is a challenging and fascinating discipline because it draws upon and affects so many features of people's lives. There is a huge variety of interactive systems and products, from business applications of computers to websites to dedicated information appliances to whole information spaces. Designing interactive systems is concerned with designing for people using technologies to undertake activities in contexts. Designing interactive systems needs to be human-centred [1] mainly because:

- It draws upon many different subject areas, including both engineering design and artistic design.
- It is needed because we live in a digital age when bits are easily transformed and transmitted.
- It is necessary if we are to have safe, effective, ethical and sustainable design.

2. The Framework

An essential part of our approach to designing interactive systems is that it should put people first; it should be human-centred. We use the acronym PACT (People, Activities, Contexts, Technologies) as a useful framework for thinking about a design situation. The aim of human-centred interactive systems design is to arrive at the best combination of the PACT elements with respect to a particular domain. Designers want to get the right mix of technologies to support the activities being undertaken by people in different contexts. A PACT analysis is useful for both analysis and design activities: understanding the current situation, seeing where possible improvements can be made or envisioning future situations. To do a PACT analysis the designer simply scopes out the variety of Ps, As, Cs and Ts that are possible, or likely, in a domain. This can be done using brainstorming and other envisionment techniques and by working with people through observations, interviews and workshops. [1]

3. Current State Evaluation

Nowadays, many calendar and planner applications are available, designed with many different features and abilities. According to the survey, all the participants use a calendar to schedule their activities. Apple and Google calendars are the most popular planning applications based on the statistics available on App Store and Google Play. Both provide users with features that allow them to easily add events and activities to their

schedules and follow up on their plans. There are two main approaches to adding events to the calendar in this applications:

1. Add an event manually wherever the user wants to the schedule.
2. Add events using URLs by pasting the address in the app or clicking on the links provided by the event organizers.

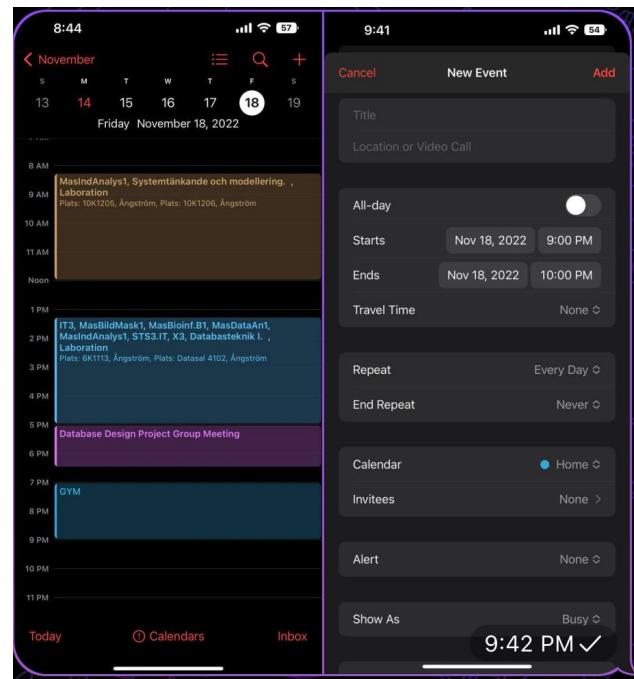


Figure 1. Apple Calendar User Interface

3.1 User Search

3.1.1 Survey

I started off my user research with a survey of 9 questions. Surveys have been a really valuable tool for gathering a large amount of quantitative data, so I took some time to craft my questions to reflect the information I really needed at the beginning of my process. I have shared my survey on several student groups and received answers from 21 individuals. Here are some important statistics relevant to my project:

- All the participants have stated they use a calendar to schedule their daily tasks.
- 53 percent of the participants modify their calendars at least once a week.
- 58 percent of the participants have felt frustrated by their calendar and planner and searched for a better one to replace

- 79 percent of the participants have felt the need for a smarter calendar with more features.
- 86 percent of the participants have stated that they will use a calendar that takes their priorities and preferences and plans their schedule.

The last two bullet points validated the need for a better planning feature in calendars, a preference-based planner in particular, so I decided to run with it and dive into some more user research to see where I can add value!

3.1.2 Interview

I conducted three interviews with people using calendars and planners to keep up with their daily scheduling. The interviews provided me with a lot of insightful information summarised below:

- All of them are inclined to have all their tasks and plans written in their calendar, but they don't do so because they find it hard to manually add every event or task to their calendar.
- They are losing a considerable amount of time deciding when to do repeating tasks by searching for free slots considering their preferences every time.
- They can not make routines in their activities because they find it hard to place them in their calendar repeatedly.
- They believe they can not dedicate the required amount of time to each task as a lack of the ability to predict their weekly or monthly schedule.

4. Defining Improvement

I converted all of my recorded interviews and survey results into digital sticky notes using Miro website. At this stage, I started to suggest improvement solutions for each frustration or hardship people have faced using calendars and planners. To adjust the suggestions with the PACT framework, I asked the below question for every single suggested improvement:

*How can this improvement utilize the right mix of technology and support the **activities** being undertaken by **people** in different contexts?*

After having all the interview results and users' needs written alongside the suggested improvement in the PACT framework, I better understood that design is messy, as stated by David Kelley as below:

"Remember, design is messy; designers try to understand this mess. They observe how their products will be used; design is about users and use. They visualize which is the act of deciding what it is."

To contrive a roadmap to design a human-centered user interface out of the messy information, I started by understanding the information in their own concept and evaluating the understanding at every step.

4.1 Understanding

Understanding is concerned with what the system has to do, what it has to be like and how it has to fit in with other things; with the requirements of the product, system or service. Designers need to research the range of people, activities and contexts relevant to the domain they are investigating so that they can understand the requirements of the system they are developing.[1]

At this stage, I started writing requirements for every suggested improvement connected to each user's needs or frustrations. Therefore, I defined each suggested improvement's constraints and evaluated whether the improvement is achievable in the scope of a human-centered design where the main goal is to provide the human user with the desired activity in the desired context utilizing the available technology.

For example, in figure 2, the orange box is the need expressed by the users in the interviews, the blue boxes are the suggested improvements, the pink boxes are the requirements, and the green boxes are the constraints. This diagram shows that requiring the user to assign a priority to each task may make them frustrated, and not requiring a priority for every task makes the calendar unable to plan the schedule because it can't compare the priority of all tasks and define which task is more important. Therefore, having an attribute of priority for every task is not a reasonable improvement.

In figure 3, the suggested improvement is to ask for the time flexibility of the tasks. This can be done by adding a simple check box that is user-friendly, and later the calendar can adjust the flexible task considering higher priority for the non-flexible ones. Therefore, adding a feature to ask for the time flexibility of the tasks is a reasonable improvement.

4.2 Final Chosen Feature

Following the process explained in the previous section, I have chosen a feature to add to the calendar that I assume will contribute to a better user experience and satisfy the needs expressed in the interviews and survey. As it is going to plan the users' daily activities considering their preferences, I have named it a preference-based calendar and planner. The main attributes are as below:

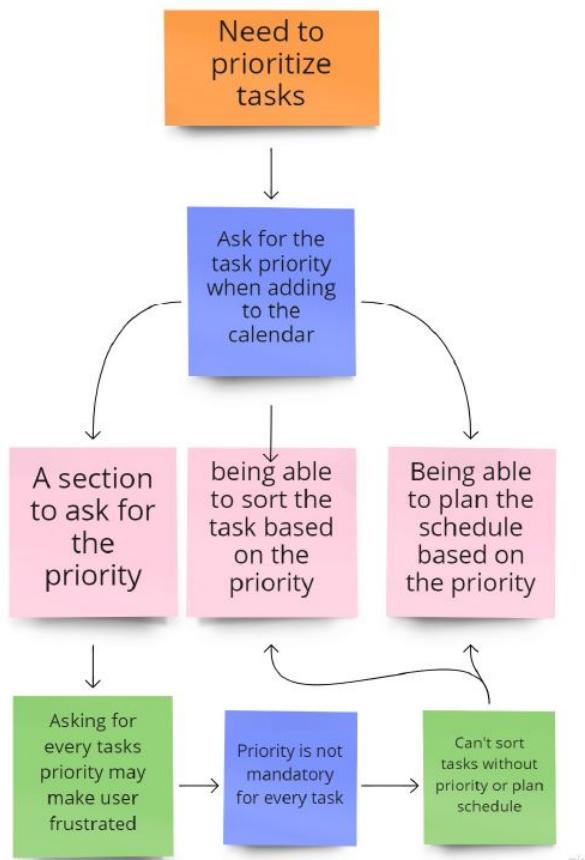


Figure 2. Sample brainstorm to define improvements considering requirements and constraints

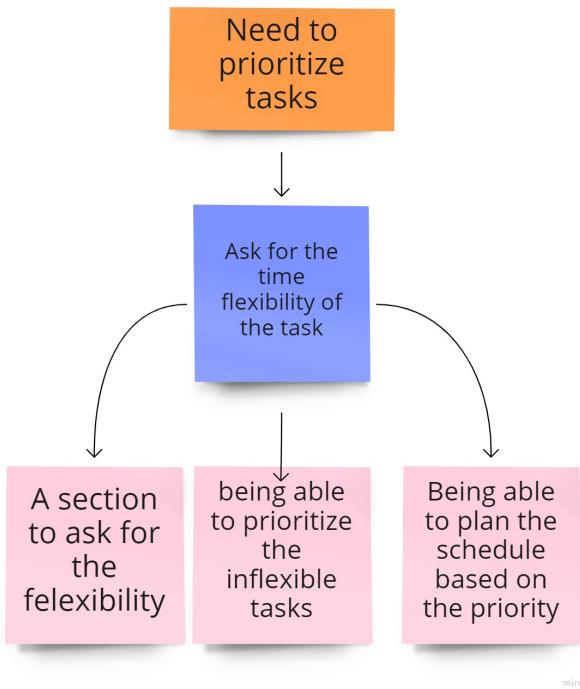


Figure 3. Sample brainstorm to define improvements considering requirements and constraints

- The planner asks whether an event is time flexible or not to prioritize the events relatively.
- The planner asks for the amount of time required for repeating events to distribute it in the required period.
- The planner asks for the time preference, day preference, and any relative preference to other events. Users can also input their life routines like sleep and wake-up time. Therefore, the planner can schedule all the user's activities based on their preferences.

