Early Bird: Morning Routine Tracker for Smartphone

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ABSTRACT

This paper is the report associated to the final project for the Course 02808 at Technical University of Denmark (DTU): Personal Data Interaction for Mobile and Wearables.

We were introduced to the principles of Personal Informatics, Human Computer Interaction, and The Quantified Self as theory for this course. We applied the concepts to solve a problem that students face when planning their routine.

We built a prototype to improve the morning routine of students.

We made two different experiments: the first about the most efficient visualization (columns bar or stack bar) and the second about the input interface.

We found that the stack bar chart is probably the best option to track the improvement of the user.

An interface with a suggestion interface and a swipeable mechanism seems to offer the most efficient and the most appreciated user experience.

Author Keywords

Tracking; Application; Morning; Routine

INTRODUCTION

Motivation

"Morning shows the day." (Milton,1671), so why not start with the right actions first thing in the morning? It has been proved that having a routine has a positive impact in our perception of happiness and makes us more successfull, thus keeping a healthy morning routine leads to a day full of achievements [6].

Analysis

To build a morning routine, we need a tool that the user want to use every day and that he/she can understand. Users should be able to add new tasks in their planning in order to improve their productivity. According to 34th president of USA, Dwight D. Eisenhower, the key to be efficient is to apply the *Eisenhower Matrix* [3]. Every mission in our life can be separated in four categories: important/not important, urgent/not urgent. Our target users would already reckon that creating a morning routine is important, so to simplify this concept, we would only consider a division in two categories: priority and not priority.
Another essential feature is the suggestion of new activities. The user must receive new ideas when the goals are reached. Because of this tool, he will be able to enhance his/her productivity during the morning.
Lastly, we need to provide meaningful visualizations, which provide relevant information about the percentage of done tasks and also about the total number of planned actions. This is essential to motivate the customer through a gamification process, in which the user can understand his results. As a consequence, this would help us building up customer loyalty.

Related work

To build an efficient morning routine, we searched an available application on the *Play Store*. We have found two existing software solutions, which promise to fulfill our goal.
The first one is *Tiny gain* [5]. This program offers a catalog of propositions for new task. Each one has a card, with the procedure to follow to finish the activity. We can also add new tasks manually in the system. Unfortunately, it is not possible to prioritize the routines. As visualizations, there is only the list of tasks per day in green if it was completed and in red otherwise. There is no graphs representing the evolution along the week or the month. It is hard to quantify the progress and so a lack of motivation for the user. This application have plenty features but it implies that the user experience is relative complex.
Another alternative is *Roubit* [8]. The users have to enter each task manually in the system and will not receive any suggestion. To improve their routine, the users must search for information outside of the application. Furthermore, a prioritization process is not provided. Concerning the visualizations, this program offers a calendar and for each day, it attributes a smiley icon. We can click on each day and see the details for each task and the percentage of done task for the given day. We do not have the possibility to see if the number of tasks increased along time. The problem is, when we introduce a new activity in our routine but we do not make it each day automatically, it will decrease the percentage. The customer can not see any form of improvement and his motivation will declined.

Prototype

The current state of development of our solution is a working prototype that runs both on iOS and Android, coded using React Native [4].

The team used Agile [9] methodologies for managing the project, specifically, Agile Scrum. Through the different iterations, the application evolved throughout various stages. From the most general ideas that motivated the team to work on this solution, see subsection 1.1; to a working prototype of a multi-platform application.

Once the idea was discussed, a set of objectives was defined:

- Help users build routines in the morning.
- Allow users to keep track of their progress and modify their routines.
- Keep users motivated to use the application in the future.

Those three main objectives were translated into goals. Tangible features that the application should include to fulfill those objectives:

- Plan a routine: where users could input the tasks they want to do every morning. To keep the motivation up, this screen may include recommendations on how to improve the routine with new activities.
- Daily performance: where users could input the activities they completed and select the ones they were not able to do.
- Visualizations of the progress: once some data has been collected, this feature will show users with a set of diagrams or charts their evolution. This way they can keep track of their work, which will provide the necessary insight for them to reflect on their next step towards a better routine.

