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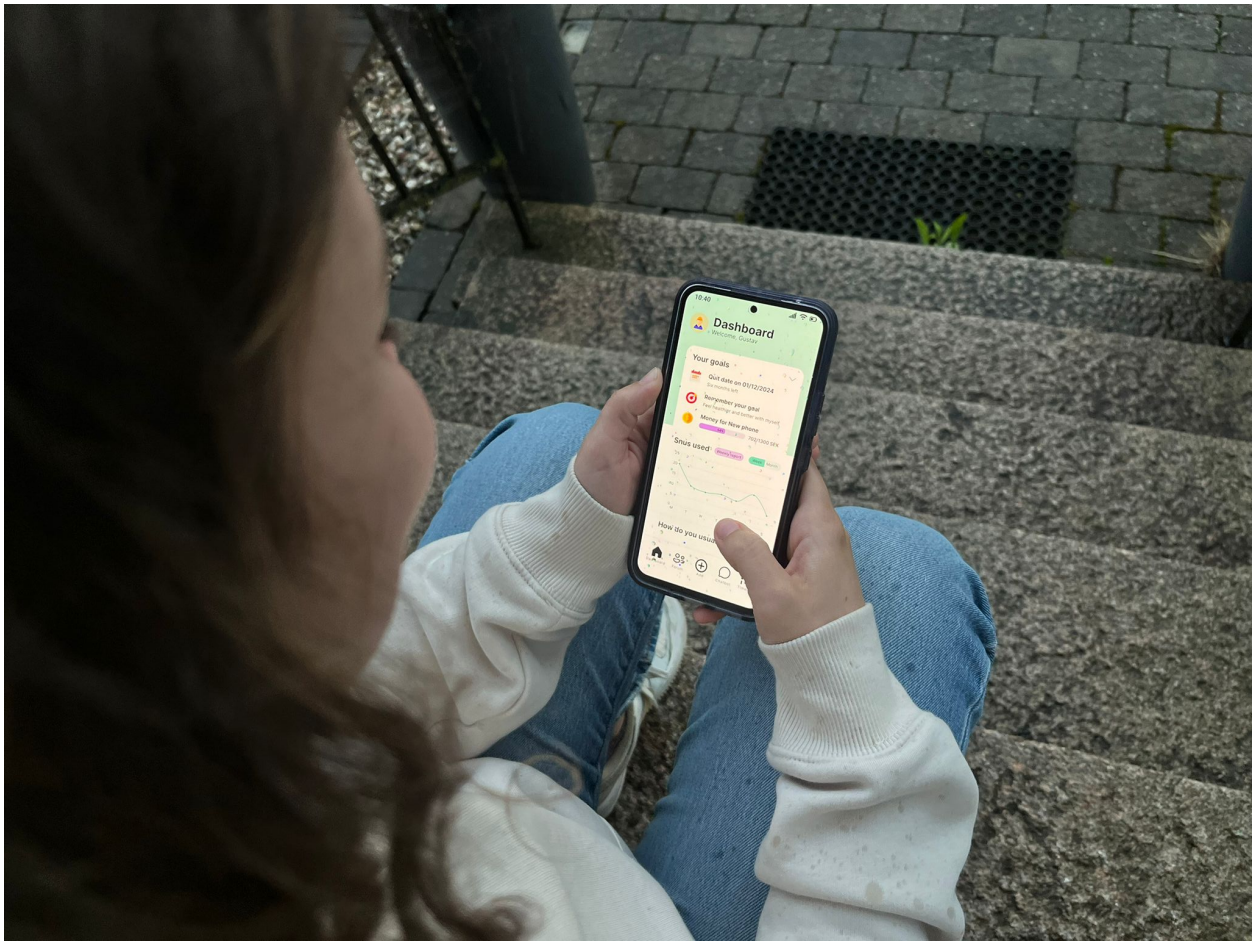

ExSnus

Designing a Prototype of a Social Snus Cessation Mobile Application with an Integrated Artificial Intelligence Function for University Students in Sweden

Master's thesis in Biomedical engineering

ALBA PUYUELO CITOLER

DEPARTMENT OF ELECTRICAL ENGINEERING
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2024
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Master's thesis 2024

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Supervisor: Eunji Lee, Signal Processing and Biomedical Engineering, Electrical Engineering
Co-supervisor: Jungna Lee
Examiner: Andreas Fhager, Signal Processing and Biomedical Engineering, Electrical Engineering

Master's Thesis 2024
Department of Electrical Engineering
Division of Signal Processing and Biomedical Engineering
Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Cover: A university student using the prototype of the ExSnus application.

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ALBA PUYUELO CITOLER
Department of Electrical Engineering
Chalmers University of Technology

Abstract

The increasing use of snus, particularly among Swedish youth, coupled with growing evidence of its health risks, presents a pressing public health concern. Among the existing approaches that aid individuals in overcoming addictive behaviors, mobile health applications have emerged as a rapidly growing, accessible, and cost-effective alternative to traditional therapy. These applications aim to educate users and provide them with the necessary tools for their cessation journey. However, there has been little research investigating the integration of social aspects and artificial intelligence (AI) assistance within such mobile appications to enhance user support for snus use cessation. This project focuses on the design of a mobile application called ExSnus, studying the diverse factors influencing individuals' behaviors towards snus to then implement several strategies within the application framework to facilitate cessation. Based on a Persuasive Systems Design framework, ExSnus emphasizes the role of social interaction. Additionally, the potential role of AI as an assistant for snus cessation is explored. Key findings from research literature and user interviews revealed that social influence, cultural normalization, and health concerns are significant factors in snus use and cessation. The designed prototype features interactive social support and an AI counselor to address these factors, which were positively received during usability testing. ExSnus effectively integrates principles from a Persuasive Systems Design framework, providing a user-friendly and engaging tool for snus cessation.

Keywords: snus cessation, mobile health application, artificial intelligence, social application, persuasive health technology.

Acknowledgements

I would first like to thank my supervisor Eunji Lee and my co-supervisor Jungna Lee for their knowledge, time, and advice that have guided me throughout this project. I look forward to continuing our collaboration on the future of this project. I also extend my gratitude to Andreas Fhager, my examiner, for his valuable contribution.

Secondly, I would like to thank all the participants of the student interviews because their contributions have been essential for the development of this project.

Finally, I am deeply grateful to my family and the friends I have made during these two amazing years here in Gothenburg for their unconditional support.

Alba Puyuelo Citoler, Gothenburg, June 2024

List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

AI	Artificial Intelligence
ACT	Acceptance and Commitment Therapy
CBT	Cognitive Behavioral Therapy
DT	Design Thinking
DTT	Distress Tolerance Training
EU	European Union
NRT	Nicotine Replacement Therapy
PHT	Persuasive Health Technology
PSD	Persuasive Systems Design
PT	Persuasive Technology
SD	Service Design
SUS	System Usability Scale
UI	User Interface
UML	Unified Modeling Language

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1
Introduction

1.1 Aim

This study aims to explore a possible design for a social mobile application tailored to assist university students in Sweden with snus cessation, incorporating an artificial intelligence (AI) feature. The application design will follow a service design process and adhere to the persuasive technology framework, ensuring the integration of both the social aspect and the AI functionalities. Additionally, user's education about snus use and quitting consequences will be part of the mobile application's features. The mobile application will also be designed to be intuitive and user-friendly, presenting health-related information in a clear way.

Given the rising snus use among youth, predominant mobile application users, this initiative is timely. By providing instant and free access to a cessation tool, the project aims to make quitting snus more approachable for university students. This approach directly addresses the accessibility and engagement preferences of the younger demographic, making it a potentially effective tool in reducing snus usage.

1.2 Research Questions

1. How can a social snus cessation mobile application, with an integrated AI function, be designed to address the main factors that influence potential end users' behaviors towards snus?
   (a) What are the main factors that influence snus use and how can a mobile application be designed to combat them?
   (b) How can a social snus cessation mobile application be designed to incorporate a persuasive technology framework?
   (c) How can a snus cessation mobile application be designed to incorporate an integrated AI function?
   (d) How is such a designed app perceived by potential end users?

1.3 Assumptions and Limitations

The scope of this project is limited to high fidelity prototypes, so modifications in the final design due to technical constraints are not considered. Hence, it is assumed that the obtained mobile application's design can be further refined during subse-

quent development phases. For the same reason, the integration of the AI chatbot is limited to a design recommendation.

Additionally, time constraints may limit the complete improvement of the design based on potential end-users' feedback, which will be considered as future work. Moreover, the mobile application is mainly directed towards young people, and the usability testing is conducted with a small group of university students. This focus can potentially introduce bias and limit feedback diversity that could otherwise be obtained from other user demographics.

2
Background

This section delves into the statistics of snus use, the physiological and behavioral dimensions of snus consumption, highlighting the factors that render it addictive and challenging to abandon, as well as the current techniques employed to assist in its cessation. This project's application design addresses these vulnerabilities to provide effective support for users embarking into their snus cessation journey.

2.1 Snus Consumption Statistics

Tobacco use is a leading cause of death globally. According to World Health Organization, it is reported that tobacco kills half of its users, corresponding to 8 million deaths annually including non-smokers exposed to second-hand smoke [2]. In Europe, smoking accounts for 16% of adult deaths [3], with half of smokers dying on average 14 years earlier than non-smokers [4]. Unlike other European countries where smoking rates remain a primary concern, Sweden has seen a notable decline in smoking prevalence. This shift is largely attributed to the widespread adoption of snus.

Snus is a moist oral tobacco product that is placed behind the upper lip in loose form or portioned pouches where the active constituents, mainly nicotine, are absorbed through the oral mucosa [6]. Its sale is prohibited in all European Union (EU) countries except Sweden, and it is also available in Norway since it is not an EU member and thus not bound by EU legislation [3]. Despite perceptions of snus as a less harmful alternative to cigarettes [3], several studies show its associated health risks, including increased mortality rates and potential links to cardiovascular and cancer-related deaths [6, 7, 8]. Recent statistics indicate that 13.6% of Swedes engage in daily snus consumption [9]. This trend is particularly alarming among younger demographics, with a notable increase in usage rates from 7% to 14% among 15-16-year-old males from 1991 to 2020, and a rise from 1% to 7% among females of the same age group [10]. While lifetime snus use was less common among young girls, recent data reveals an upwards trend in snus usage by them, highlighting a shift in traditional gender patterns of tobacco use. Last year reports from the Swedish Public Health Agency further illuminate this trend [11], showing significant usage among 9th-grade students and 2nd-year high school students, with both groups reporting increased experimentation with nicotine snus products (see Figures 2.2, 2.3, 2.4).