In the next section, a scenario-based design is followed as the process of designing the user interface of the presented feature. I have tried to make a documentation of requirements simultaneously with writing the personas and scenarios.

5. Scenario-Based Design

In order to guide the design process, we need to think about the PACT elements. The people who will use the system are represented by personas; profiles of the different types, or archetypes, of people we are designing for. Activities and the contexts in which they will occur are envisioned through scenarios of use.

Scenarios are stories about people undertaking activities in contexts using technologies. They appear in a variety of forms throughout interactive systems design and are a key component of many approaches to design. [1]

5.1 Persona

Personas are concrete representations of the different types of people that the system or service is being designed for. Personas should have a name, some background and, importantly, some goals and aspirations.[1]

The most prominent users of a versatile calendar and planner are organized and self-oriented people. To better address the needs and problems of these characteristics, I have considered the persona an ISTJ MBTI personality type, someone with the Introverted, Observant, Thinking, and Judging personality traits. ISTJs are responsible organizers, driven to create and enforce order within systems and institutions. Figure 4 pictures the persona used to design the planner in detail.

John



'A task-oriented person that feels motivated by checking-off the tasks as he completes them'

Age: **25**

Work: **Student**

Status: **In a Relationship**

Location: **Uppsala, Sweden**

Character: **The Super Active**

Organized

Dedicated

Direct

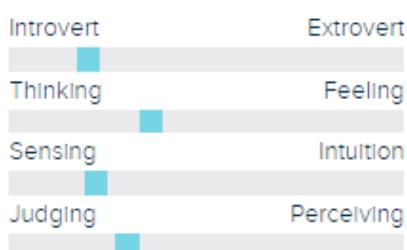
Goals

- To have all his tasks and events written in his calendar
- To better plan his daily activities in advance
- To make healthy routines in his life
- To make sure he is using his time effectively

Frustrations

- Modifying his calendar every day
- Not to be able to follow his pre-defined schedule
- Losing time finding an empty slot in his calendar suitable for his activities
- Not dedicating the required time to each activity
- Losing deadlines or working under pressure close to deadlines

Personality: ISTJ



Tasks:

- Classes
- Assignment
- Projects
- Gym

Bio

John is a master's student at Uppsala University. It is of great importance for him to participate in all the lectures and lab sessions and keep up with the assignments and projects in a timely manner. He wants to dedicate a pre-defined amount of hours based on the number of credits to each course. He has not been working out regularly because he needs help finding a workout routine in his schedule. He believes he can better complete tasks that are already written in his plan compared to spontaneous activities. He also has a girlfriend with whom he wants to spend time at least a couple of times every week. John has tried many different calendars and planners yet has found none of them as beneficial as he expected.

Figure 4. Persona

5.2 Scenario

"John, 25, is a master's student at Uppsala University. He has enrolled in three courses in the second period of the Autumn 2022 semester, Database Design, System Thinking, and Human-Computer Interaction. Each course contains several lecture hours as well as assignments and projects. John has added the courses' schedules to his calendar by subscribing to them on the university's website. Each course is five credits, meaning he has to study 40 hours a month besides the lectures, lab sessions, and seminars to satisfy all the requirements and get a good grade. He also wants to make a routine of going to the gym three times a week to stay fit. He also has a girlfriend with whom he wants to spend time at least twice a week.

John has decided to plan everything at the start of the period and add all his tasks and activities to his calendar. He wants to add 20 study sessions with a duration of 2 hours for each course to his calendar, as well as three gym sessions each for 1 hour. He prefers to go to the gym in the morning if no classes are scheduled at the university. He also likes not to go to the gym on the days he has lab sessions because he may feel tired in the lab. Moreover, he wants to dedicate more time to the subjects for which he has a deadline a day before the deadline. Therefore, he thinks he will have some leisure time to spend with his girlfriend without worrying about his assignments and projects.

As John has started to write every task down in his calendar, he has felt frustrated because he has to check many things before adding a task, and later on, he has found it harder to keep up with his preferences as the empty slots in his calendar are decreasing. Therefore, he thinks that following such organized scheduling is impossible, and he has to give up on the gym again and maybe work on each assignment full days just before the deadline.

On the last try, John used many different calendars and planners to find one that got a feature to optimize his plan and offer him a well organized schedule automatically. Yet he has not found the expected tool. He wishes there was a feature that takes the amount of time he wants to dedicate to each course or gym, takes the length he wants for each session, and asks for his preferences, such as when he wants to do the task in the day or whether he doesn't want the task to be in the same day with another task or whether he needs more hours for a task before a specific date, and then suggest him a clear schedule automatically."

5.3 Feature Overview

The feature is an auto-planner that would be added to the already existing calendars. The auto planner would take some information about the user's preferences and schedule the plan for the selected period. The auto planner should be able to modify the user's schedule later if any other new event is added to the program. It also should be able to notify the user if it doesn't find any or enough empty slots based on the assigned preference criteria for the task.

In order to minimize the required information from the user, I have written an object-oriented program in Python containing a planner class to test the feature's functionality, trying to have the least overlapping input from the user. Though this step is not entirely related to the design process, I have still considered Benyon's 12 design principles in this matter. The input should be flexible so that users can choose ways of doing things. Moreover, the feature should not make the user feel frustrated with so much required input and information. The final selected required input from the user is as below (These inputs are above the already implemented required information in calendars, such as the task title and location):

1. The user's sleeping and wake-up routine or working hours routine.
2. The tasks' flexibility.
3. The start and end of the required period in which the user wants to have a schedule.
4. The total time user wants to do a task in the selected period.
5. The preferred length of each session.
6. The day preference for the task sessions.
7. The time preference for the task sessions.
8. The preferred time distance between two sessions
9. The task's relativity to other tasks. The user can choose to or not to have some tasks on the same day or in an order

5.4 Requirements Elicitation

Following the process explained in the Understanding section, each solution and improvement brings some requirements. A MoSCoW method is used to prioritize the project's requirements. Figure 5 depicts the "Must Have" and "Should Have" requirements of the system design.

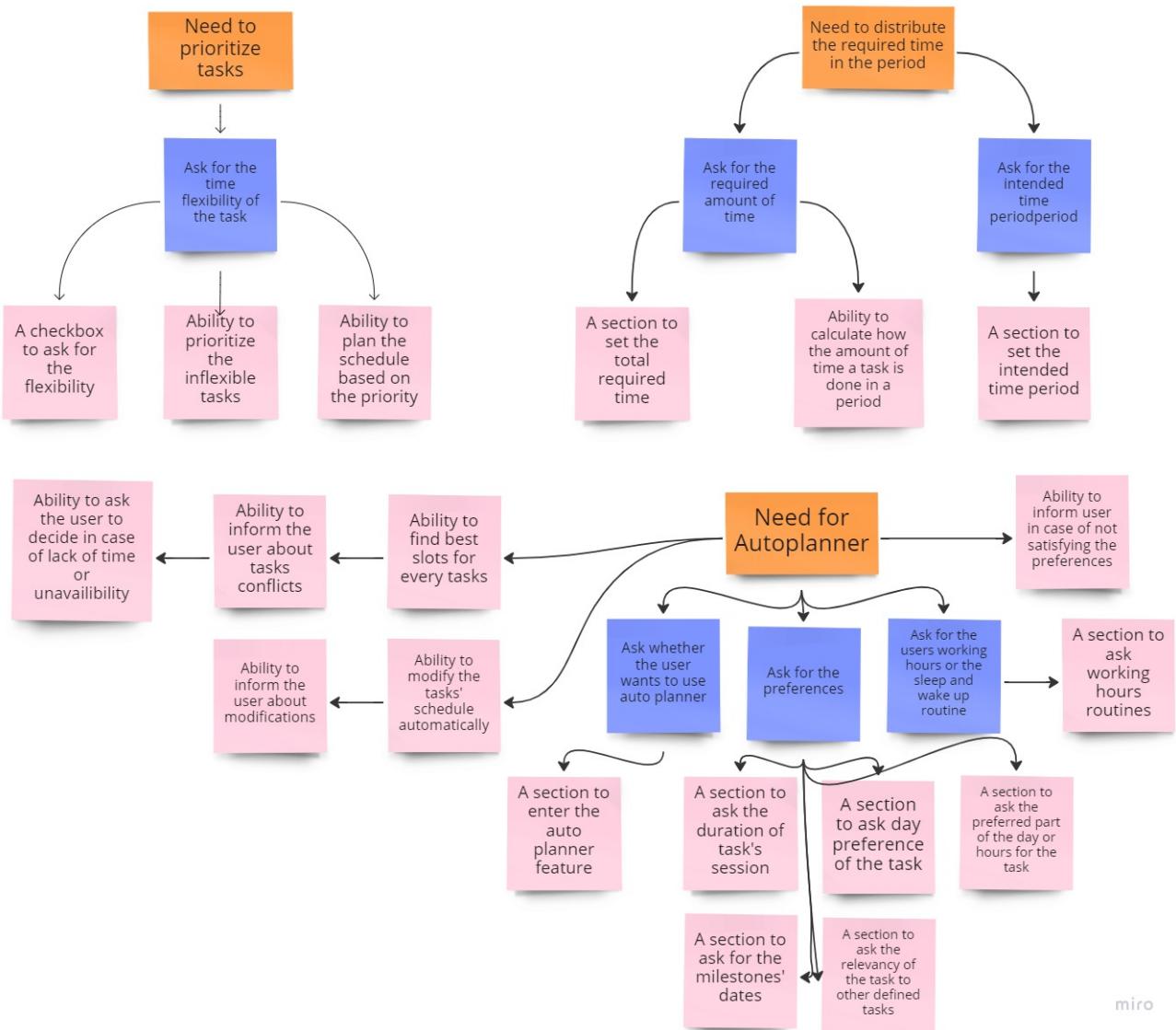


Figure 5. Requirements. Pink boxes are the requirements of the UI design

Some of the widgets that are considered "Could Have" and "Won't Have" are as below:

- Connecting group members' calendars to each other to schedule team tasks.
- Providing different themes for users so they can choose among them.
- Following the users' progress toward reaching their goals and giving a report of their productivity.