The first few iterations did not involve programming. They were mock-ups that showed how the features would look like. The workload those weeks was heavy on design and pre-prototyping, but no coding was done. To design possible layouts of the screens, the team used Sketch [2]. In order to test this designs on different smartphones, the selected software was Marvel [1].

As a result of this work, some conclusions were reached and were implemented in the design; and later, in the final prototype as well. The colors for the background and menus are chosen to be different tonalities of purple and blue. These colors transmit calm to the user and help keeping focus in the activity [10].

Once the line of design was decided on, the next step was choosing the technology that should be used to start working on the final prototype.

One of the premises was to deliver the solution to the two main mobile operating systems in the market (iOS and Android). So the team looked for technologies that allowed multi-platform native development, since platform-specific development would have increase the workload at least twice.

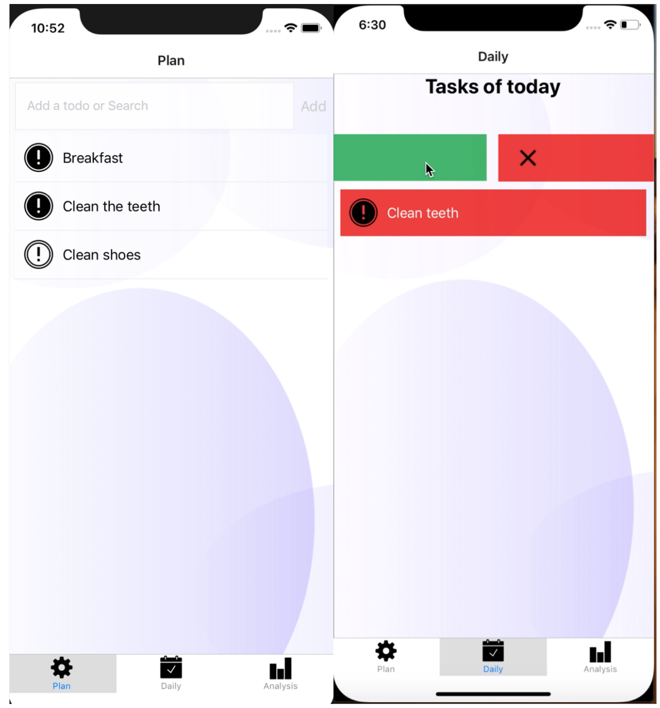

Figure 1. Final Input Interface Design

Finally, the chosen technology was React Native [4]. Engineered by Facebook, React Native allows developing native applications by using JavaScript and React.

Stage-Based Model Of Personal Informatics Systems

During the development of the application, it was carefully considered where would its features fit in the Stage-Based Model Of Personal Informatics Systems [7].

- **Preparation**: a user of this application is determined and motivated to create a healthy morning routine. The user would need to download the application on his/her smartphone.
- **Collection**: the application provides two levels of collection, see figure 1:
  - Users can plan their routine by typing new activities, categorizing them as a "priority" (or as "not a priority").
  - On a daily basis, the user can choose the activities that he/she finished that morning, by swiping right (the activity was completed) or left (the activity couldn't be completed) [11].
- **Integration**: the data introduced by the user in the previous stage is collected, combined and transformed by the application to generate the content in the following stage.
- **Reflection**: users can look into the collected data, which is displayed in a set of charts that was selected after one of the experiments. They can explore the charts to reflect on the short term actions (the past few days) as well as long term (month view). See figure 2.

- **Action**: finally, the user can decide what to do based on his/her conclusions from the reflection stage. However, the application is ready for a first step into improving a routine. In the input screen, the final prototype includes a section with recommended activities to include in the routine.

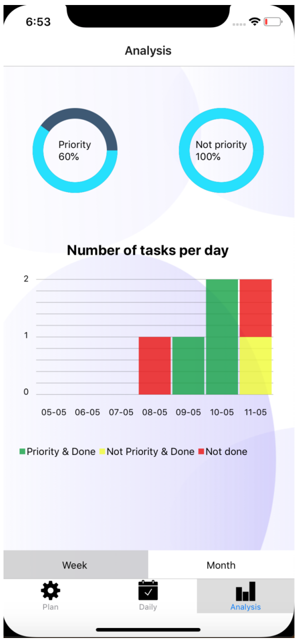

Figure 2. Analysis Screen Design

METHOD

Visualization Experiment

Participants

We have selected 14 students, from various backgrounds, but mostly engineering. They were all volunteers and they were between 20 and 27 years old. There is more men than women.