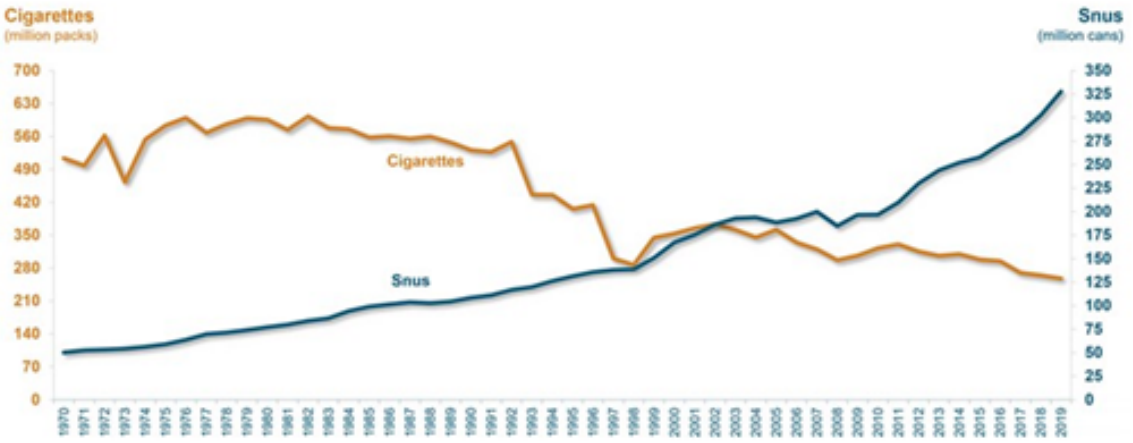


Figure 2.1: Comparison of the change in cigarette consumption compared to snus consumption in Sweden [5].

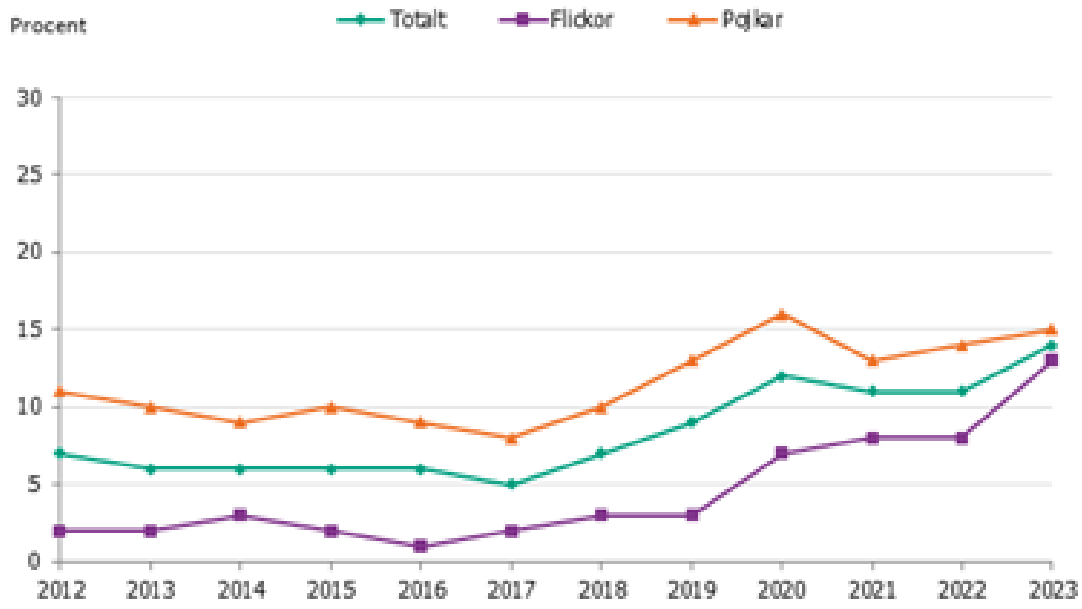


Figure 2.2: Percentage of students in grade 9 who use snus (daily/almost daily or sporadically) during the period 2012-2023, broken down by gender (as stated in Swedish in the legend, green is the total, purple is female, and orange is male) [11].

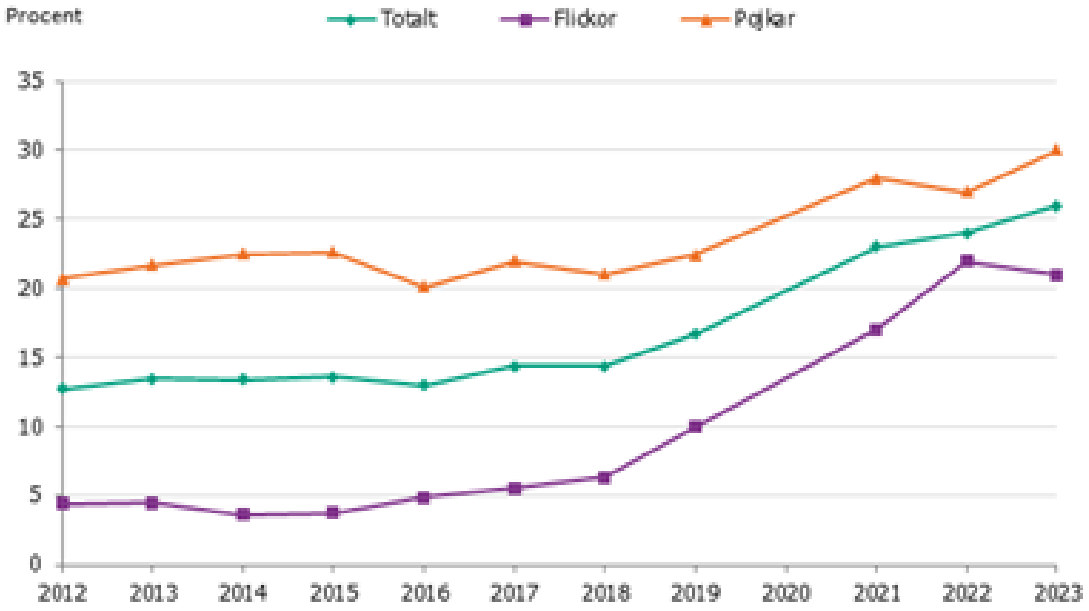


Figure 2.3: Percentage of 2nd-year high school students who use snus (daily/almost daily or sporadically) during the period 2012-2023, broken down by gender (as stated in Swedish in the legend, green is the total, purple is female, and orange is male) [11].

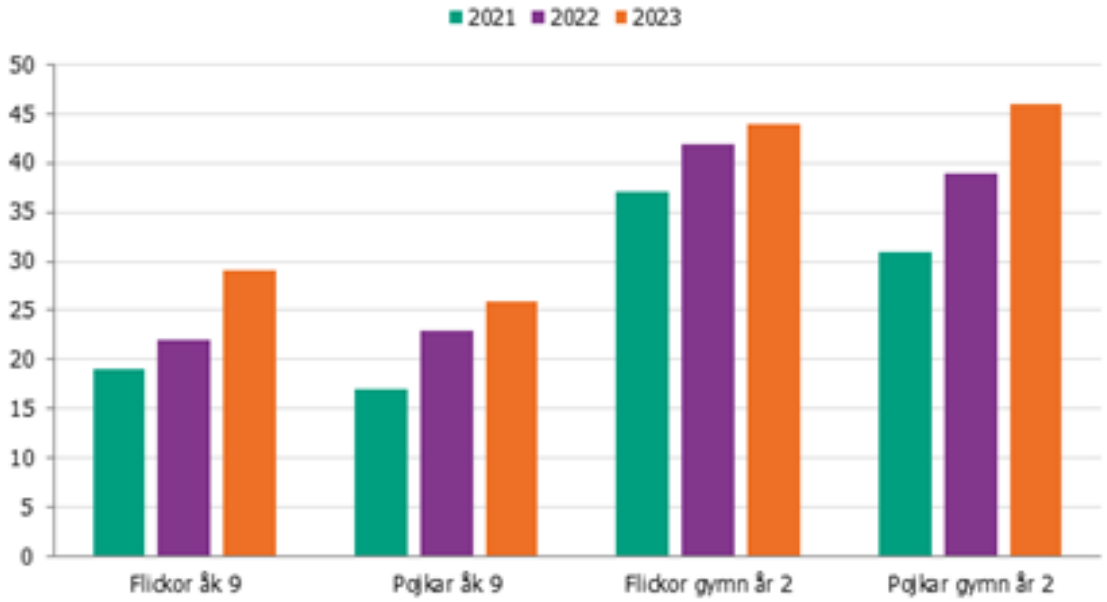


Figure 2.4: Percentage of 9th-grade and 2nd-year high school students who have used nicotine snus at least once during the period 2021-2023 [11].

The increasing popularity of snus among Swedish youth, despite the mounting evidence of its health risks, entails a critical public health issue. As snus use grows, particularly in younger demographics, it becomes imperative to address this trend with targeted interventions. Education on health risks related to snus use within effective cessation approaches is necessary to mitigate its impact on public health and protect future generations.

2.2 Physiological and Cognitive Effects that Contribute to Snus' Addiction and Motivations to Quit

Snus exerts several positive effects on the body, primarily attributed to its nicotine content, a highly addictive substance that attracts individuals to its use. Snus induces relaxation, aiding concentration, and enhances mood, resulting in a cheerful feeling. The duration of this effect typically lasts around half an hour, depending on the nicotine level [12]. Furthermore, snus consumption can be associated with certain beliefs and cognitive distortions that also contribute to dependency, similar to smoking. These beliefs include the notion that snus use helps relieve stress or the belief that it is necessary to cope with challenging emotions. Cognitive distortions, such as underestimating the health risks of snus and overestimating its benefits, play a role in reinforcing these addictive behaviors [13]. Other influential factors in snus consumption include that it is perceived as a less risky alternative to cigarettes or a help during smoking cessation [14], coupled with its cultural significance in Sweden [15]. These aspects contribute to the perception that snus is relatively harmless. The presented factors show that nicotine addiction depends on several influences, such as the how much the person has been exposed to it, culture, socioeconomic position, and education background; making it a complex physiological process [16].

Several studies have shown that snus use can lead to overall morbidity and mortality [6, 7], which motivates individuals to quit it. A study conducted among young male and female conscripts at the beginning of their military service in Finnish Defense Forces units showed that almost half of daily snus users were willing to quit [16]. Snus use has also increased in Finland as large traveller imports for personal use have contributed to its wide availability in this country [17]. The study also highlighted that the perception of snus-related health risks and getting advice to quit positively impacted their motivation to quit snus. Hence, it is crucial to incorporate both counseling and education about the dangers of snus use into the designed mobile health application directed to help people quit snus. This approach can significantly enhance the motivation of snus users to quit and should be a key consideration in this study.

Another study, conducted among Swedish smokers aged 16-84 who used snus as a method to quit smoking, uncovered additional reasons to quit snus [9]. These reasons included health issues such as high blood pressure and dental problems, economic concerns due to the high price of snus, negative impacts on relationships

due to complaints about the smell, and the habit being perceived as disgusting. Interestingly, some cited challenges in carrying snus abroad and purchasing it as a reason to quit. Therefore, the economic aspect can be another incentive considered in this study.