6. Design

In this section, the layouts and sketches of the feature are designed step by step, considering Benyon's 12 design principles. To do so, I will explain the principles that are more relevant to the context and application and oversee the ones that may be neutral or less effective among the design options. **All the figures in this sections are sketches or low fidelity designs using paint application just to show the design ideas, not the final digital design.**

6.1 Auto Planner Button

The auto planner button is a command button in the calendar. As all the command buttons in the Apple calendar are located on top of the page, the auto planner button should be in the same section in order to be "consistent." It will also be "visible" on top of the page, and to increase the user's "familiarity" with the newly established feature, I have decided to write the name "Auto Planner" on the button instead of using a symbol.

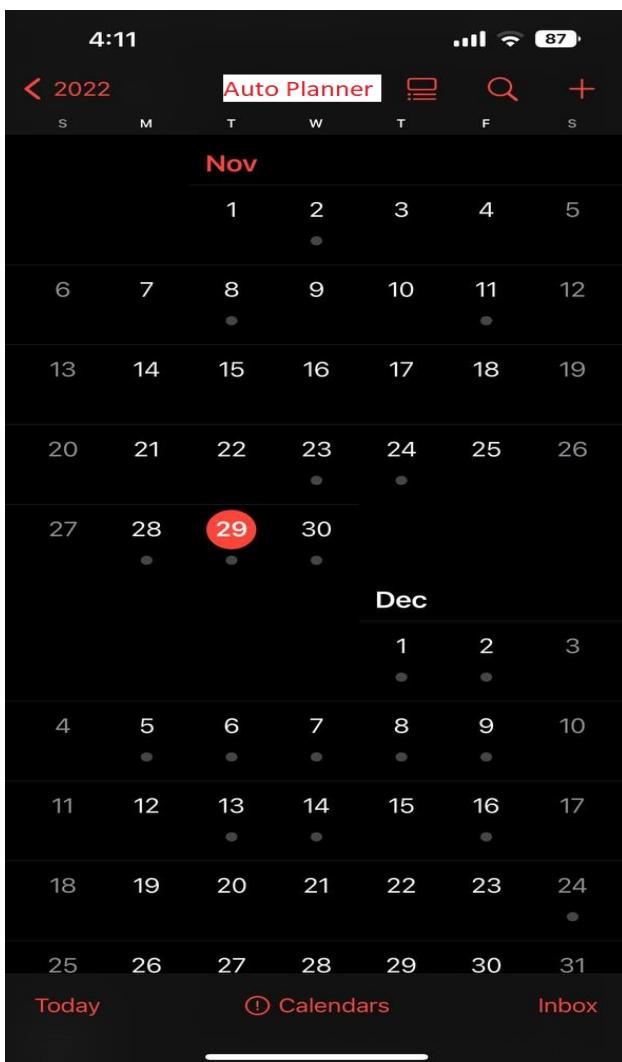


Figure 6. Auto Planner Button

6.2 Set Sleep Schedule

When the users open the auto planner for the first time, they are required to set up their sleep schedule. Apple has a feature to set sleep schedules already implemented on the clock application. Therefore, to keep the design "flexible" by offering several ways to do a thing to the users, I have offered them to connect to the "Bed Time" in the clock or add their sleep schedule manually. The user interface to manually add the sleep schedule is the same as it is on the clock application bedtime, but it doesn't require the excessive health information required in the clock. The buttons are screen wide to be "visible," and the "style" should be "consistent" to the other command buttons in iOS. In order to give the users the feeling of being in "control" and knowing the "feedback" on their actions, a brief description is provided.

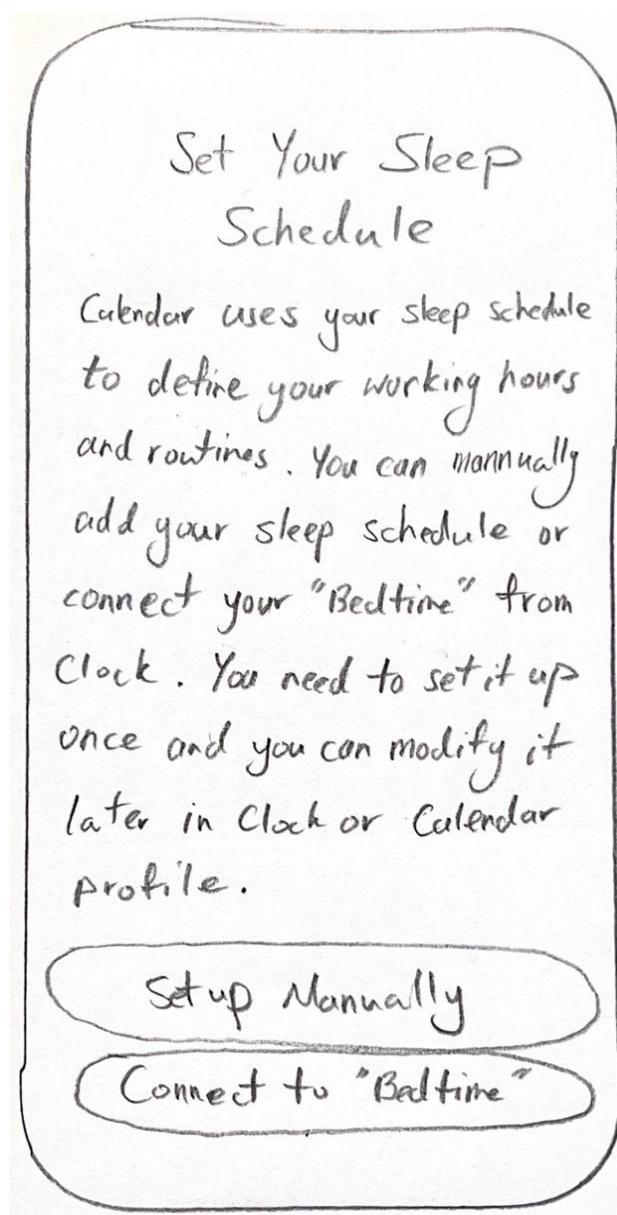


Figure 7. Set Sleep Schedule - First Page

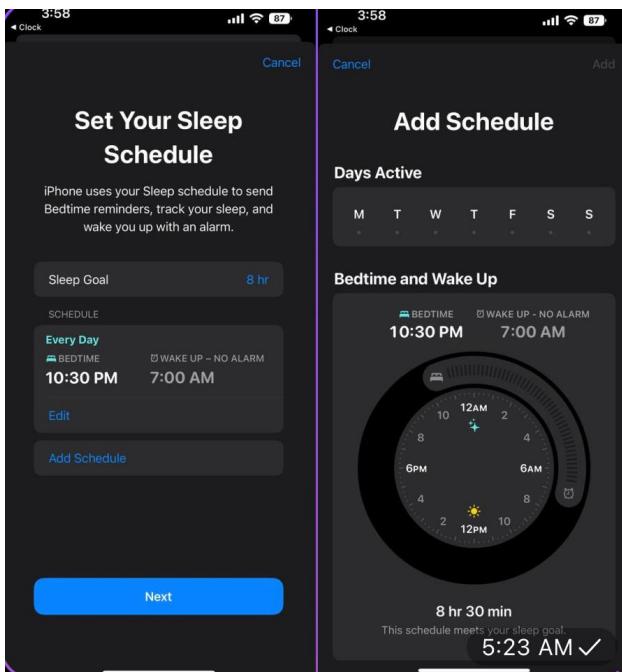


Figure 8. Set Sleep Schedule - Manually Set Up Interface

6.3 Auto Planner First Page

After setting up the sleep schedule once, the user must be able to add activities and routines using the auto planner. The first page should be designed to ask the user to input the required information No.2-5 introduced in the previous section, besides the already existing required information in the calendar event adding (+) page.

6.3.1 Already Existing Sections

In order to keep the design "Consistent" with the Apple calendar's interface, I have tried to keep the already existing features and sections. Moreover, these sections satisfy all the Benyon's 12 principles of design. In the first section, the user should add the name of the event. The keyboard pops up by taping on the title section, and the user types the name. By taping on the location section, the Apple location interface window opens and allows the user to add saved or recent locations or a new location by searching or moving on the map. The "Travel Time" and "Alert" sections have an accessible waterfall option to determine the event features. (Figure 10)

6.3.2 New Sections designed for Auto Planner

The sections in the red box in Figure 9 are the new sections designed for the auto planner. The first one checks the flexibility of the event with the user using an on/off button. Table 1 analyzes the compliance of this design with Benyon's design principles.