Apparatus

We wanted in this experiment to find the best visualization for the reflection phase. We tried two type of diagrams: the columns chart and the stack chart. We looked into which one has the lowest error rate and with the less difference of interpretation with what is expected.

We used the platform Google Form to make a survey. The participants used their own device to access the experiment.

We defined 4 datasets, as described in *Appendix A*. For each dataset, we have created two types of charts, one stack chart and one columns chart (see *Figure 3*).

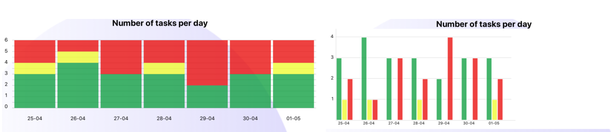

Figure 3. Two different types of visualization

Procedure

We asked the potential participants if they could help us for our project. When they accepted, they were provided with the link and they were told to answer the questionnaire about the charts. The goal of our prototype was also explained. No further information nor formation was given to the participants.

In the experiment, all the visualizations described in *Apparatus* were shown in a random order and participants were asked three different questions for each one of the charts (see *Figure 4*):

- Is the number of total tasks decreasing, stable or increasing?
- Is the number of done tasks decreasing, stable or increasing?
- Is the ratio of done tasks over the number of total tasks decreasing, stable or increasing?

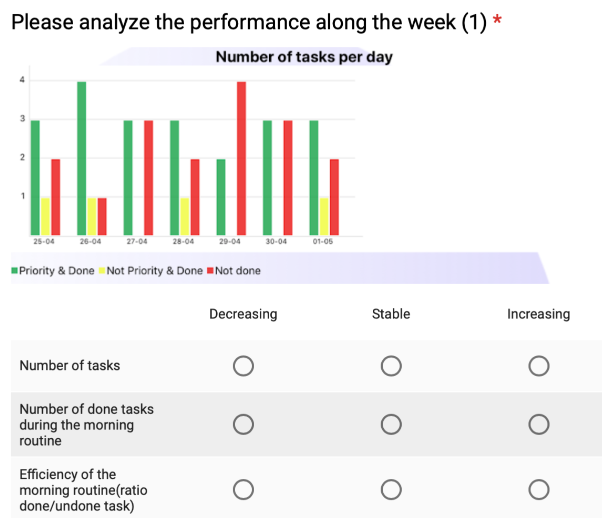

Figure 4. Example of the survey for one visualization

Design

The experiment was a within-subjects design because each participant was exposed to each visualization ordered randomly. The independent variables were the datasets and the type of charts. The dependent variables were the error rate (with the expected answers) and the average distance (considering that decreasing = -1, stable = 0 and increasing = 1). The random variables were the stress and the tiredness of the participants and their previous experience with charts.

Input Interface Experiment

Participants

This experiment was developed between-subjects with engineering students. In total, 9 students were interviewed, with an average age of 23. Four of them for the first version of the design, the rest for the second version.

Apparatus

The main goal of this experiment was to identify barriers in our design for the input method in the Application, see figure 1. At the same time, the usability of the different designs of the

Application was evaluated. It consisted in an think-aloud interview, where the subject was asked to perform certain tasks and they would narrate what they were doing and why. The subject was provided with a smartphone running the Application on the Operating System (OS) the user was most comfortable with, e.g., iPhone users did the experiment using the application on iOS. Meanwhile, the interviewer took notes about the performance of the subject.

Procedure

Before starting the experiment, the subjects were presented a document that stated they were attending the experiment voluntarily, and that the data resulting from the experiment was to be used in this project. The experiment would only start after the subject would have signed their consent.

First of all, the subject was presented the experiment: the structure, the expectations, and the procedure.