2.3 Cessation Consequences

Quitting snus can be a challenging process due to its nicotine content, a highly addictive substance that affects neurotransmitters in the brain's reward system. The withdrawal symptoms experienced when quitting snus are similar to those encountered when quitting smoking [18]. These withdrawal symptoms commonly include intense cravings and mood changes such as restlessness, irritability, and difficulty focusing and sleeping [19, 20]. It is essential for individuals aiming to quit snus to be aware of these symptoms and their timeline. Understanding that these symptoms are temporary can help them maintain their motivation throughout the cessation journey [21].

Quitting snus involves a series of stages and symptoms, as outlined in Table 2.1. Understanding these stages and symptoms is crucial for individuals undergoing the quitting process. It enables them to anticipate what they might encounter and develop strategies to effectively manage these symptoms, reducing in this way the risk of relapse.

Table 2.1: Timeline of withdrawal symptoms after quitting snus [22].

Days after quitting	**Symptoms**
1-3	Physical withdrawal symptoms are intense, including strong cravings for snus, dizziness, nausea, and difficulties focusing and sleeping. However, during this time, there is a complete restoration of taste and smell that may have been reduced by snus use.
4-5	Cravings for snus start to reduce, and some individuals may experience a few good days. Others may have recurring headaches, which can persist during the first 1-2 months but gradually become less frequent.
6-7	As the worst snus cravings subside, individuals may experience sweet cravings, leading to concerns about weight gain after quitting. Headaches and mood issues, such as irritability or melancholy, are also common. After the first week, sleep typically improves, and nicotine is completely eliminated from the body.
2nd week	Blood sugar levels can still be challenging for most, and sweet cravings persist. Sudden and strong irritability may occur.

4th week	Oral health improvements become noticeable, with exposed tooth necks and changes in the mucous membrane disappearing. These improvements continue throughout the first year of being snus-free.
5th-6th week	Around 40 days after quitting, many individuals experience a crisis period. This happens because habits developed over an extended period have become dependencies. Quitting is more complex than mere nicotine abstinence, as the brain needs to unlearn a habit intricately linked with a rewarding nicotine kick. At this point, individuals may suffer a decline in motivation and determination to avoid relapse.
7th-8th week	After overcoming the 40-day crisis, a lighter period follows, although some former snus users may experience moments of mental fatigue. Engaging in other activities, such as exercise, can help manage this condition.
12th-13th week	After 90 days a new milestone is reached where life without snus is finally manageable. By this time, the 40-day crisis is usually behind, and a lighter period follows. Some former snus users may experience moments of mental fatigue, which can be managed by engaging in activities like exercise.
One year	The time required for the body to return to a state as if snus had never been used depend on the duration and intensity of snus consumption. While the restoration of nicotine dependency is a relatively quick process, it takes longer to completely mitigate the increased risk of conditions such as diabetes.

2.4 Snus Cessation Treatments

It is crucial to develop effective cessation strategies to address the health risks associated with snus use. Over the years, various treatments have been developed to support smoking cessation efforts, which can also be applied for quitting snus.

Nicotine Replacement Therapy (NRT) is the most prevalent method for assisting cessation, utilizing products that administer controlled nicotine doses to alleviate cravings and withdrawal symptoms experienced during quitting [21]. Available in various forms such as patches, gums, lozenges, nasal sprays, and inhalers, NRT can be more effective when using a combination of long-acting and short-acting products, such as the patch and the gum respectively, to manage withdrawal symptoms [23]. Additionally, non-nicotine medications like Varenicline serve for the same purpose, offering an alternative approach to managing dependency [24].

These treatments' effectiveness is enhanced when complemented with guidance or counseling, typically provided by healthcare professionals [23, 25]. This counseling usually involves cognitive approaches that help patients modify their attitudes towards tobacco and snus use, with Cognitive Behavioral Therapy (CBT) being one of the most established methods for managing nicotine withdrawal during smoking cessation [26]. CBT focuses on identifying maladaptive thoughts and behaviors to then alter them. It helps individuals recognize their smoking triggers to develop healthier coping mechanisms, such as engaging in healthy activities or using relaxation techniques to handle cravings [13]. Moreover, CBT emphasizes the value of setting achievable goals and creating a practical quit plan to prevent relapse, alongside other strategies such as self-reminders of the reasons to quit and rewards for resisting cravings [27, 28, 19]. The CBT method is considered when defining this project's application functionalities.

Other cognitive interventions that might aid smokers with smoking cessation, and thus can also be applied for snus cessation, are the mindful-based ones. These techniques teach individuals to mindfully manage negative emotions, cravings, and other related nicotine withdrawal symptoms [29]. These include mindfulness training, acceptance and commitment therapy (ACT), distress tolerance training (DTT), and yoga.

First, mindfulness training involves breathing techniques and other guided techniques such as guided imagery or mindfulness walking [30, 31]. These techniques teach individuals to observe their thoughts and feelings without judgement and let them pass. As nicotine withdrawal symptoms usually include anxiety and depressed or irritable mood, these treatments help people realize their feelings are temporary and help them cope with these, rather than be controlled by them.

Secondly, ACT is another behavioral therapy that encourages individuals to accept their thoughts and emotions without resistance or guilt [32]. It combines mindfulness with the practice of self-acceptance. ACT encourages individuals to confront uncomfortable emotions, refrain from overreacting to them, and not avoid situations that trigger them [33], opposite to CBT. Research has shown that ACT is effective for smoking cessation, also delivered through the telephone [34].

Thirdly, DTT helps develop a set of skills for individuals to respond in a healthy way during distressing situation where they might not have the control [35]. However, studies do not show a clear improvement of smoking cessation success due to DTT [36].

Finally, yoga has shown promising results as adjunctive treatment for smoking cessation by alleviating nicotine withdrawal symptoms and improving negative affect, attributed to the benefits that aerobic exercise offers [37, 38].

As the landscape evolves, new and more accessible alternatives of advice and counseling emerge, including mobile health technologies, from now on referred as mHealth.

mHealth are mobile applications used to deliver healthcare or disseminate health-related information [39]. As over 3.7 billion people had smartphones [40] and more than 250 billion mobile apps were downloaded in 2023 [41], these technologies promise to significantly transform cessation strategies by making support, such as the cognitive therapies previously explained, readily available to those aiming to quit both smoking and snus.

3
Theory

3.1 Adopted Design Methodologies

This section provides an insight into the theoretical basic of the methodologies utilized when designing the mobile application in this study. Drawing from principles rooted in the Service Design (SD) methodology and the Persuasive Technology (PT) framework, the adopted approach integrates various functionalities aimed at enhancing user engagement and influencing behaviors effectively. Furthermore, the visual aspect of the mobile application follows the User Interface (UI) design principles to ensure that the user experience is both intuitive and aesthetically pleasing. In this way, this section clarifies the design decisions made and shows how the methodologies shape the mobile application's overall design.

3.1.1 Service Design for the Design of mHealth Applications

mHealth applications are shaping a new healthcare paradigm where information related to individuals' health is easily accessible and ubiquitous [42]. As previously introduced, mHealth offers a promising avenue for delivering behavioral interventions, such as supporting snus cessation efforts. The development of these applications employs diverse methodologies [43], including the SD methodology. SD is an approach to designing services that considers both the needs of the customer and the needs of the business to create quality service experiences [44]. This approach is based on the design thinking (DT) methodology, which applies a user-centric, solution-oriented strategy for solving complex challenges [45]. It has been used in the development of various mHealth applications [46, 47, 48]. In this way, it emphasizes a creative and user-centred process to design new services, including digital applications.

The SD process uses research, prototyping, and a set of visualization tools to create the necessary characteristics of a product that meet the user needs [44]. These core tools are divided in three main groups during the design and development process of the product or service [82]:

1. Research: Different guidelines are provided to perform different types of research, such as preparatory research and autoethnography, and several tools are described to interpret the raw collected data, including key insights, job-to-be-done, user stories, personas, journey maps, and system maps. The ones employed on this project are further explained in the 4. Methods section.

2. Ideation: SD contains tools for both generating new ideas for the service or product that is being created, and then filter and arrange them to keep and further develop the promising ones.
3. Prototyping: In the SD process, prototyping help to identify important aspects of a new service concept and explore different alternative solutions that are evaluated to see if they work in the real world [44]. SD offers various mechanisms to translate ideas into a tangible product, enabling early and cost-effective validation of its efficacy in real-world scenarios. These include several levels of realism of the prototype. For example, for a software product, it offers tools from idea sketching to interactive click-models.

3.1.2 Persuasive Health Technology

Although individuals may feel motivated at first when quitting snus, it is not an easy process due to the withdrawal symptoms that come with nicotine addiction. In addressing this, PT plays a crucial role in facilitating changes in snus usage behaviors. This technology, which forms the foundation of the functionalities in the mobile application designed in this study, employs non-coercive methods to alter user behaviors or attitudes, proving valuable across different fields, including public health [49, 50]. In health domain, through interactive digital platforms, ranking from desktops and internet services to mobile devices; persuasive health technology (PHT) targets health-related behaviors, aiming to enhance health outcomes or manage diseases effectively to maintain or improve a person's health-status [51, 52]. PHT, provided particularly through mHealth applications, is an effective tool to promote health as well as prevent and manage diseases. To do so, it includes a wide range of activities like encouraging physical activity, promoting healthy eating, and facilitating tobacco cessation.

For this project, PHT aimed at tobacco cessation is especially relevant. These technologies often incorporate cognitive approaches to modify users' attitudes towards tobacco use [50], being CBT one of the most established methods, as previously introduced.

The Persuasive Systems Design (PSD) framework [51] guides the design of persuasive systems, outlining the design principles across four main areas: Primary Task Support, Computer-Human Dialogue Support, System Credibility Support, and Social Support (see further detail in section A.2. of the Appendix). These principles guide the definition of this project's app functionalities that align with snus cessation, ensuring an effective mHealth solution [26]. Especially focus is given to the Social Support part, where the system motivates users through social influence [53]. Interpersonal relationships are crucial for both psychological and physical well-being and they can assist individuals in managing stress, motivating behavioral changes, and sustaining new habits [54]; three key elements for snus cessation. Several studies have shown that a supportive social environment improves the success of smoking cessation and prevents from relapse [55, 56].

Based on Fogg's principles on mobility and connectivity [57], the system can employ various strategies to encourage users to change their behaviour. These include allowing users to observe others performing similar behaviors, comparing their progress, creating a sense of belonging to a group with shared goals, facilitating cooperation or competition among users, and offering public recognition for their achievements. Some of them are included in the app's functionalities of this project.

3.1.3 User Interface Design

Effective mHealth applications require not only the right functionalities but also a user-friendly presentation. This is where UI design principles become indispensable. UI design focuses on building interfaces in software and digital devices that are both aesthetically pleasing and easy to navigate [45]. To achieve this, it is essential to define a clear navigational structure, incorporating standard app navigation components such as hamburger bars, tab bars, or navigation drawers. Additionally, following Paret's principle that suggest that 80% of users typically use no more than 20% of available options [58], the number of functionalities offered on each screen should be kept simple. This principle is especially crucial when designing the home screen, where determining and prioritizing the most important features for users is key.