In the second section, users define the period they

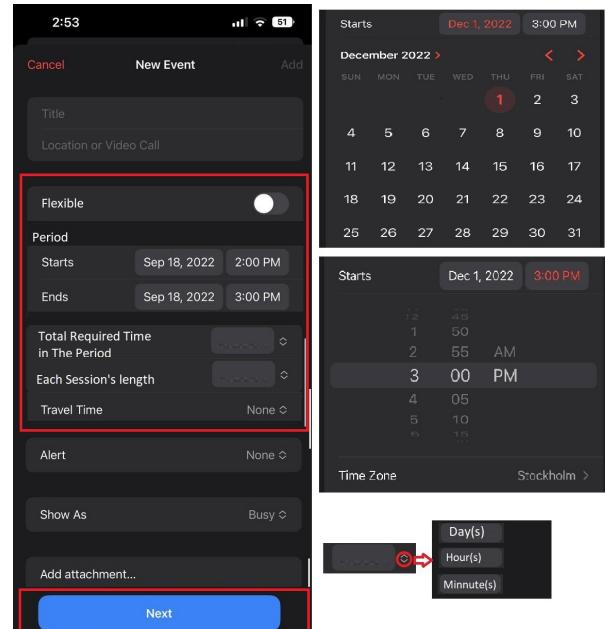


Figure 9. Auto Planner First Page User Interface

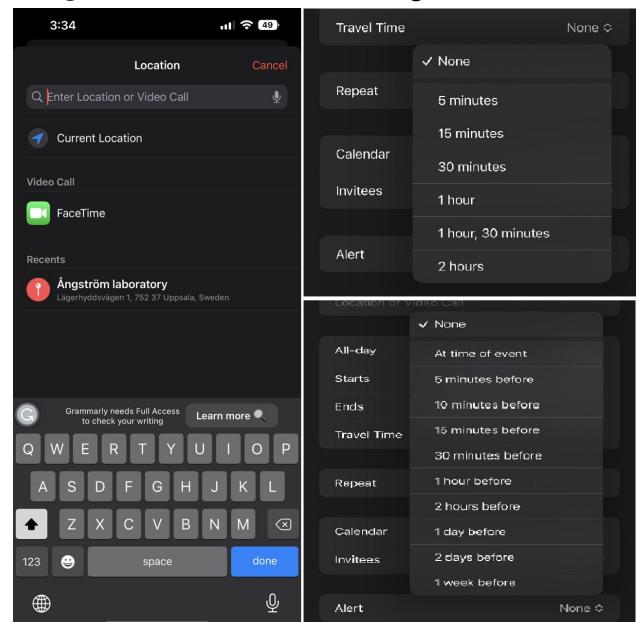


Figure 10. Location, Travel Time, and Alert User Interface

Principle	Compliance
Visibility	The text representing the section is visible. Also, the on/off button is visible in front of it. Both section's name and input tool are located in a box separating them from the other sections.
Consistency	The box, section's name, and input style are consistent with other parts of the calendar as well as the iOS.
Familiarity	The on/off button style is so common among smartphone users and they are familiar with it
Affordance	The on/off button is designed in a way that users would recognize its function instantly.
Control	The relation between the flexibility of the task, hence the priority of tasks and the functional button is clear
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 1. "Flexibility" Input Section Compliance with Benyon's Design Principles [1]

want to schedule their plan in. By pressing on the date of the start and end of the period, a small calendar (Figure 9 top right) would show up. By taping the time box, a rounding set of numbers (Figure 9 middle right) would allow them to select their preferred time. These interfaces for selecting dates and times are already implemented in the calendar. Table 2 analyzes the compliance of this design with Benyon's design principles.

In the next section, users enter the amount of time they want to dedicate to a task in the period as well as a preferred length for each session of the task. By tapping on the empty box, a numerical keyboard pops up in which the user enters the number. Then, by tapping the sign on the right side of the box, users can choose if the scale should be the day(s), hour(s), or minute (s). (Figure 9 bottom right) Table 3 analyzes the compliance of this design with Benyon's design principles.

The "next" button is designed at the bottom of the page to lead the user to the next page after entering the required information on this page. (Figure 9) Table 4 analyzes the compliance of this design with Benyon's design principles.

6.4 Auto Planner Second Page

After pressing the "Next" button, the user would see the second page of the auto planner in which they can add their preferences. The first page should be designed to ask the user to input the required information No.6-9 introduced in the previous section. (Figure 11

In the first section, users select their preferred days

Principle	Compliance
Visibility	The text representing the section is visible. Also, the boxes to input the date and time are visible in front of it. Both section's name and input tool are located in a box separating them from the other sections.
Consistency	The box, section's name, and input style are consistent with other parts of the calendar as well as the iOS.
Familiarity	The input interface for the dates and times were already implemented in the calendar, so users are familiar with them.
Affordance	The boxes to input dates and times for the start and end of the period are designed so the user recognize their function instantly.
Control	The relation between the start and end of the period for the task, and the fact that the planner would schedule in this period is clear
Constraint	The input of the dates and times are designed in a way that the user can't enter wrong information or format
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 2. "Period" Input Section Compliance with Benyon's Design Principles [1]

Principle	Compliance
Visibility	The text representing the section is visible. Also, the box to input the amount of time time is visible in front of it. Both section's name and input tool are located in a box separating them from the other sections.
Consistency	The box, section's name, and input style are consistent with other parts of the calendar as well as the iOS.
Familiarity	The numerical keyboard is so common and the user knows its function. The input interface for the scale is already implemented in the calendar in other sections, so users are familiar with them.
Affordance	The boxes to input the amount of and chose the scale are designed so the user recognizes their function instantly.
Control	The relation between the total amount of time and each session's length is clear.
Constraint	The input of the amount of time is designed in a way that the user can't enter the wrong information or format
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 3. "Dedicated Time and Session's Length" Input Section Compliance with Benyon's Design Principle

for the task sessions. To do so, by tapping on the sign in front of it, a waterfall selection of days opens to the user (Figure 11 top right). Then, the user chooses the days, and the selected days get a blue circular sign on their left, as checked. Table 5 analyzes the compliance of this design with Benyon's design principles.

In the second section, the user chooses the preferred time for the task sessions. They can select the

Principle	Compliance
Visibility	The text representing the section is visible. Also, the bottom is blue and screen width that makes it visible to users.
Consistency	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS.
Familiarity	Users are familiar with the blue command buttons
Affordance	Users recognize the function instantly
Control	The relationship between the first page and second page through the next button is clear
Constraint	The button is designed in a way that the user can't do anything wrong with the process.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 4. "Next" Button Compliance with Benyon's Design Principle

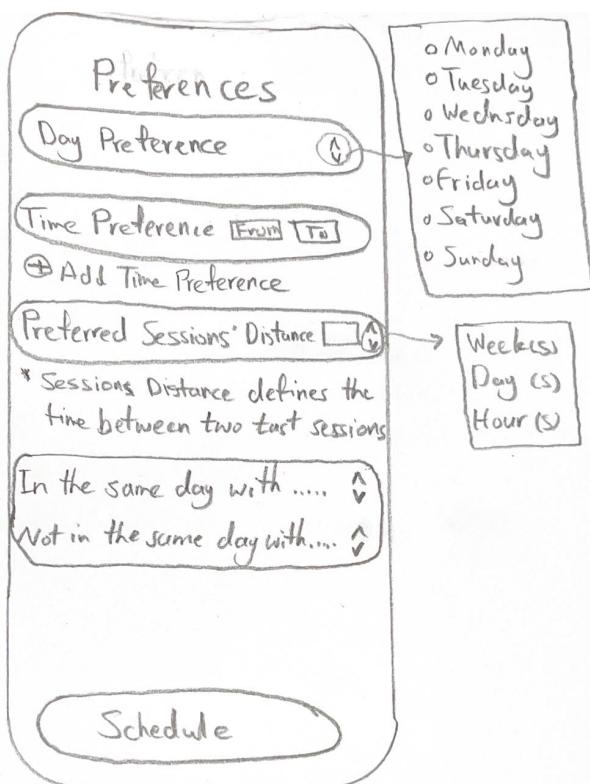


Figure 11. Auto Planner Second Page Sketch

start and end of their preferred period. By tapping on the "From" and "To" boxes, a round set of the clock shows up in which they can select the time (Figure 9 middle right). Users can also select more time preferences by tapping on the "+" sign below the input section. Table 6 analyzes the compliance of this design with Benyon's design principles.

In the next section, the user enters the amount of time they prefer between two task sessions. In the box, they can add a number, and by tapping on the sign on the right side of the box, they can choose among week(s), day(s), and hour(s) as the scale. (Figure 11

Principle	Compliance
Visibility	The text representing the section is visible. Also, the sign is visible on the right end of the section.
Consistency	The section is separated and in a different colors.
Familiarity	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS. The waterfall selection is consistent with the calendar's other sections
Affordance	Users recognize the function instantly. The days selection is also visible and recognizable.
Control	The relationship between the desired function and day preference is clear
Constraint	The options are designed in a way that the user can't choose the wrong information or format.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 5. "Day Preference" Input Section Compliance with Benyon's Design Principle

Principle	Compliance
Visibility	The section, name, boxes, and + sign are visible. The section is separated and in a different colors.
Consistency	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS. The round clock selection is consistent with the calendar's other sections
Familiarity	Users are familiar with the calendar sections and the signs, as well as the round-clock time selection
Affordance	Users recognize the function instantly. The time selection is also visible and recognizable.
Control	The relationship between the desired function and time preference is clear
Constraint	The options are designed in a way that the user can't choose the wrong information or format.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 6. "Time Preference" Input Section Compliance with Benyon's Design Principle

middle right). As this section may seem vague to the user, a brief description is added below it.

In the final section, users choose whether they want a task session on the same day as another task. By tapping the sign in front of each sentence, a list of other set calendars which is already implemented in Apple calendar opens that users can select among them. (Figure 12)

The "Schedule" button is designed at the bottom of the page to schedule the user's plan after entering the preferences on this page. (Figure 11) Table 9 analyzes the compliance of this design with Benyon's design

Principle	Compliance
Visibility	The section, name, boxes, and sign are visible. The section is separated and in different colors from the background.
Consistency	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS. The waterfall selection is consistent with the calendar's other sections
Familiarity	Users are familiar with the calendar sections and the signs, as well as the waterfall selection.
Affordance	As the function of this section may seem vague to the user, a brief description is added below it. Therefore, the user recognizes the function and can decide better how to choose and be in control.
Control	The relationship between the desired function and the time distance between sessions is clear.
Constraint	The options are designed in a way that the user can't choose the wrong information or format.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 7. "Time Distance" Input Section Compliance with Benyon's Design Principle

Principle	Compliance
Visibility	The section, name, boxes, and sign are visible. The section is separated and in different colors from the background.
Consistency	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS.
Familiarity	Users are familiar with the calendar sections and the signs. As this is a new entry section and may be vague for user, the text is a complete sentence to increase familiarity
Affordance	As the function of this section may seem vague to the user, the name of the section is a sentence that define its functionality. Therefore, the user recognizes the function and can decide better how to choose and be in control.
Control	The relationship between the desired function and the task relativity is clear.
Constraint	The options are designed in a way that the user can't choose the wrong information or format.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 8. "Tasks Relativity" Input Section Compliance with Benyon's Design Principle

principles.