The subject was asked to perform a set of tasks:

- Add a new task (Task 1) to your routine
- Add two more tasks (Task 2, Task 3).
- Define Task 1 and Task 3 as a priority.
- Mark Task 1 and Task 2 as a done tasks.
- Mark Task 3 as not-done.

Design

The experiment followed a between-subjects design, where the participants were divided in two groups, and each group was presented a different design (*Figure 1* or *Appendix C*). Independent variables, OS, each user did the test with the OS of their choice. The subject had to perform an action, followed by a variation of it. In order to measure the ease of returning to a same point in the application. The notes from the interviewer focused on the specific actions the subject was doing.

Afterwards, by reading those notes, we could quantify the amount of *extra taps* done by the subject. In this project *extra taps* are defined as unproductive trials of interaction with the interface. For example, a subject that is asked to perform a task that takes 3 taps on the screen and the subject tries 2 menus before choosing the correct one and finishing the task (5 taps in total), the subject would have done 2 *extra taps*.

We introduced a distinctive for the tasks the subjects were asked to perform:

- New Task: for every task that the subject was asked to do and never saw before.
- Repeated Task: after a New Task was presented, the user was asked to do a variation of this task.

RESULTS AND DISCUSSION

Visualization Experiment

Result

Responses with the columns chart have an **error rate** of **0.13%** and an **average distance** of **0.23**.
Answers with the stack chart have an **error rate** of **0.15%** and an **average distance** of **0.21**.
The null hypothesis is, that the error rate and the average distance is equal with both type of visualization. We have **p > 0.05** for the average distance and for the error rate (details in *Appendix A.2*).
Furthermore, we received feedback from some participants and they said unanimously, that the stack chart is easier and quicker to read.

Designs	*New Task*	*Repeated Task*	*Total Avg.*
Design 1	0.5	0	0.19
Design 2	1.33	0.08	0.48

Table 1. Extra Taps Per Action And Design.

Discussion

According to the high p-value, we cannot conclude, on the basis of this experiment, that a type of diagram is better than the other. The average error rate of 14% is quite high. This number can be explained by multiple reasons:

- We don't have the same definition of decreasing, stable and increasing.
- We don't interpret in the same way the graphic.

Based on the feedback, we prefer the stack chart for our prototype. The experimenter were sometimes next to the participants during the survey and they have seen, that it took more time to analyze the columns chart than for the stack chart. It is why we think that we miss, in our experiment, a dependent variable for the time needed to read the diagram. With this observation, we will be able to conclude which type of visualization is more suitable.
In order to reduce the error rate, we can try to put an indicator next to the visualization to show if the ratio between done tasks over total number of tasks is improved during the previous days.

Input Interface Experiment

Result

Subjects with the first design finished all their new tasks, on average with **0.50** *extra taps*. The repeated tasks with the expected amount of taps. Then, the total of tasks (new plus repeated tasks) were completed with **0.19** *extra taps*.

For the second design, subjects finished their new tasks with **1.33** *extra taps*, the repeated ones in only **0.08** more taps than expected, giving a total average of **0.48** *extra taps* (Details in *Appendix B*).

We have **p > 0.05** for the new tasks, the repeated tasks and the total average. We can explain this by the low number of participants.

In addition, the subjects were asked to give feedback about the design and the experiment. Different subjects expressed uncertainty in some of the actions, and their re-design was added to the product backlog for future iterations.

Most of the feedback collected were suggestions about what icons to use, or whether they felt the colors were appropriate. However, since those notes were regarded as subjective and we were not able to measure them, the team decided not to include them in this report.

Discussion

There is a clear difference between the tasks that are performed for the first time and the ones that are just a variation of the previous. Users were able to learn how to do them thus improve the number of extra taps in both designs.

By observing the table 1, we can see a big difference in performance between the first and the second design. Subjects were more efficient in the first design by 0.83 taps in the new tasks and by 0.29 on average. This can be due to two factors:

- Minor changes in the design, e.g., icons, text size.
- Implementation of a new feature.

This new feature was a section for suggestions: whenever the users are about to type a new task for their routine, a list of recommended tasks appears.