The final app design should be customized for the target audiences, in this case, young people who use snus. While the design might draw inspiration from popular social media platforms to resonate with the user base, it should also include health-specific adaptations [58]. These may include a simple design with calming white and smoothing colors to maintain user focus, consistent and friendly tone in textual content, health-specific icons for the application buttons, and motivational messages to promote a positive approach to the snus quitting process. Furthermore, micro animations, such as progress bars or interactive elements when clicking on buttons, can enhance user engagement and interaction within the application. This design aligns with the PSD model's guidelines outlined above for an effective health intervention tool.

3.2 Artificial Intelligence Counseling in Health

During recent years, AI has expanded its presence to the healthcare field, including its use in mental health management [59]. AI chatbots are already widely used for self-service in other industries and now they are being developed for therapeutic purposes, too. These chatbots are created combining big data, natural language processing, and machine learning algorithms to make them able to talk and guide individuals for different tasks [60].

In the context of mental health, traditional psychotherapy can be inaccessible and expensive, so AI chatbot therapists offer basic psychological tools in a more affordable way [61]. These chatbots are used to offer advice and as a line of communication during treatment for mental health patients [62]. Numerous studies have explored

the effectiveness of AI chatbots that treat diverse mental health conditions. For instance, XiaoNan, a chatbot powered by the open-source conversational AI "RASA"[1] and based on CBT principles, was used effectively for self-help depression treatment among Chinese university students [63]. Another chatbot, Weabot[2], has proven to be effective in helping individuals with conditions such as depression, anxiety, and substance abuse. It does so by adapting to users' personalities and offering exercises to cope with these conditions. These studies highlight the potential of AI chatbots to address common mental health disorders, especially for unserved populations [60].

However, the ethical implications that integrating AI into therapy can create must be evaluated. Professional organizations should develop guidelines for assessing and regulating AI applications in mental health to ensure they complement professional care while emphasizing transparency, ethical use, and ongoing research on their impact and long-term effects [61].

Focusing on smoking cessation, AI-powered chatbot mobile applications have been developed like QuitBot [64]. QuitBot, based on scientifically validated content, combines conversations to guide users through the quitting process with the flexibility offered by the trained AI to answer the users' questions about smoking. In this way, it provides personalized support that sets it apart from other existing apps. Nevertheless, the evaluation of the effectiveness of these AI-chatbots when assisting tobacco cessation is mixed and should be interpreted cautiously [65, 66, 67].

3.3 Ethical Considerations

In the process of designing a mobile application for snus cessation, it is key to establish a clear and transparent communication with users regarding the purpose, use, benefits, and potential risks of the mobile application, especially considering that the users are likely to be young individuals.

Additionally, the information and guidance provided to users about snus and addiction must be accurate and evidence-based. It should adhere to medical standards to ensure its veracity and safety in addressing nicotine addiction and cessation. This becomes particularly important in the context of AI counselling or user-generated content, where there is a risk of disseminating misinformation.

Furthermore, the mobile application should employ respectful and non-manipulative strategies in its aim to engage users to enhance its effectiveness in assisting them in quitting snus. Positive incentives that do not negatively impact the users' psychological well-being should be used. Moreover, the design of the mobile application should be inclusive, catering to a broad user base, and it should incorporate multilanguage support to enhance accessibility. Continuous improvement of the mobile application is also vital. This improvement should be guided by user feedback to

[1] Conversational AI Platform
[2] Woebot Health

maintain the effectiveness and relevance of the mobile application over time.

During the interviews with potential end users, the interviewees are thoroughly informed of the purpose of such interviews, including the main objectives of the project and its status as a master's thesis for Chalmers University of Technology. They are also notified about how their personal data regarding their snus usage will be used in the design of the mobile application and that it will be anonymously included in the project's report. This ensures that participants can provide informed consent to participate in the interview process.

4
Methods

This chapter outlines the methodology employed in this study, offering insights into the approaches used to research key aspects related to snus use and cessation. It also presents the methods employed in the overall design of the mobile application and their relevance to the project. The mobile application designed in this study is called ExSnus and will be referred to by this name throughout the document.

A SD process was followed for the design of ExSnus to ensure that its design and functionalities truly resonate with its intended users. This decision was influenced by research showing that mobile applications developed without sufficient user and clinician input often fall short in quality [46, 48]. The process began with a review of academic literature to gather insights into existing mHealth tools targeting snus cessation and other treatments directed to nicotine addiction, as well as numerical data regarding snus consumption to have an idea of the potential end-users' number. In parallel, interviews were conducted with potential users to gain a deeper understanding of their experiences, perspectives, and needs related to snus cessation. This knowledge informed the definition of the specific functionalities of ExSnus to aid snus cessation, guided by the PSD's model principles. Subsequently, mock-ups were created to visually represent these features in an application prototype, starting with rough sketches during the ideation phase and culminating in a detailed digital prototype. The prototype then underwent an iterative improvement process, incorporating feedback from potential users. In this manner, end-users actively participated in providing valuable insights and validating the viability of ExSnus. This methodology is applied throughout the steps depicted in Fig.4.1.

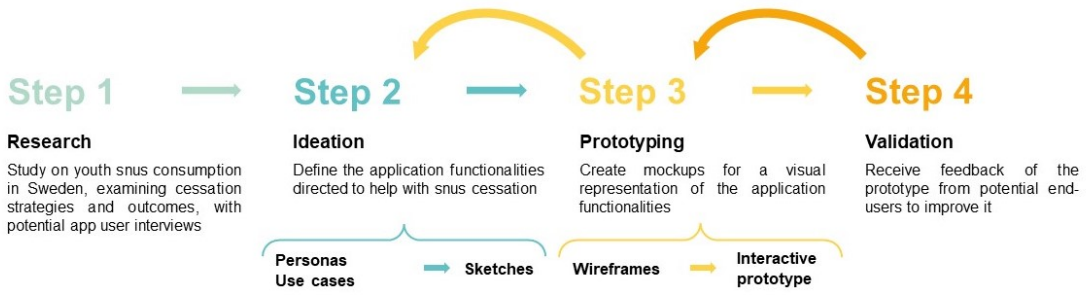


Figure 4.1: Project steps followed in the application design based on the Service Design process [11, 46].

4.1 Research Approach

The initial phase of this project involved conducting a comprehensive review of important factors related to snus use and cessation. This included examining demographic information and understanding the physiological and cognitive impacts of snus. Additionally, interviews were conducted with college students who use snus to further explore their relationship with it. These insights guided the definition of the features of the ExSnus mobile application, aiming to address users' vulnerabilities and boost their strengths as they embark on their journey to quit snus.

4.1.1 Preparatory Research

In the initial phase of this study, which corresponds to Step 1 of the project framework following the SD process in Fig. 4.1, preparatory research is conducted to gain insights into the subject matter and similar existing products [68]. In this case, the research served to understand the current landscape of snus consumption and the existing approaches to help in its cessation, with a particular focus on existing mHealth applications. This literature study aims to provide a holistic understanding of the matter and identify potential techniques for snus cessation that could be addressed through the design of ExSnus (i.e., using theory as a contextual tool [69]). The literature study includes various sources, ranging from research articles and books to websites.

The first stage is to profile individuals who use snus, quantifying their numbers and exploring their reasons to consume snus. Moreover, the physiological effects of snus on the human body, its addictive properties, and the reasons why individuals find it challenging to quit are also studied. In this manner, this first stage provides a contextual understanding of the issue ExSnus addresses, illustrating potential user behaviors and needs that are later represented as a persona. This stage is further informed through interviews with young snus users as later explained.

Secondly, a review of current strategies employed to assist both smoking and snus cessation is conducted, with particular emphasis on existing mHealth applications related to snus cessation. The goal is, on the one hand, to understand cognitive methodologies for managing snus cessation withdrawal symptoms that could be integrated into ExSnus and, on the other hand; to identify any gaps in these mobile applications that ExSnus could potentially address. By assessing the strengths and weaknesses of existing solutions, the effectiveness of the designed mobile application can be enhanced. Additionally, the possibility of adding an AI counselor and its effectiveness is studied.

Finally, current tendencies in application design are explored to apply these design principles to ensure that ExSnus would align with user expectations and preferences, which are presented in depth in the following section.

Throughout the literature study, each information source undergoes a rigorous evaluation process to assess its quality and relevance. This assessment involves a meticulous examination of the studies' content, an evaluation of the methodologies employed, and an assessment of the source's relevance to the research questions.

4.1.2 Interviews with Snus Users

In addition to reviewing literature related to the causes of snus use and nicotine addiction, interviews were conducted with college students from Chalmers University in Gothenburg who use snus. The interview approach was chosen from the different research methods offered in the SD process alongside the preparatory research because it serves as an effective method to empathize with users, enabling a deep understanding of their values, perceptions, and experiences. Young university students were chosen for the interviews guided by the belief that a mobile application aimed at helping with snus cessation is more likely to be utilized by the youth . It is important to note that higher education seems to act as a protective factor against regular nicotine use [70, 71], so the answers to the same questions regarding snus consumption could differ among individuals with other educational backgrounds.

The type of interview chosen is a semi-structured interview as there is an initial set of questions, but there is room for clarification or follow-ups, facilitating deeper exploration of interviewees' comments and insights [72]. This approach allows for asking specific questions while remaining open to exploring the participants' point of view.

The interview's initial set of questions covers various aspects related to snus use, addiction, motivations, and thoughts on cessation:

1. How long have you been using snus?
2. Why/How come did you start using snus?
3. What time do you use snus first time each day after waking up?
4. What time do you use snus last time each day before sleeping?
5. When do you use snus most during the day? Is it any trigger for you to use it?
6. Do you consider yourself addicted to snus? Why do you think so?
7. How much do you snus daily and how often do you snus daily?
8. Do you also smoke or did you smoke before? If so, how much and how often?
9. Why do you use snus? Do you feel like it helps you in some ways?
10. Do you know what snus contains? Do you consider that it can be dangerous for your health?
11. Do you think snus is a part of the Swedish culture? Do you feel the use of snus is regarded as something normal in society or something cool in your generation?
12. Have you thought about quitting snus or reduce the frequency or the amount of snus? What were the reasons behind your thought?
13. What do you think you need to help yourself to quit snus?

These questions were asked to five students from Chalmers University of Technology who are current or former users of snus. The interviewees were four male participants and one female participant in their twenties. Among these individuals, three are of Swedish nationality while the remaining two are international students.

Subsequently, the interview responses undergo thematic analysis. Thematic analysis is a qualitative content analysis method employed to identify, analyze, and report patterns, known as themes, within the data [73]. The analysis involves dividing the data set into units of analysis [74], with each transcribed interview response serving as a unit of analysis in this project. Phrases are then grouped into meaning units, understanding by 'meaning unit' sentences containing aspects related to each other through their content and context. These meaning units can be condensed to shorten them while persevering their core. Finally, the condensed meaning units are categorized into themes, each capturing an important pattern of the data related to the research questions.