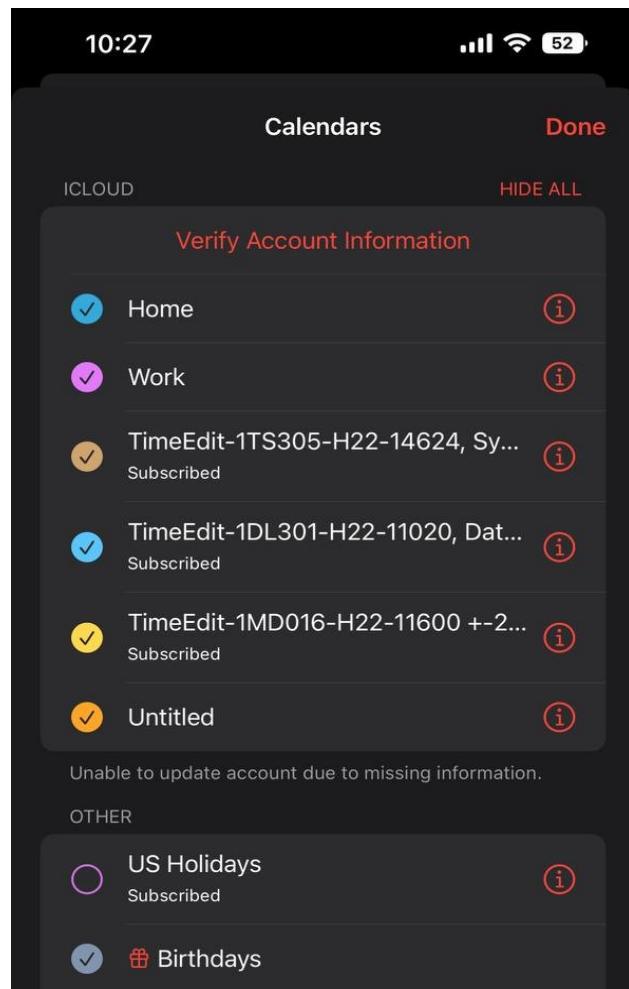


Figure 12. List of Pre-Defined Schedules User Interface

Principle	Compliance
Visibility	The text representing the section is visible. Also, the bottom is blue and screen width that makes it visible to users.
Consistency	The box, section's name, and color are consistent with other parts of the calendar as well as the iOS.
Familiarity	Users are familiar with the blue command buttons
Affordance	Users recognize the function instantly
Control	The relationship between the desired function and scheduling is clear
Constraint	The button is designed in a way that the user can't do anything wrong with the process.
Style	The design is stylish and compatible with the other sections and whole iOS interface

Table 9. "Schedule" Button Compliance with Benyon's Design Principle

7. Cognitive Walk-trough

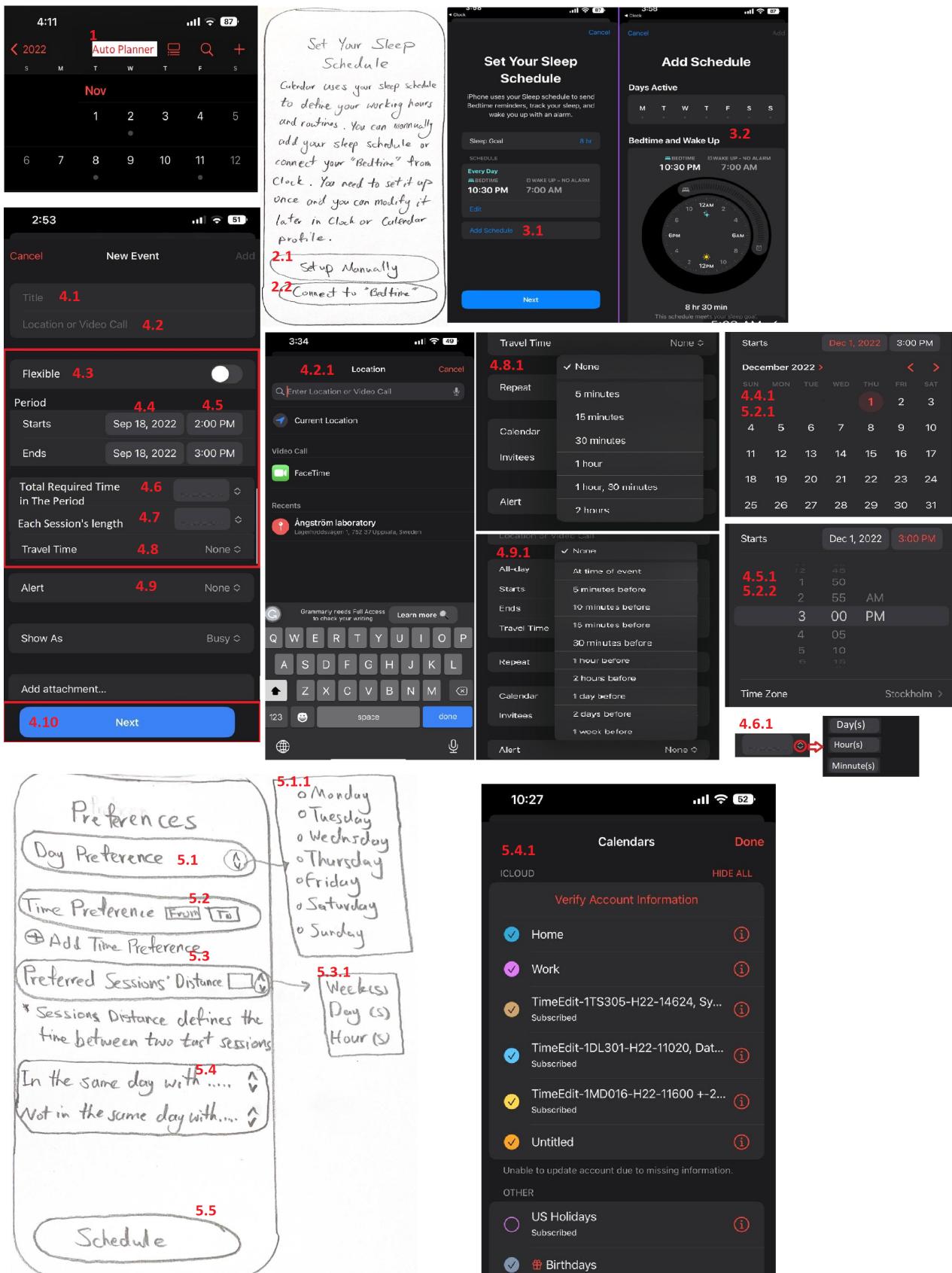


Figure 13. User Interface Action Steps

A cognitive walkthrough is a rigorous paper-based technique for checking through the detailed design and logic of steps in an interaction.[1] Figure 13 depicts the step-by-step actions the user takes. The actions and inputs are explained in the Design section. To evaluate the design, four main cognitive questions suggested by Benyon are asked (Table 10 and 11). The designs that do not pass all the required criteria will be modified in the next step.

Steps:	1	2.1	2.2	3.1	3.2	4.1	4.2	4.2.1	4.3	4.4	4.4.1
Will the people using the system try to achieve the right effect?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Will they notice that the correct action is available?	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Will they associate the correct action with the effect that they are trying to achieve?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
If the correct action is performed, will people see that progress is being made towards the goal of their activity?	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y

Table 10. Cognitive Walkthrough Part 1 - Y: Yes, N: No

Steps:	4.5	4.5.1	4.6.1	5.1	5.1.1	5.2	5.3	5.3.1	5.4	5.4.1	5.5
Will the people using the system try to achieve the right effect?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Will they notice that the correct action is available?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Will they associate the correct action with the effect that they are trying to achieve?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
If the correct action is performed, will people see that progress is being made towards the goal of their activity?	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

Table 11. Cognitive Walkthrough Part 2 - Y: Yes, N: No

8. Expert Evaluation

In our human-centred approach to design, we evaluate designs right from the earliest idea.[1] For example, in the previous section every design decision were mocked-up and reviewed, to be followed later by more realistic prototyping and testing of a partially finished system and finally by evaluation of the near-complete device in its intended home setting. There are two main types of evaluation. One involves a usability expert, or an interaction

designer, reviewing some form of envisioned version of a design: expert-based methods. The other involves recruiting people to use an envisioned version of a system: participant methods. Where possible these people should be representative of the people at whom the system is aimed (sometimes called ‘end-users’).[1]

8.1 First Expert Evaluation

A simple, relatively quick and effective method of evaluation is to get an interaction design, or usability, expert to look at the system and try using it. Expert evaluation is effective, particularly early in the design process. [1] In this step, five experts are asked to use the design and share their ideas regarding the design’s compliance with Benyon’s 12 design principles in a think-aloud session. Table 12 explains experts’ ideas to increase the design’s usability. Except for the four problems and suggestions, the experts verify other designs’ compliance with Benyon’s design principles.

No.	Type	Principle	Step	Explanation
1	Content	Affordance	4.3	A description is needed for this section to help user understand the function of this input
2	Functionality	Flexibility	2.1	Another option should be included to let users skip this section as some users may not be inclined to have a sleep routine.
3	Functionality	Recovery	Second Page	A back button should be added to let users go back to the first page and change information. Also a cancel button should be added to let user discard the functions.
4	Wayfinding	Feedback	5.5	After pressing the schedule button a notification should inform the user that a plan is scheduled.

Table 12. Expert Evaluation - Problems/Suggestions List

8.1.1 Modifications

According to the problems stated by the experts’ group as well as the suggestions, four modifications are needed as below:

1. A description to explain the functionality of the “flexible” button. This modification were also suggested in the cognitive walkthrough section.
2. “Skip” button to give users an option not to add their sleep routine.
3. “Back” button for the second page (preference page) and “Cancel” button for all functional pages.
4. A notification at the end of the process stating that the plan is scheduled.
5. The style of the day selection in step 5.1.1 should change so the user can see the day preferences the whole time (This modification is from cognitive walkthrough.)

8.1.2 Modifications' Design

The "Skip" button design on the sleep scheduling page (figure 15 top second picture) allows the user to have the option not to set any sleep routine and still use the planner. Table 13 describes this design's compliance with Benyon's 12 principles. It is essential to consider that the "Skip" button results in adding no value and information to the system; therefore, its design should be different from other functional buttons that actually provide more information or value to the system. There is the same philosophy behind the design of other "Skip" buttons in iOS.