After seeing the results, the team discussed the impact that the new feature had on the performance of the users. As a consequence, a new hypothesis appeared: whether more features in the system confused users more. This confusion can be translated in more mistakes when trying to use the application. Since there are more options displayed on the screen, the user might find them misleading. Or in the long term, it could suppose a barrier that prevents users from using our application for tracking their morning routine.

CONCLUSION

First of all, looking at the experiments, the comparison of data visualization designs resulted in the implementation of the most understandable one. According to the results, the stack bars were found easier to interpret. However, the statistical values recorded were not enough to clearly conclude which chart was better.

Similarly, in the interviews about the input method in the application, even though one of the designs had better results than the other, the distance between the two of them was not large enough to state a clear winner.

After discussing these results in the team, we concluded that for future projects, more resources and effort should be put into finding a bigger sample of our target users to take the experiment.

Additionally, measuring the use of the application in the long-term was not feasible. The main concern was if the recommendation system would be appealing for users to keep using the application. In this case, the limitation was the time span of the course. For an experiment like this, 13 weeks are not enough.

Secondly, regarding the organisation and communication within the team, the results have been satisfactory. The team devoted time at the beginning of the project to detail the goals, allocating the days to work on them. Thus the project was constrained to a dimension that fitted the 13 weeks of the course while kept the core purpose of the solution.

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CODE

GitHub: `https://github.com/alexandredeleze/early_bird`

CONTRIBUTION

Each author of this paper contributed equally to this project.

Appendices

Appendix A

Visualization experiment

A.1 Datasets

A.1.1 Dataset 1

Day	Priority Done	Not Priority Done	Not Done
1	3	1	2
2	4	1	1
3	3	0	3
4	3	1	2
5	2	0	4
6	3	0	3
7	3	1	2

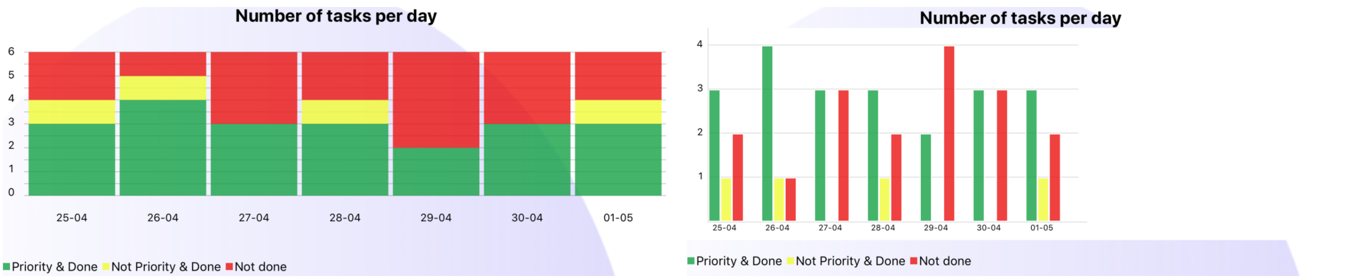

Figure A.1: Representations of the first dataset

We can see, that the number of tasks and the number of done tasks and so the efficiency (done tasks/total tasks) are stable.

A.1.2 Dataset 2

Day	Priority Done	Not Priority Done	Not Done
1	1	0	5
2	2	0	4
3	2	1	3
4	2	1	3
5	3	1	2
6	3	0	3
7	3	1	2

We can see, that the number of tasks is stable and the number of done tasks and so the efficiency (done tasks/total tasks) are increasing.