Several decisions need to be made before starting the theoretical analysis. Initially, it is crucial to define what constitutes a theme within the theoretical analysis framework. In this project, themes are selected with flexibility in mind, considering that they are not dependent on quantifiable measures, but rather capture important aspects related to the overall research questions [74]. A theoretical thematic analysis is chosen as the type of analysis to perform because it focuses on providing a detailed examination of the most relevant aspects to define the functionalities of ExSnus. Furthermore, a semantic approach is adopted since the analysis does not extract any further meanings beyond what a participant has said. In this way, the answers of the interviews are categorized into different themes, as shown in the 5. Results section. To ensure the quality of the thematic analysis, the 15-point checklist provided by [73] is followed (see section A.1. of the Appendix for the whole list).

4.2 Ideation of the Mobile Application

Following the SD process [44], the data collected during the preparatory research and the analysis of the interviews with young snus users' were used to define a persona. This persona represents a group of people characterized by shared interests, behaviors, demographics, or geographical traits [75]. In this project, it represents potential users of ExSnus and their needs regarding snus use and cessation. Subsequently, the functionalities of ExSnus are defined to address this persona's needs. Inspiration is drawn from the already existing mHealth applications developed to aid snus cessation presented in the 5. Results section. The functionalities of ExSnus are represented through use cases, outlined then in a Unified Modeling Language (UML) use case diagram.

Use cases are a tool used to understand, interpret, and organize the features of an application by illustrating how users interact with it [76]. They help outline who the users are, their goals, the steps they take to accomplish tasks, and how the system responds to these actions. Additionally, use cases serve to brainstorm potential

misuses and malfunctions of the application and how to respond to them. When creating a use case, it should contain several key elements [77]:

1. System: The software being discussed within the context of the use case. In the case at hand, the ExSnus mobile application prototype.
2. Actors: They represent entities that exhibit behavior when interacting with the system. In the case at hand, it refers to the users, who are primary actors that initiate interactions with the system. For this project, the created persona is utilized as the user to formulate the use cases.
3. Scenario: It is a specific sequence of actions and interactions between actors and the system under discussion. It is also known as a use case instance usually numbered.
4. Use case: Use cases outlines both successful and unsuccessful scenarios that may arise when actors interact with the system.

A UML use case diagram summarizes the actions that can be done by the actors and their interactions with the system, depicting a high-level representation of the relationship between use cases, actors, and system [78].

In conclusion, the process of outlining the functionalities of ExSnus involves interpreting the raw data gathered from the preparatory research and from the interviews with young snus users. Main themes are extracted from this data that supports the creation of the persona to represent potential users of the mobile application. Use cases show the functionalities of ExSnus and are then summarized in the UML diagram. These specifications ensure a thorough understanding of the mobile application's intended behaviors and user interactions, serving as a blueprint for the design phase.

4.3 Prototyping of the Mobile Application

This section delves into the methodologies and techniques employed to create a tangible representation of ExSnus, ensuring its features and user interactions are effectively realized before full-scale development. The process involves multiple stages, starting from initial sketching to interactive click modeling, each contributing to the refinement of the application's design and usability.

4.3.1 Sketching

Sketching plays a vital role in design process, facilitating translation of the functionalities of ExSnus into visual representations for testing them and ensuring their effectiveness. Widely recognized as a valuable method for idea generation in design field [79], sketching offers several advantages, including the visualization of concept designs, rapid ideation, and flexibility in refining the initial design of the application layout until it aligns with all the requirements. Additionally, it is the most cost-effective means of exploring design alternatives compared to other methods, such as

prototyping.

In this project, the sketching approach combines analyzing existing mobile applications and their layouts, along with rough sketching to derive inspiration from them and learn from past design mistakes [80, 81]. This process entails translating the functionalities of ExSnus into different screen elements, such as buttons and text. Once the primary design is selected from the rough sketches, the Solution Sketch technique is employed for further refinement. This technique involves incorporating real text and clear titles for each screen sketch to produce a well-defined and elaborated design concept [83]. Subsequently, this final sketch can be translated into more realistic designs using prototyping software.

4.3.2 Interactive Click Modeling

Prototyping in the context of mobile application development involves creating detailed representations of applications that showcase their functionalities and designs without actual functional code [81]. These prototypes offer stakeholders insights into the application's appearance and behavior, serving as a cost-effective way to evaluate the suitability of a solution before proceeding with full-scale development.

Prototypes vary in fidelity, with initial wireframes being the quickest and most cost-effective. Wireframes provide the basic gray-scale layout and structure, outlining the application's features as interface elements such as basic representations of buttons, text inputs, and screen layouts. They focus on structure and layout, excluding visual design details like content and color schemes [84]. Additionally, wireframes illustrate transitions between screens, offering an overview of the application's features and user interactions [81, 85]. In this way, wireframes serve as digital translations of the initial on-paper sketches [81].

Lastly, the final digital prototype incorporates detailed design elements such as real images, button styles, font specifications, and responsiveness to different devices [85]. It should also address accessibility concerns like color blindness and legibility, ensuring an engaging flow to retain user attention [86]. This prototype is an interactive click model that is then validated through usability testing with potential end users of ExSnus in the validation step of the project.

For creation of both the initial wireframe and the final interactive prototype, the project utilizes the software Figma[1]. Figma is a well-known and established web-based prototyping tool widely adopted in the design community which allows for design of interactive mobile application prototypes, offering clickable interface elements and serving as a representation of a fully functional application.

[1]Figma: The Collaborative Interface Design Tool

4.4 Usability Testing

Usability testing evaluates the user experience to assess how intuitive a system is [87]. This process can involve qualitative or quantitative methods, be moderated or unmoderated, and conducted remotely or in person. In this project, an in-person approach that incorporates both qualitative and quantitative evaluation elements is chosen, aligning with the interview style to gain insight into users' thoughts and feelings when using the prototype of ExSnus.

First, participants are provided with a consent form (refer to section A.4.1 of the Appendix) to inform them how their information is going to be handled. Secondly, the participants fill a questionnaire (outlined in section A.4.2 of the Appendix) that collects basic demographic data relevant to the system being tested. This information is then taken into account when analyzing the results.

The testing is moderated; participants are guided through the process and given specific tasks to ensure all main functionalities of the application are explored. These tasks are detailed further in section A.4.3 of the Appendix.

On the one hand, the qualitative analysis part consists of encouraging participants to verbalize their thoughts and expectations while using ExSnus, a method known as think-aloud protocol. Follow-up questions to some of their thoughts are asked while they complete the tasks. Think-aloud approach aims to reveal aspects of the interface that either delighted, confused, or frustrated the users [88]. After completing these tasks, two final questions are posed to participants, one of them focusing on the overall application's functionality and the second one comparing the two specific features highlighted in the project; the AI assistance and the social part:

1. Which parts of the application do you think are the most helpful ones for the purpose of quitting or reducing snus use? Why?
2. Would you feel more comfortable using the AI chatbot or the forum to get support or information? Why?

On the other hand, the quantitative analysis part uses the System Usability Scale (SUS) by John Brooke to quantify perceived usability through 10 questions [89]:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.

10. I needed to learn a lot of things before I could get going with this system.

The responses range from 'Strongly disagree' to 'Strongly agree' and it then gives a score between 0 and 100.

Apart from the three documents they need to fill, including the consent form, the initial questionnaire and the SUS questionnaire; during the usability testing participants are provided with the interactive click model prototype, which effectively represents a functional application due to its clickable elements. The selected participants are from the target audience identified in the project's initial phase ensuring that the feedback is reliable [58]. This group includes individuals from a previous group interview and other new university students.

The results obtained from the test and feedback from participants are documented, analyzed, and utilized to refine the design of ExSnus. Usability testing is a crucial step as it ensures that the application prototype is effective and user-friendly before actually developing it.

5
Results

5.1 mHealth Applications and Cognitive Behavioral Therapy for Snus Cessation and Their Incorporation in the Functionalities of the Application

Motivated by the rise of mHealth technologies as explained in the section 2.4 Snus Cessation Treatments and the subsection 3.1.1 Service Design for the Design of mHealth Applications, a review was conducted of the existing mHealth applications focused on snus cessation. While there are numerous mobile applications for smoking cessation such as the WHO QuitTobacco App[1] and EasyQuit[2], as well as other more general mobile applications directed to build healthy habits and routines like Habinator[3], snus-specific cessation mobile applications are limited and relatively unknown. A summary of the identified snus cessation mobile applications can be found in Table 5.1.

Table 5.1: Comparison of Snus Cessation Mobile Applications.

Mobile application name	**Language**	**Operating system**	**Features**
Snus Stop [4]	English	Android	1. Information on money saved, snus spared, and life regained. 2. Details on withdrawal symptoms. 3. Graph tracking snus pouch usage over time. 4. 25 achievements related to snus pouches not consumed and money saved. 5. Setting saving goals.

[1] WHO QuitTobacco
[2] EasyQuit
[3] Habinator
[4] Snus Stop: Quit Dip & Nicotine

Application name	**Language**	**System**	**Features**
Quit Snus[5]	English	iPhone	1. Information on money saved and snus spared. 2. 12 achievements related to days without using snus. 3. Reports on craving occurrences in various situations: alcohol, bored, coffee, driving, food, love, morning, party. 4. Setting saving goals. 5. Calculation of health-related benefits. 6. Breathing exercises.
DipQuit: Sluta Snusa [6]	Swedish	iPhone	1. Information on money saved and snus spared. 2. Achievements related to days without using snus and money saved. 3. Calculation of health-related benefits. 4. Live chat with other users.
Sluta Snusa - Bli Miljonär[7]	Swedish	Android	1. Information on money saved and snus spared. 2. Allows multiple users on the same device.
Snuskollen[8]	Swedish	Android	1. Provides statistics on snus usage by hour of a day and days of the week.

[5]Quit Snus
[6]DipQuit: Sluta Snusa
[7]Sluta Snusa: Bli Miljonär
[8]Snuskollen

Application name	**Language**	**System**	**Features**
Snusfri[9]	Swedish	iPhone	1. Information on money saved and days without using snus. 2. Ability to create a contract to quit snus. 3. Achievements related to days without using snus or personal goals. 4. Audio exercises for mindfulness.
Slutta[10]	Norwegian, English	Android	1. Information on money saved and days and hours without using snus. 2. Sharing option of money saved or time without using snus. 3. Link to a Norwegian webpage with advice and tools to change habits. 4. Add a 'Call Friend' to call when you need to talk to someone. 5. Tips offered when struggling with cravings. 6. Add a motivational photo. 7. Achievements related to days without using snus 8. Breathing exercises.

It is worth to highlight that while some snus cessation mobile applications provide information on health regained, this information often lacks scientific backing, a situation that is not unique to snus applications and has been observed in smoking cessation applications as well. For instance, Haskins et al. [90] found that out of 50 smartphone applications for quitting smoking recommended by the app stores, only two had scientific support.

ExSnus incorporates some of the features found in the existing snus cessation mobile applications, including information on money saved, achievements related to snus not used, reports on cravings, and statistics on snus use. However, unlike these mobile applications, it also includes social features and an AI chatbot, along with more scientifically-based information on the withdrawal symptoms and the existing therapies explained in subsection 2.4 Snus Cessation Treatments. Moreover, it pro-

[9] Snusfri
[10] Slutta

vides deeper insights on the users' feelings and activities that trigger cravings and tips to address them.