Principle	Compliance
Visibility	The button is in blue and completely visible in the dark gray background
Consistency	The button is consistent with other skip buttons in iOS
Familiarity	Users are familiar with the Skip buttons
Affordance	Users recognize its function instantly. Also in the above text it is explained that they can skip this section
Control	The relationship with the function of button and the purpose is clear
Navigation	The button provides support to move around the feature with less required information
Style	The design is stylish and compatible with the other sections and the whole iOS interface

Table 13. "Skip" Button Compliance with Benyon's Design Principles

The Preferences Page is the only consecutive page of another input page. Therefore, a "Back" button is required to lead the user to the previous step. Table 14 describes this design's compliance with Benyon's 12 principles.

All the pages require having a "Cancel" button. It is essential to define the function of the "Cancel" button on top of each page. Some "Cancel" buttons get the user to the previous step without losing any information, usually because the user decides not to take action with the function introduced on that page. But some other "Cancel" buttons may result in terminating the information that the user has added in the previous section and destroy the whole function that is in the middle of the process. The design should somehow imply this to the user. To do so, the "Cancel" buttons

Principle	Compliance
Visibility	The button is in blue and completely visible in the dark gray background
Consistency	The button is consistent with other "Back" buttons in iOS
Familiarity	Users are familiar with the "Back" buttons
Affordance	Users recognize its function instantly. Also the location on the top left imply the function more
Control	The relationship with the function of button and the purpose is clear
Navigation	The button provides support to move around the feature with less required information
Style	The design is stylish and compatible with the other sections and the whole iOS interface

Table 14. "Back" Button Compliance with Benyon's Design Principles

that destroy the information or previous actions are on the right side, while those that just means not use a function are on the left side (This type is kinda similar to a back button, but because they are not in the middle of a process a "Cancel" button should be used).

Principle	Compliance
Visibility	The button is the same color as command button on that page
Consistency	The button is consistent with other "Cancel" buttons in iOS and Calendar
Familiarity	Users are familiar with the "Cancel" buttons
Affordance	Users recognize its function instantly. Also the location on the top left or top right imply the function more
Control	The relationship with the function of button and the purpose is clear
Navigation	The button provides support to move around the feature by terminating actions
Style	The design is stylish and compatible with the other sections and the whole iOS interface

Table 15. "Cancel" Button Compliance with Benyon's Design Principles

A notification is required in the last step to inform the user whether the plan is scheduled or additional steps are required. The planner should let the user decide whether they want to add the remaining slots manually or they want to change and broaden the preferences. Table 16 describes this design's compliance with Benyon's 12 principles.

Principle	Compliance
Visibility	The notification is in a new frame on a blurred background, so it is visible.
Consistency	Notification and command buttons are consistent with other parts
Familiarity	Users are familiar with the notification pop ups and command buttons
Affordance	Users recognize its function instantly. Command buttons imply their function with the text above them
Control	The relationship with the function of button and the purpose is clear
Navigation	The button provides support to move around the feature by directing users to the page in which they require to take action next.

Table 16. "Notification" pop up Compliance with Benyon's Design Principles

After adding the suggested modifications, the digital prototype provided in section 9 is designed.

8.2 Second Expert Evaluation

After applying the suggestions and resolving the problems stated in the first expert evaluation, the new prototype is examined by another expert to prepare the final version for participant-based evaluation. The following are the suggestions in the second think-aloud session with an expert:

1. The first step to open the feature's page by pressing on the "Planner" button should be changed to an icon to be consistent with other sections of the calendar.
2. The user should be able to select different time preferences for different days, while on the preference page, the user can select the same time preference for all the selected days.

8.2.1 Discussion

Both these suggestions conflict with the principles considered in their design. First, replacing the "Planner" button with an icon may increase the consistency of the design but decreases the familiarity and affordance,

as the feature is new and an icon doesn't imply its function at first glance.

Second, there is always a controversy about requiring information in more detail from the user and the design's affordance and control. Asking users to add time preferences separately for each selected day may make the user feel exhausted with the feature and decrease the affordance of the design.

8.2.2 Modifications

Based on the suggestion from the expert and the discussion, the following modifications are taken:

1. Instead of just having an icon or "Planner" button, an icon next to the "Planner" is used; Therefore, the users understand the feature's function at first glance, and later on, the "planner" word can be removed in the next updates of the application as users are already familiar with the function. (Figure 15 top left page)
2. Instead of asking the users for the same time preference for all selected days or different time preferences for each day, the day and time preferences sections can be combined, so the user can add new choices if needed. (Figure 14)