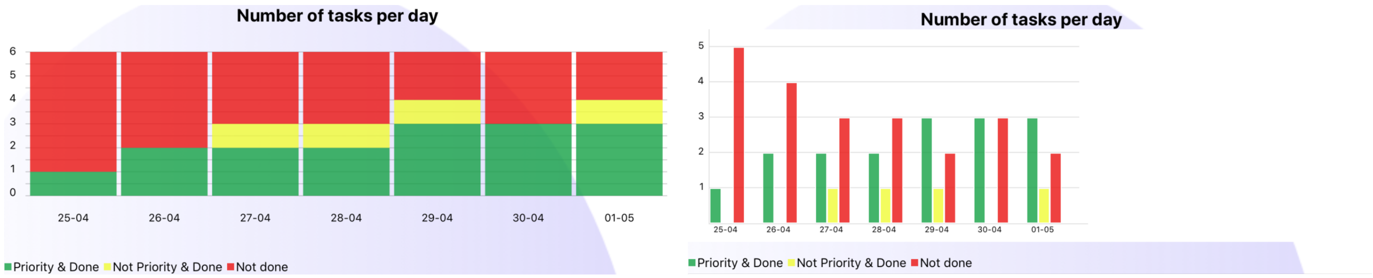

Figure A.2: Representations of the second dataset

A.1.3 Dataset 3

Day	Priority Done	Not Priority Done	Not Done
1	3	1	2
2	3	0	3
3	3	1	3
4	3	2	3
5	3	1	4
6	3	1	5
7	4	1	6

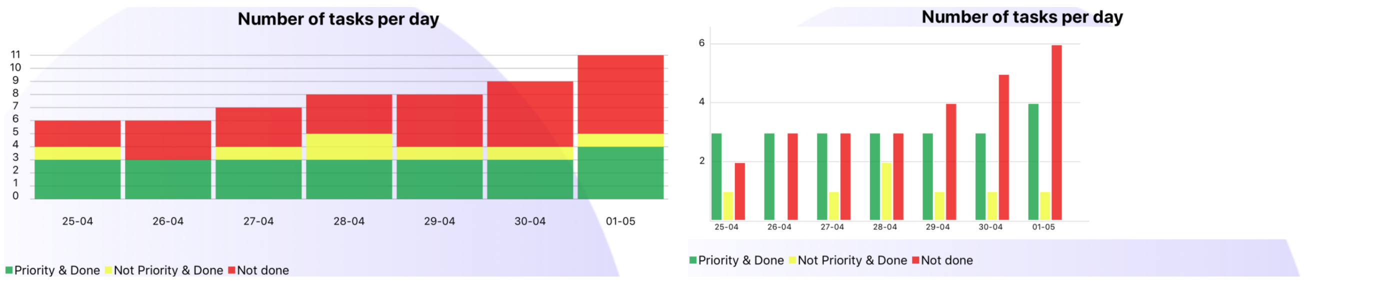

Figure A.3: Representations of the third dataset

We can see, that the number of tasks is increasing, the number of done tasks is stable and so the efficiency (done tasks/total tasks) is decreasing.

A.1.4 Dataset 4

Day	Priority Done	Not Priority Done	Not Done
1	3	2	5
2	3	1	5
3	4	2	2
4	2	1	3
5	3	1	2
6	3	1	1
7	4	1	0

We can see, that the number of tasks is decreasing, the number of done tasks is stable and so the efficiency (done tasks/total tasks) is increasing.