Another important aspect is the effectiveness of these applications that help users overcome their addictions. Research studies have explored the efficacy of applications designed to aid smoking cessation [90, 91, 92, 93], but similar studies specific to snus cessation mobile applications are currently lacking. The collective findings regarding smoking cessation applications suggest that they are helpful, either independently or when combined with face-to-face assessments or online programs. This is particularly true in high-income countries with established tobacco control measures, media campaigns, and educational efforts. From the few applications that have given information about their quality and reliability, the reported quit rates for smoking cessation applications range from 12.5% to 51.5% [94]. Their success is mainly attributed to their ability to reach a wide audience at a minimal cost, making them more accessible to treatment-seeking individuals compared to other cessation interventions.

When it comes to CBT, previously introduced as one of the most common cognitive approaches to help with smoking cessation; studies have tested CBT delivered through phone or computer platforms for various mental health conditions, including depression and anxiety disorders [95, 96]. These studies have shown that digital CBT interventions can deliver efficient and practical healthcare, especially to individuals who might otherwise remain untreated. Furthermore, mobile applications for smoking cessation that incorporate CBT features have been associated with higher user engagement [97, 98]. Key features of these applications such as having a quit plan, tracking progress, and offering audio-visual content and sharing capabilities are highly accepted and utilized by the users [93]. Thus, these CBT features are included when defining the functionalities of ExSnus.

In summary, research supports the effectiveness of both smoking cessation applications and CBT delivered through digital platforms for quitting smoking and addressing mental health conditions, particularly in high-income countries. These findings highlight the potential of technology-driven interventions to promote behavioral change and expand healthcare accessibility, which can be applied to snus cessation as well.

5.2 Interviews Analysis

From the theoretical analysis of the interviews, the main meaning units extracted from the answers that were similar among the interviewees are the following ones:

1. The interviewees were introduced to snus at parties or by friends.
2. All the interviewees that consider themselves addicted always start their day with snus, using it for the first time within the first hour of waking up.
3. Use snus to focus on study or work as it makes the interviewees feel relaxed.

4. All the interviewees that consider themselves addicted feel anxiety when not using it.
5. Lack of knowledge of what snus exactly contains, but a slight sense that it is dangerous.
6. Snus is regarded as a part of the Swedish culture for the majority of the interviewees, or at least its use is regarded as normal for everyone.
7. The interviewees' main concerns regarding their snus use is related to health and economical aspects.
8. How do the interviewees think a mobile application can help quit snus varies for each person. They are considered to define the use cases of the app:
   (a) Identify situations that trigger snus use to avoid them and have alternatives to those triggers to handle cravings.
   (b) Share the journey of quitting with friends.
   (c) Rewards when not using snus.
   (d) Combine with medication when addiction is stronger.
9. Some of the interviewees were skeptical when asked if AI could help them in the journey of quitting snus.

Several core themes that highlight the psychological, social, cultural, and health-related dimensions of snus consumption can be summarized from these meaning units to provide a more integrated understanding of the main issues related to snus usage and cessation, depicted below. From these themes, it becomes clear that addressing snus usage through the designed mobile application requires considering the social influence, addressing the addiction and perceived benefits, and enhancing awareness of health risks.

5.2.1 Social Influence and Cultural Normalization

Snus usage is a socially influenced behavior, deeply integrated in Swedish daily life. The role of friends and social gatherings in introducing snus, along with its normalization within the Swedish culture, creates a supportive environment for its continued use. This influence highlights the importance of addressing snus considering the social and cultural context.

5.2.2 Addiction and Use

On one hand, the routine of using snus right after waking up and the associated anxiety without it, points to a physical and psychological dependency. On the other hand, the use of snus to enhance focus and relaxation suggests that users perceive immediate, functional benefits, which may reinforce the habit despite the awareness of potential addiction. Therefore, an alternative must be provided for the functional benefits given by snus usage to encourage its cessation.

5.2.3 Health Concerns and Motivations for Cessation

Despite individuals not knowing detailed information about the contents and risks of snus, they still perceive it as health risky, which acts as a significant motivator

for quitting. This limited awareness and health concerns are a critical area for intervention through the mobile application, where increasing knowledge about the risks could strengthen the motivation to quit, particularly when coupled with the economic incentives to reduce or stop its use.

5.2.4 Cessation Support and Technology Skepticism

The difference among the answers to which functionalities of the application help each interviewee indicate the diverse needs among users in their quitting journey. Additionally, the skepticism towards AI assistance needs to be considered when deciding whether to add it.

5.3 Persona

A persona, depicted Fig.5.1, was created using the insights gathered from the literature study and interviews. This persona embodies a university student from Sweden and serves as a representative model of potential app users. His goals, preferences, and challenges are considered when creating the use cases that define the app's functionalities. [14] [15] [16]

5.4 Use Cases

In illustrating the use cases, the software serves as the system, portraying the functionalities of the ExSnus mobile application and considering possible alternative scenarios.

Table 5.2: Use Case 1: User Creates a Profile

Use Case 1	Create Profile
Use Case Goal	To enable Gustav Olsson to create a personal profile on ExSnus, which is essential for tailoring the application's features to his specific preferences.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. The user, Gustav, has downloaded ExSnus on his phone. 2. Gustav has a stable internet connection. 3. Gustav has all the necessary information ready, such as his email address, a desired username, and personal goals related to quitting snus.

[14] This Person Does Not Exist - Random Face Generator
[15] 20 User Persona Templates
[16] Vector Icons and Stickers

Basic Scenario	

1. Gustav opens ExSnus on his phone.
2. The application displays a welcome screen containing a congratulating phrase for having started the journey to quit snus and an option to "Start the journey".
3. Gustav selects the "Start the journey" option.
4. The application prompts Gustav to enter his personal information, including email address and a secure password. Additionally, he is asked to provide his name, which the app will use in future interactions to create a more personalized experience. Finally, he must accept the Terms and Conditions, as well as the handling of his personal data, to be able to continue with the profile creation.
5. The application then asks Gustav to input additional information relevant to quitting snus, some of which is mandatory including his daily snus usage, how much a snus can costs, and preferred quit date (today or a future date). Additionally, there is optional information that can be added to tailor his quitting plan. This includes the number of prior quit attempts and a questionnaire to measure his addiction level. Finally, he can optionally personalize the experience on the app to motivate himself further, including his motivation for quitting, a financial saving goal, and what he intends to do with the saved money.
6. Gustav fills in the details.
7. The application creates Gustav's profile and shows a screen that informs him of the amount of money he could save in a year, the number of snus pouches he would avoid, and the key health benefits he could gain. If Gustav entered his motivation, the application reaffirms how achieving his goals aligns with these benefits. Furthermore, the application suggests a tailored quitting plan for Gustav:
    - If he obtains a high score on the addiction test and/or has previous failed quit attempts, ExSnus recommends Nicotine Replacement Therapy (more information can be obtained once inside the app) and gradually reduce snus usage.
    - If he obtains a low score on the addiction test and does not have previous failed quit attempts, ExSnus recommends Cognitive Behavioral Therapy and/or mindfulness techniques (more information can be obtained once inside the app) and snus use can be reduced more abruptly.
8. Gustav is directed to the main dashboard, where he can start using various features to assist in his goal of quitting snus.

	Continued on next page
Alternative Scenarios	1. If Gustav enters an email address that is already in use, the application informs him and prompts him to either log in or use a different email address. 2. If Gustav's internet connection is lost during the profile creation process, the application saves the entered information and prompts Gustav to complete the process once the connection is restored. 3. If Gustav decides not to provide some optional information, the application allows him to skip certain steps but reminds him that providing more information can lead to a more personalized experience.

Table 5.3: Use Case 2: User Records Snus Usage

Use Case 2	Record Snus Usage
Use Case Goal	To allow Gustav to log each instance he uses snus, capturing his emotional state and the context of the activity during the usage, to provide support and insights of his quitting journey.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav knows how to register snus usage on ExSnus.
Basic Scenario	1. Gustav uses snus and wants to register it on ExSnus. 2. Gustav opens ExSnus and clicks the 'add' button from the main menu. 3. The application directs him to a new screen where he can select several options to register, including having taken snus and having overcome a craving. 4. Gustav selects the 'Snus use' option and is then presented with a list of emotions to choose from, reflecting what he was feeling when he decided to take snus (e.g., stressed, bored, sad). 5. After selecting the emotion, he can also indicate the activity he was engaged in when taking the snus from a list (e.g., studying, drinking, socializing). 6. Gustav submits his inputs, and the application logs the information provided to display it in the dashboard.

Alternative Scenarios	1. If Gustav accidentally clicks the 'add' button, there should be an option to cancel the entry. 2. If Gustav is unsure about how he felt or what he was doing, the selection should be optional. Following this choice, the application could provide a gentle reminder for him to pay more attention to his emotions and activities during future instances to help recognize triggers. 3. If the application fails to save Gustav's entry due to a technical issue, it should notify him of the error and prompt him to try again.

Table 5.4: Use Case 3: User Records Craving Overcame

Use Case 3	Record Craving Overcame
Use Case Goal	To allow Gustav to log each instance he overcomes a snus craving, capturing his emotional state, the context of the activity during the craving, and any method he used to resist the craving, to provide support and insights of his quitting journey.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav knows how to register overcoming a craving on ExSnus.

Basic Scenario	1. Gustav experiences a snus craving but successfully resists it and wants to register in on ExSnus. 2. Gustav opens ExSnus and clicks the 'add' button from the main menu. 3. The app directs him to a new screen where he can select several options to register, including having taken snus and having overcame a craving. 4. Gustav selects the 'Overcame craving' and is then presented with a list of emotions to choose from, reflecting what he was feeling when he felt the craving (e.g., stressed, bored, sad). 5. After selecting an emotion, he can also indicate the activity he was engaged in at the time of the craving from a list (e.g., studying, drinking, socializing). 6. Next, Gustav can select how he managed to overcome the craving, including default choices like breathing exercises or drinking water. There is also an option for Gustav to add and save new methods that have worked for him, including the use of nicotine medication or other personal strategies. 7. Gustav submits his inputs, and the application logs the information provided to display it in the dashboard.
Alternative Scenarios	1. If Gustav accidentally clicks the 'add' button, there should be an option to cancel the entry. 2. If Gustav is unsure about how he felt or what he was doing, the selection should be optional. Following this choice, the application could provide a gentle reminder for him to pay more attention to his emotions and activities during future instances to help recognize triggers. 3. If the application fails to save Gustav's entry due to a technical issue, it should notify him of the error and prompt him to try again.