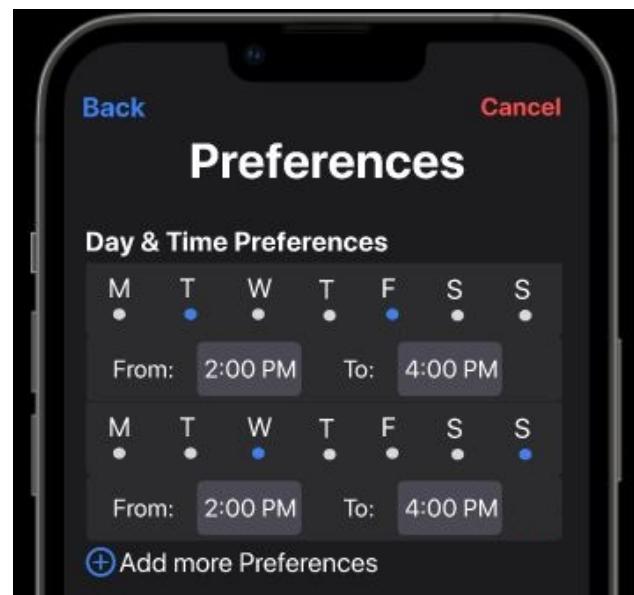


Figure 14. Day and Time Preferences Redesign 1

9. Digital Prototype Design

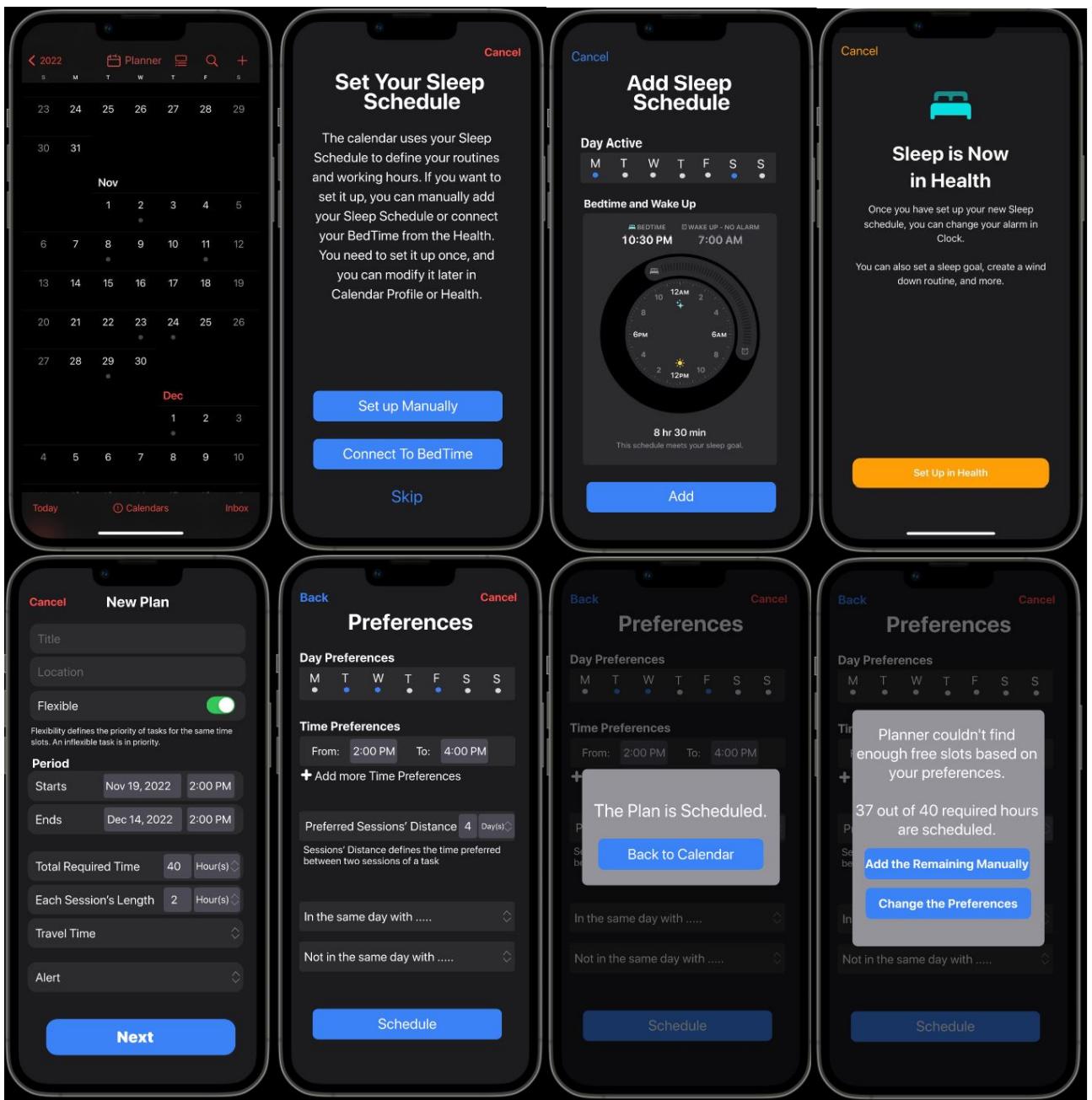


Figure 15. User Interface Main Pages

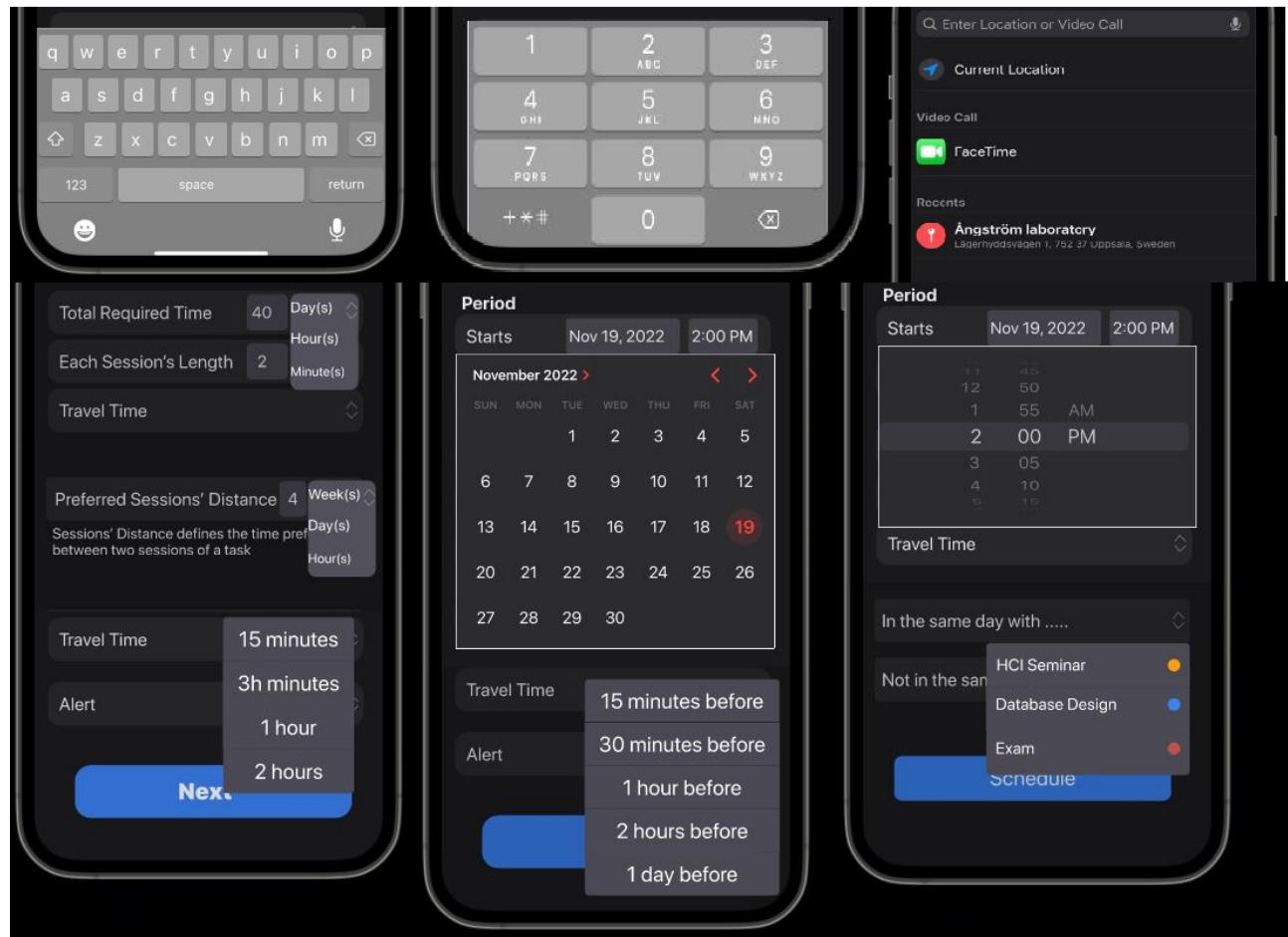


Figure 16. User Interface Overlays

10. Participant-Based Evaluation

Whereas expert, heuristic evaluations can be carried out by designers on their own, there can be no substitute for involving some real people in the evaluation. Participant evaluation aims to do exactly that. There are many ways to involve people that involve various degrees of cooperation. The methods range from designers sitting with participants as they work through a system to leaving people alone with the technology and observing what they do through a two-way mirror.[1]

The ISO 9241-11 standard defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”. The ISO/IEC 9126-4 Metrics recommends that usability metrics should include:

- Effectiveness: The accuracy and completeness with which users achieve specified goals.
- Efficiency: The resources expended in relation to the accuracy and completeness with which users achieve goals.
- Satisfaction: The comfort and acceptability of use.

10.1 Effectiveness and Efficiency Measurement

To adopt the end users test with the real-life encounter of users with the application, two series of experiments are designed to be given to two groups of three users. All the participants are provided with the design Scenario and asked to consider themselves in the same situation or put themselves in the Personas’ shoes. The test contained 25 action steps from opening the feature to getting back to the calendar after the final notification.

The first group (Trained Group) will have an explanation of the feature and a walkthrough of the functionality of different sections. This is to replicate Apple’s introduction of new features on every release of the new version of iOS. A similar thing is available for most applications that give first-time users a tutorial walkthrough. (Table 17)

The second group (Not Trained Group), on the other hand, won’t have any explanation on how to use the application except for the overall function of the application. (Table 18)

10.2 Satisfaction Measurement

A survey is designed to measure users’ satisfaction and investigate the general impression of users confronted with the design. In this survey, users grade

Criteria	Measurement Type	
Average Percentage of Tasks Successfully Completed	Effectiveness Measure	100 %
Average Percentage of Tasks Required Help for	Effectiveness Measure	4 %
Average Time to Finish the Test	Efficiency Measure	66 seconds
Average Time to learn with help per task	Efficiency Measure	23 seconds

Table 17. Trained Group End User Test Results

Criteria	Measurement Type	
Average Percentage of Tasks Successfully Completed	Effectiveness Measure	96 %
Average Percentage of Tasks Required Help for	Effectiveness Measure	12 %
Average Time to Finish the Test	Efficiency Measure	79 seconds
Average Time to learn with help per task	Efficiency Measure	51 seconds

Table 18. Not Trained Group End User Test Results

each impression they have been associated with from 1 to 5.

User No.	One	Two	Three	Four	Five	Six	All
Helpful	5	4	5	5	5	4	28/30
Effective	5	3	5	4	5	5	27/30
Learnable	5	4	5	5	5	5	29/30
Fast	5	5	5	5	5	5	30/30
Obvious	4	4	5	4	5	5	27/30
Friendly	5	4	5	4	5	5	28/30
Useful	5	3	5	5	5	4	27/30
Complicated	1	2	1	1	1	2	28/30
Uncontrolled	1	3	1	1	1	1	28/30
Inflexible	1	2	1	2	1	1	28/30
Total Point	264/300						

Table 19. Satisfaction Survey Results

10.3 Results Analysis

The main purpose of this test is to analyze the design’s learnability and find the sections that have given rise to common problems. Following are the inferences from the test results:

1. All tasks are completed successfully by the participants except for one, which is analyzed and modified in the next section.
2. One task from the trained group and three tasks from the second group were required for help

(out of 25). This means that participants have found themselves in control of using the design and learned the functions and usability quite well

3. It has taken the second group 13 more seconds (20 percent more) to figure out the action steps and different sections' functions compared to the trained group. This also confirms the learnability of the design.
4. In average, the time spent to help participants to learn tasks is 50 percent of the time they have spent finishing the whole test. Therefore, the time spent on help is reasonable.

Above this, one of the participants was asked to add an event to his ordinary calendar (Apple Calendar Add Event section) consisting of 12 action steps which took him 29 seconds to complete. Therefore, it has taken them 18 percent more time to do a new task compared to doing tasks they have been doing for several years. Moreover, the result from the satisfaction survey shows that users have been 88 percent satisfied with the system and design usability.

10.4 Problems and Modifications

The participant-based evaluation manifested a significant design problem in the "Day and Time Preferences" selection section. When the user presses the "Add more Preferences" button, a new section for adding preferences opens up. The problem is that the user couldn't retrieve the previous situation with only one preference selection because there is no button designed to remove the second preference selection section. This problem is functional and concerns the recovery principle of design. A "Minus" button is designed to remove the added preference selection section to solve this problem. Table 20 describes this design's compliance with Benyon's 12 principles. Figure 19 depicts the "Plus" and "Minus" buttons' function in the preference selection sections.

11. Project Overview

In this project, a preference-based planner is designed to be added to the calendar as a new feature. The project has followed five major steps as stated below:

1. Understanding human-centered design and defining a framework
2. User search and defining personas and scenario
3. Developing design ideas

Principle	Compliance
Visibility	The button is red and visible in the gray background.
Consistency	The design is consistence with other retrieval or recovery buttons in iOS
Familiarity	Users are familiar with minus buttons
Affordance	Users recognize its function instantly
Control	Users feel in control of their choices by this button.
Recovery	Users can recover their previous action by this button. Also, they can again add a preference selection section by pressing the plus button.
Navigation	The button provides support to navigate around different actions in this section

Table 20. "Minus" Button Compliance with Benyon's Design Principles

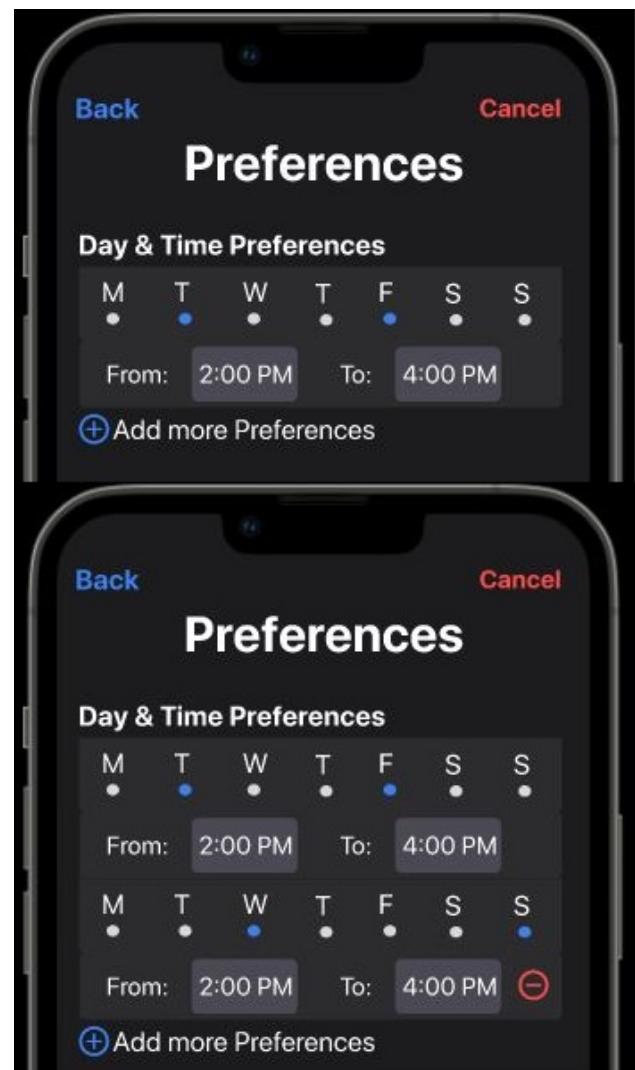


Figure 17. Day and Time Preferences Redesign 2

4. Digital prototype design
5. Evaluation and redesign

The goal of the design is to use suitable technology in the predefined context to help people undertake activities. To accomplish this goal, some principles are considered to enlighten the design process. This project is based on the 12 principles presented by Benyon [1]. In every stage of the design or redesign, compliance with the principles is considered to keep the design in the PACT framework. In this project, the design and evaluation are followed in a repetitive cycle to adjust the design with the principles and reach the eventual goal of a human-centered design.