A.2 Result

Decreasing = -1, Stable = 0, Increasing = 1

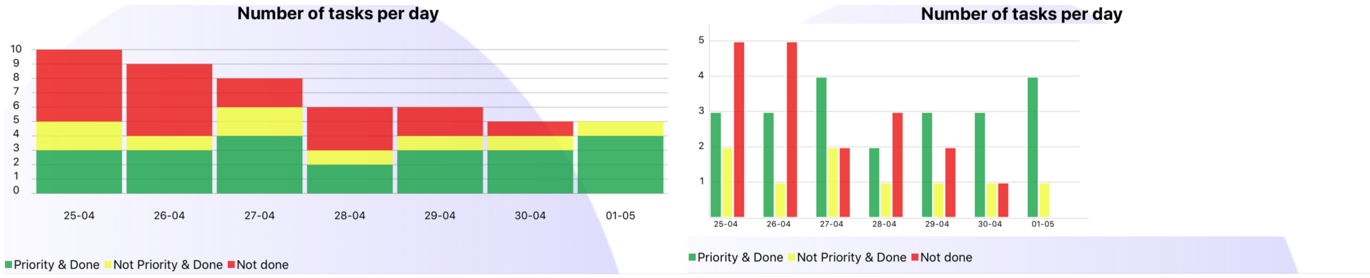

Figure A.4: Representations of the fourth dataset

A.2.1 Columns Chart

Question	Expected	-1	0	1	Sum of Distance	#Error
Dataset 1 #Tasks	0	0	14	0	0	0
Dataset 1 #Done Tasks	0	3	10	1	4	4
Dataset 1 efficiency	0	3	11	0	3	3
Dataset 2 #Tasks	0	0	13	1	1	1
Dataset 2 #Done Tasks	1	1	3	10	5	4
Dataset 2 efficiency	1	1	2	11	4	3
Dataset 3 #Tasks	1	1	0	13	2	1
Dataset 3 #Done Tasks	0	0	8	6	6	6
Dataset 3 efficiency	-1	11	3	0	3	3
Dataset 4 #Tasks	-1	12	1	1	3	2
Dataset 4 #Done Tasks	0	1	10	3	4	4
Dataset 4 efficiency	1	2	0	12	4	2

Average distance = 0.23, Error rate = 0.13

A.2.2 Stack Chart

Question	Expected	-1	0	1	Sum of Distance	#Error
Dataset 1 #Tasks	0	0	14	0	0	0
Dataset 1 #Done Tasks	0	5	8	1	6	6
Dataset 1 efficiency	0	6	7	1	7	6
Dataset 2 #Tasks	0	0	13	1	1	1
Dataset 2 #Done Tasks	1	0	2	12	2	2
Dataset 2 efficiency	1	1	0	13	2	1
Dataset 3 #Tasks	1	0	1	13	1	1
Dataset 3 #Done Tasks	0	1	12	1	2	2
Dataset 3 efficiency	-1	10	2	2	6	4
Dataset 4 #Tasks	-1	14	0	0	0	0
Dataset 4 #Done Tasks	0	3	10	1	4	4
Dataset 4 efficiency	1	1	3	10	5	4

Average distance = 0.21, Error rate = 0.15
P-value of the experiment on the average distance = 0.73
P-value of the experiment on the error rate = 0.78

Appendix B

Input Interface Experiment

- **Independent variables:** Application Interface, predefined list of routines (with their status of undone/done and priority), predefined list of tasks
- **Dependent** variables: Number of needed steps to accomplish a predefined task, logical reasoning of the user
- **Control variable:** Run the application on a Honor 8X or on an Iphone using Expo
- **Random variable:** Prior experience to use a smartphone, stress of the user

B.1 Procedure

1. Welcoming
2. Read the consent form and ask if the participant is agree with
3. Give the following information: "You will test today an application, with which you can plan a morning routine. I will give to you a serie of tasks to accomplish. For each task, say what you are doing and, if it is the case, what you search".
4. Do the below experiment tasks
5. Ask a feedback about the interface and about the experiment

B.2 Experiment tasks

Ask the participant to execute the following tasks and in the same time ask him to explain his reasoning:

1. Add the routine "Breakfast"
2. Add the routine "Clean the teeth"
3. Add the routine "Clean shoes"
4. Define "Breakfast" has a priority
5. Define "Clean the teeth" has a priority
6. Define "Breakfast" has done task
7. Define "Clean the teeth" has done task
8. Define "Clean shoes" has undone

The experimenter takes notes about the reasoning of the participants. When one task is finished, the experimenter gives the next task to the user.

B.3 Consent form

This experiment consist of testing the application “Early Bird” developed for the course “02808 Personal Data Interaction For Mobile and Wearables” at DTU. The participant is not the object of the research and is not personally evaluated.

The participant must be volunteer and approve to participate to the experiment. He can at any time, during and after the experiment, withdraw his consent. The participant can ask to stop the experiment at any moment.

All the collected data will be anonymised and used uniquely for the project “Early Bird” and for its corresponding scientific paper.