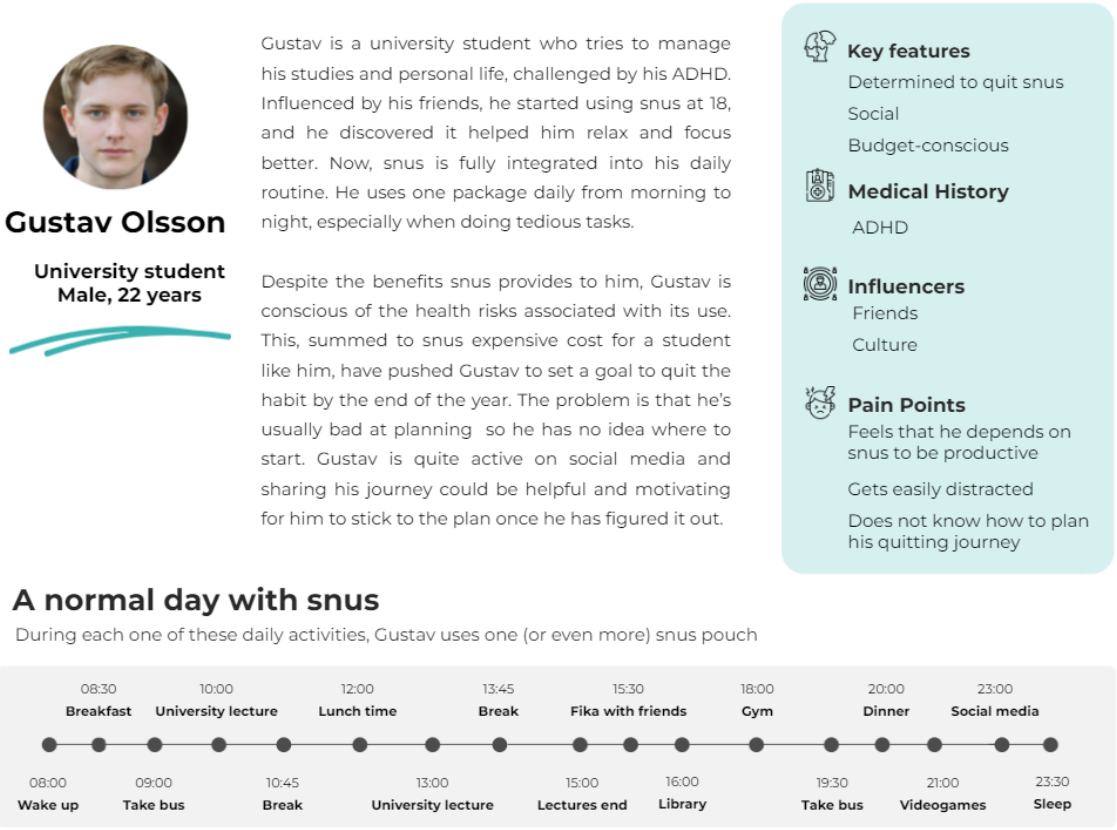


Figure 5.1: Persona that represents a potential user of the project's app. The image of the persona was generated using the website This Person Does not Exist[11]. The layout was created based on a template from Visme[12]and the icons were from Flaticon[13].

Table 5.5: Use Case 4: User Visualizes Dashboard

Use Case 4	Visualize Dashboard
Use Case Goal	To provide Gustav with a visual representation of his progress in quitting snus, including data on his usage, emotional triggers, activities, savings, and goal (if provided) progress, to motivate and guide him through his quitting journey.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav has registered snus used and cravings overcame in ExSnus. 3. Gustav has set a quit date and possibly a financial goal and motivation related to quitting snus.
Basic Scenario	1. Gustav opens ExSnus, and the main screen contains the dashboard. 2. The dashboard displays his avatar, which, when clicked, takes him to his profile. Below the avatar, there are the main goals of Gustav, if provided. These goals include his set quitting date and his motivation for quitting, which is prominently displayed as a reminder and source of inspiration. Additionally, the saved money from not purchasing snus is also displayed, along with a progress bar toward his financial goal if he has set one. 3. Below this information, a graph shows his snus consumption over the week, with an option to switch to a monthly view. 4. Pie charts provide insights into his emotional states and activities at times when he typically uses snus, aiding him in identifying patterns and triggers. Moreover, the main activities that help him overcome cravings are also displayed for him to learn what works for him to reduce snus use. 5. At the end of the week, the graph includes a summary comparing his current week's snus usage to the previous week, informing of the percentage of increase or decrease of snus use compared also to his consumption before starting the quitting process. If there is an increase in usage, the application provides a message encouraging Gustav to review and utilize his strategies for overcoming cravings.

Alternative Scenarios	1. If Gustav has not logged any snus usage or craving overcame, the application indicates him that there is a lack of data and encourages him to log activities to get personalized insights. 2. If Gustav has reached his quit date, the dashboard updates to celebrate his achievement and transitions to support his maintenance phase, continuing to track his progress and emotional states. 3. If the application detects a significant improvement in Gustav's snus usage patterns, the dashboard highlights this success, and the application offers congratulatory feedback, reinforcing positive behavior.

Table 5.6: Use Case 5: User Visualizes Timeline

Use Case 5	Visualize Timeline
Use Case Goal	To enable Gustav to view a comprehensive timeline of his quitting journey, showcasing his snus usage, cravings he overcame, milestone achievements, withdrawal symptoms, and health improvements, to motivate and provide insights into his progress.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav has registered snus used and cravings overcame in ExSnus.

Basic Scenario	1. Gustav accesses the timeline feature within the application from the main menu. 2. The timeline displays a chronological sequence of events: each instance of snus usage, moments when he overcame a craving, and the achievement of key milestones (like 1 week, 1 month, and subsequent months without snus). 3. Alongside these events, there is another tab that switches to a different timeline showing withdrawal symptoms extracted from scientific literature, helping Gustav understand the correlation between his physical experiences and his quitting journey. This second timeline also illustrates health improvements over time, based on general expectations of recovery and healing from snus usage. 4. Gustav can interact with the timeline, clicking on events or milestones to get more details or insights, including the details of the logged snus use and craving overcame, and more in-depth information about health benefits and withdrawal symptoms. 5. When clicking on a withdrawal symptoms, more in depth information about the symptom extracted from scientific literature is displayed. Alongside it, there is educational content on nicotine replacement therapy and mindfulness therapy with links to reliable sources offering further information online about these therapies.
Alternative Scenarios	1. If Gustav has not logged any recent activity, the timeline only shows milestones, withdrawal symptoms, and health benefits if existing for that week. 2. In case of reaching a new milestone, the application congratulates Gustav, reinforcing his achievements and motivating him to continue his journey.

Table 5.7: Use Case 6: User Engages with Social Features

Use Case 6	Engage with Social Features
Use Case Goal	To enable Gustav to share his quitting journey achievements and statistics with others, both on external social media platforms and within the mobile application's community forum, making him feel supported.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav has achieved milestones or statistics that he wants to share. 3. Gustav has other social media and is willing to engage with the mobile application's forum.
Basic Scenario	1. The application offers Gustav options to share his achievements and statistics on external social media or on the application's dedicated forum from the dashboard or the timeline. 2. If Gustav chooses to share on external social media, the application generates a shareable graphic or message highlighting his achievements, which he can post directly to his social media accounts. 3. If Gustav opts to share within the ExSnus's forum, he can create a new post, attach his achievements and statistics, and add any additional text, like a message sharing his experiences or asking for advice. 4. Gustav can also create a new post by accessing the forum from the main menu and then clicking on the button to create a new post at the top of the forum's screen. 5. Other users can view Gustav's posts in the forum, react to them, and engage in conversation, offering support, sharing their experiences, or providing tips, on the post's comment section. 6. Gustav can visualize on the forum's screen the posts created by other users, react to them, and engage in conversation.

Alternative Scenarios	1. If Gustav starts a post by accident on the forum, he can cancel the process. If he wants to edit or delete a post that is already created, there are tools to do so. 2. If Gustav faces technical issues while trying to share his achievements, the application provides troubleshooting tips and allows him to save his post to share later. 3. If Gustav receives negative feedback or encounters a discouraging interaction on the forum, the application offers tools for reporting inappropriate behavior.

Table 5.8: Use Case 7: User Manages Their Profile

Use Case 7	Profile Management
Use Case Goal	To enable Gustav to personalize his profile settings, including his quit date, motivational message, financial goal, notification preferences, light or dark mode, and avatar.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav knows how to access his profile.

Basic Scenario	1. Gustav taps on his avatar on the dashboard to access his profile settings. 2. In the profile section, he sees several options: • Modify the end date for snus use. • Update his motivational message. • Adjust his financial saving goal. • Turn notifications on or off. • Switch between light mode and dark mode. • Change his avatar. • Access and adjust other basic tools and settings, such as the app's language, and the account email and password. 3. Gustav selects and modifies his end date for quitting snus, ensuring it reflects his current goals. 4. He updates his motivational message to something that currently resonates with his journey. 5. Gustav adjusts his financial saving goal based on his progress or changing aspirations. 6. He chooses his preferred notification settings and switches to dark mode for a more comfortable visual experience in low-light environments. 7. Gustav changes his avatar to a new image that he feels represents his journey or current mood. 8. After making the desired changes, Gustav saves his updated settings, which are immediately reflected in his app experience.
Alternative Scenarios	1. If Gustav faces technical issues while trying to update his profile, the application provides troubleshooting tips. 2. If Gustav is unsure about the implications of certain settings (like turning off notifications), the application provides brief descriptions explaining what each setting does and how it might affect his experience and progress.

Table 5.9: Use Case 8: User Receives Notifications

Use Case 8	Receive Notifications
Use Case Goal	To provide Gustav with timely and relevant notifications about his milestones, forum engagement, and progress updates, encouraging continuous engagement and motivation throughout his quitting journey.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into the app. 2. Gustav has enabled notifications in his profile settings.
Basic Scenario	1. If Gustav reaches a milestone (e.g., one week without snus), ExSnus sends a notification congratulating him on his progress and encouraging him to review his health benefits and withdrawals. This notification takes Gustav to the 'Timeline' screen. 2. When another user interacts with his post or comments on the forum, Gustav receives a notification, prompting him to view the interaction and engage with the community. This notification takes Gustav to the 'Community' screen. 3. At the end of each week, ExSnus notifies Gustav that a summary of his weekly progress is available, encouraging him to review his achievements and areas for improvement. This notification takes Gustav to the 'Weekly report' screen. 4. As Gustav approaches his set quit date or reaches it, ExSnus sends a notification reminding him of the upcoming date, reinforcing his commitment to quitting. This notifications takes Gustav to the 'Dashboard' screen. 5. If Gustav is close to reaching his financial goal related to saving money by not purchasing snus or reaches it, ExSnus notifies him to acknowledge his progress and motivate him further. This notifications takes Gustav to the 'Dashboard' screen. 6. The chatbot periodically sends notifications to Gustav asking about his well-being to prompt a conversation. This notification takes the user to the 'Chatbot' screen where the question appears written in the chat.

Alternative Scenarios	1. If Gustav chooses to disable notifications temporarily, the application stops sending notifications.