References

- [1] D. Benyon. *Designing Interactive Systems: A Comprehensive Guide to HCI and Interaction Design*. Addison Wesley, 2010. ISBN: 9780321435330.
URL: <https://books.google.se/books?id=P923PwAACAAJ>.

A. Digital Prototype - Final Version

The final version of the digital prototype can be found at this [link](#). Figure 18 depicts the functionality sequence of the user interface design.

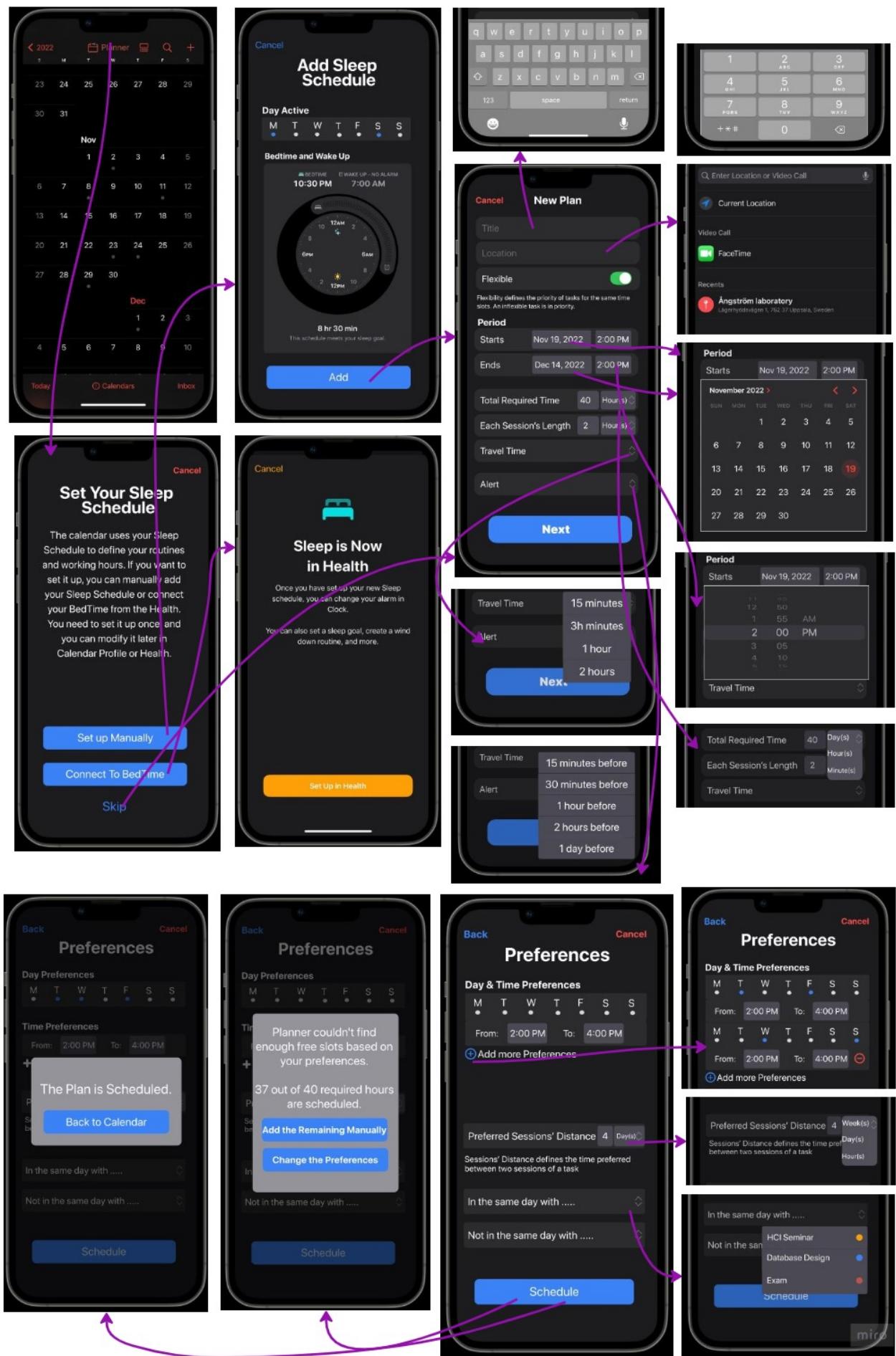


Figure 18. User Interface - Functionality Sequence

B. Appendix: Requirement Compliance

Two out of 19 functional and nonfunctional requirements considered for the design are not satisfied. These requirements are considered to be in the "Could Have" section and be designed in the future.

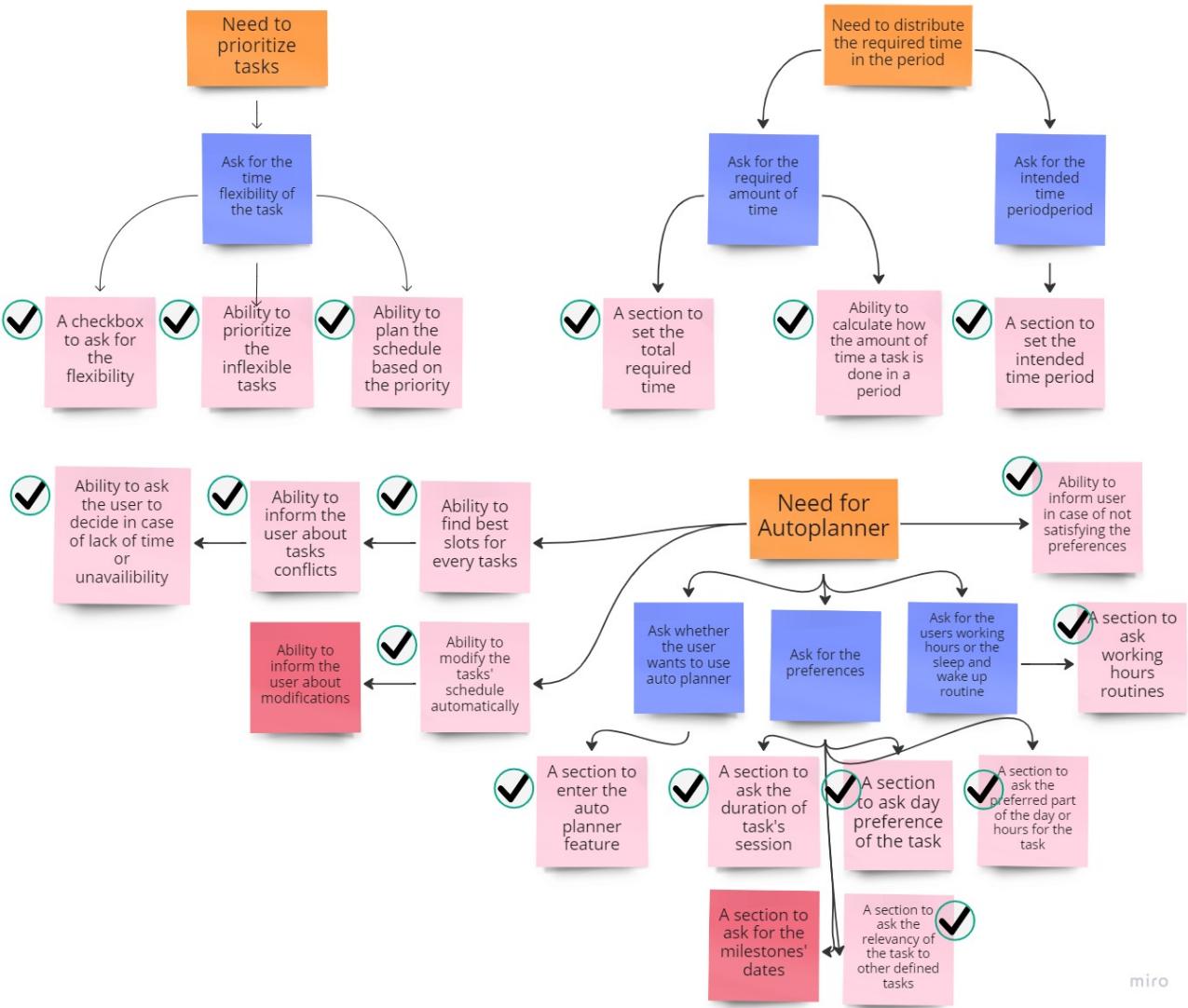


Figure 19. Requirement Compliance

C. Appendix: Survey Overview

Question	Choices	Result
Which calendar do you use?	Google Calendar Apple Calendar Other	37.5% 57.5% 5%
How much of your daily activities are pre-defined in your calendar?	100% 80% 60% 40% 20% or less	0% 12.5% 25% 37.5% 25%
How often do you modify your calendar?	Every Day Twice a Week Once a Week Once every two Week Once every Month	5% 32.5% 14.5% 20.5% 26.5 %
Have you ever felt frustrated with the calendar you use and searched for a better one?	Yes No	58% 42%
Have you ever felt the need for a smarter calendar?	Yes No	79% 21%
Have you ever felt the need for a new feature in your calendar? If yes, explain it please	Yes No	74% 26%
Do you consider priorities for your daily activities?	Yes No	79% 21%
Would you use a calendar that takes your priorities and preferences and plans your schedule?	Yes No	86% 14%
How would you define your preferences for the calendar? Give an example please	-	-

Table 21. Survey Overview