B.4 Results

Average extra tap:

Task	Design 1	Design 2
1	0.5	1.2
2	0	0
3	0	0.4
4	0.5	0.2
5	0	0
6	0.5	2
7	0	0
8	0	0

We can then calculate the extra taps for the new task, the repeated task, total avg:

Design	New task	Repeated task	Total Average
Design 1	0.5	0	0.19
Design 2	1.33	0.08	0.48
p-value	0.35	0.37	0.20

Appendix C

First Input Interface

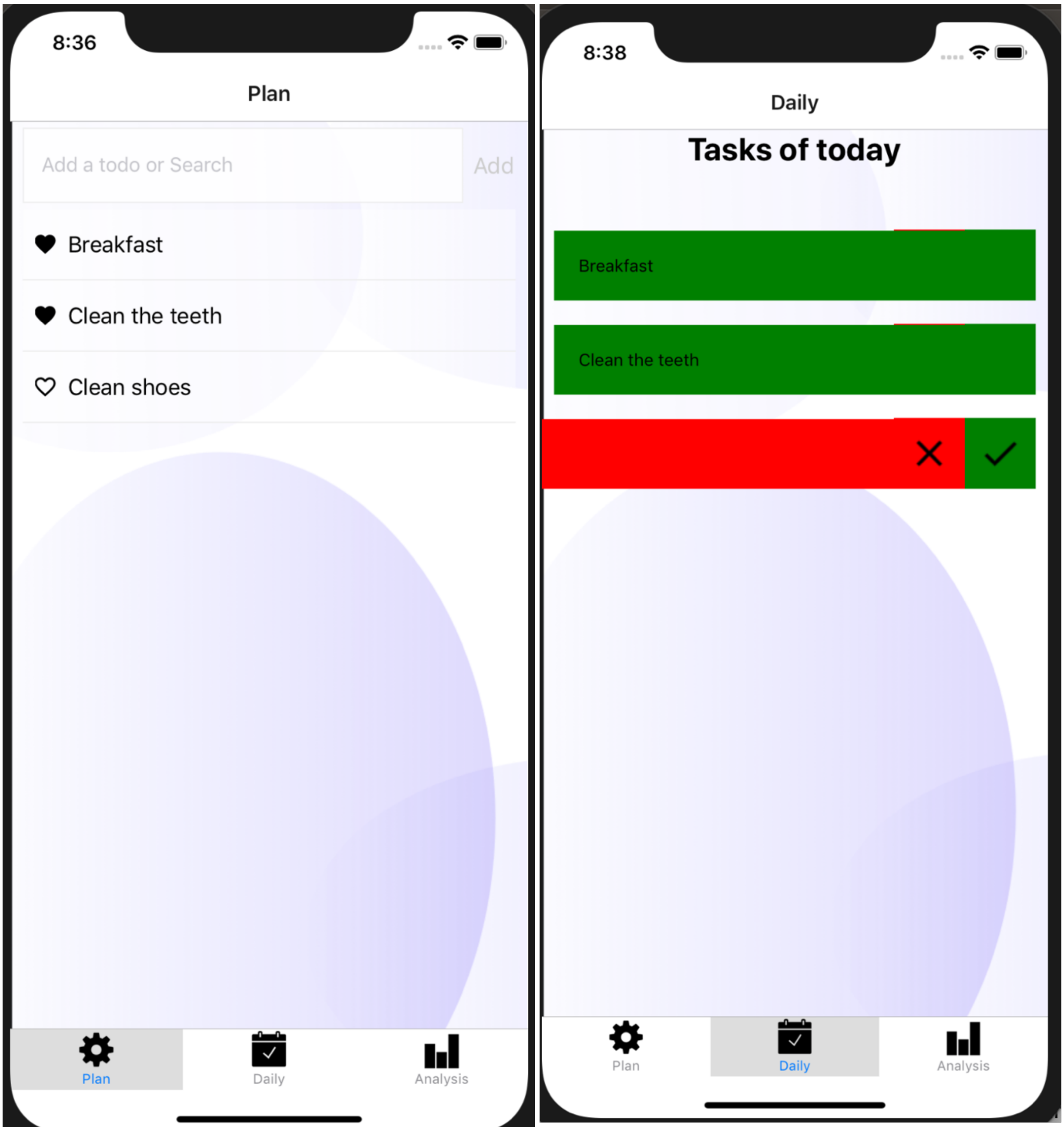

Figure C.1: First Input Interface Design