Table 5.10: Use Case 9: User Chats with AI Counselor

Use Case 9	Chat with AI Counselor
Use Case Goal	To provide Gustav with immediate support and guidance through an AI-driven chat feature, helping him address concerns, receive advice, and maintain motivation throughout his quitting journey.
Primary Actor	Gustav Olsson, 22-years old student.
Preconditions	1. Gustav has a profile and has logged into ExSnus. 2. Gustav knows how to access the AI counselor chat.
Basic Scenario	1. Gustav feels the need for support or has questions about his quitting process. 2. He opens ExSnus and clicks on the chat icon to initiate a chat with the AI counselor. 3. The AI counselor greets Gustav and encourages him to share what is in his mind or ask questions. Suggested questions are also available to click. 4. Gustav interacts with the AI chatbot, sharing his thoughts, concerns, or questions, by writing on the chat or using his voice. 5. The AI chatbot processes Gustav's input and provides feedback, advice, or motivational messages based on his inquiries. 6. The conversation continues as needed to support Gustav's quitting journey. 7. Gustav ends the chat session when he feels satisfied with the interaction or has received the help he needed. 8. Alternatively, the chatbot sends regular notifications to Gustav asking about his well-being, if enabled the function.

Alternative Scenarios	1. If the AI counselor cannot adequately address Gustav's concerns due to the complexity or specificity of the issue, the application should suggest Gustav to seek advice from a human professional or provide resources for further assistance. 2. If Gustav does not enable the application's notifications, the chatbot does not send prompts asking about his well-being.

A UML case diagram, depicted in Fig.5.2, was created to represent the functionalities defined in the use cases, as well as the interactions between the users of ExSnus and the ExSnus system itself. Several existing diagrams of similar processes from other studies were used as inspiration, including the diagram of a forum discussion [99], a chat bot [100], and mobile application's notifications [101].

5.5 App Design

After defining the functionalities of ExSnus through use cases, these were translated into visual elements across various screens. Initially, rough hand-drawn sketches were made to capture all the essential features to ensure that ExSnus contained every defined functionality. These sketches were then translated into a digital wireframe. This wireframe include basic gray-scale screen components like buttons, main text, image placements, and various screen statuses such as error messages as well as all the inter-screen connections, showing the logic behind the mobile application's functioning. Finally, the main screens were refined into visually appealing designs to be used as the interactive click model during usability testing.

5.5.1 Sketches

The initial sketches were drawn to fulfill the requirements of each use case. These sketches contain the main basic screens and the connections between them, as well as some comments of special cases or design elements. An example can be found in Fig.5.3. The rest of sketches are displayed in section A.3.1 of the Appendix.

5.5.2 Wireframe and Functionalities of ExSnus Depicted by Screens

The created wireframe connects all existing screens in low-level detail through the buttons and presents the different statuses some screens can have. The design of these screens was inspired by various sources. Indications were followed for placing screen elements such as personal settings or navigating elements [102], as well as

[17] VisualParadigm Online

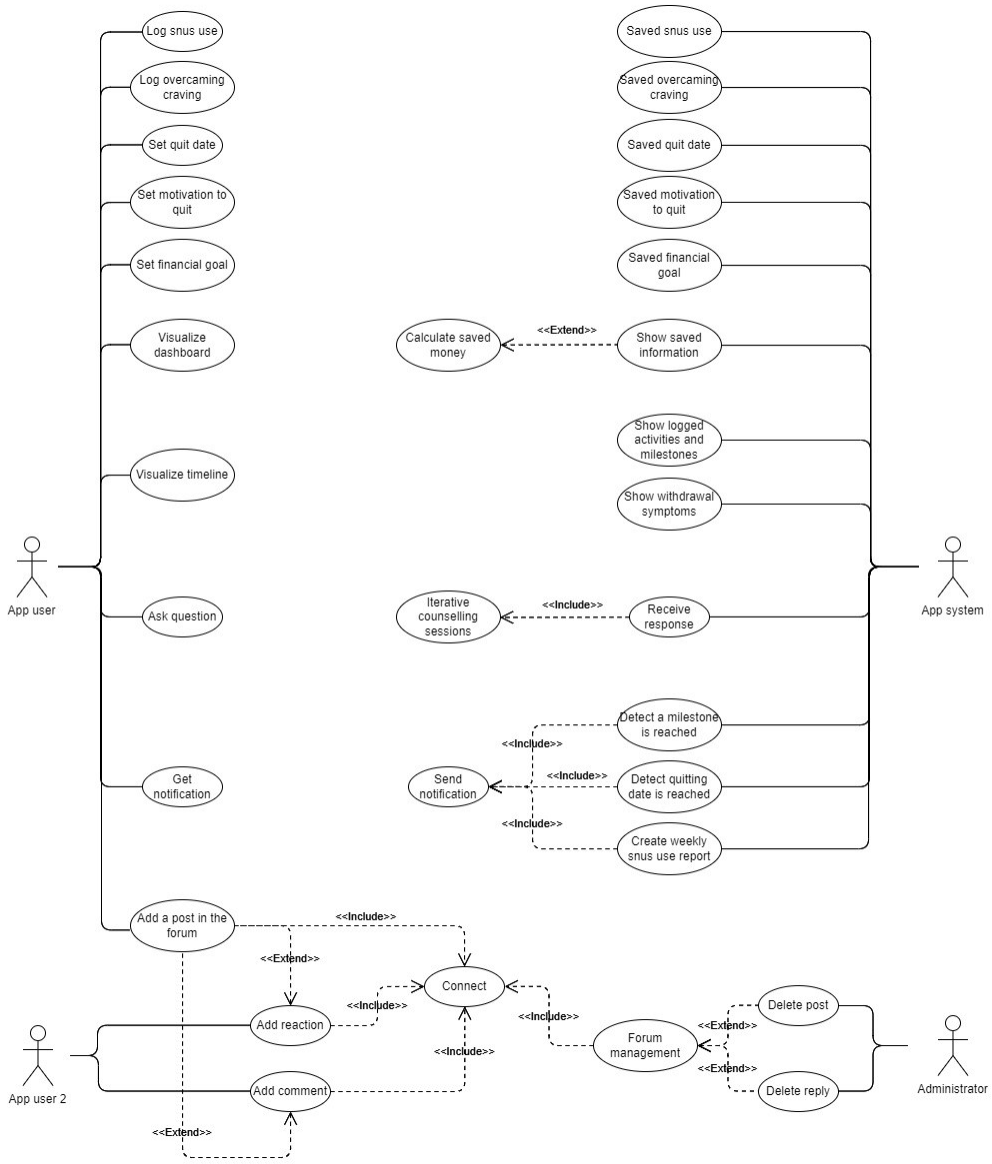


Figure 5.2: UML use case diagram for ExSnus. It was drawn using the Visual-Paradigm Online tool[17].

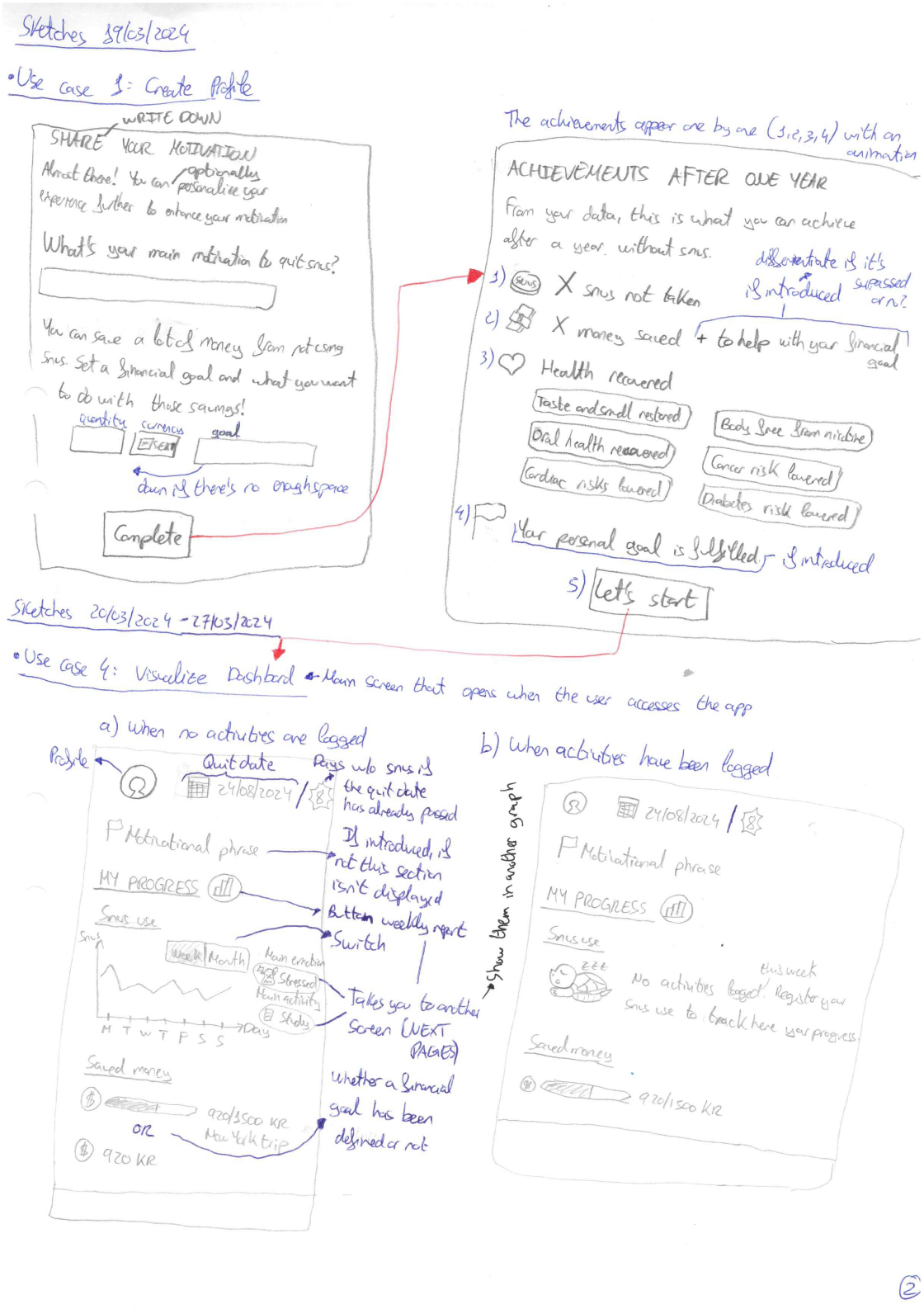


Figure 5.3: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

for displaying specific elements like multiple-option choices [103] and error messages [104] to enhance user experience. Furthermore, the screens related to the timeline, the forum and the application's settings were based on existing designs found online using the key search words "Timeline mobile app design", "Forum mobile app design", and "App settings design".

In this document, the application's wireframe is presented divided in the functionalities of each use case. Due to its large size, the entire wireframe cannot be properly included in a single figure, thus it can be accessed through the link provided in the Appendix section A.3.2.

5.5.2.1 Screens Corresponding to Use Case 1: Create Profile

After downloading and opening ExSnus for the first time, the user is presented with a series of screens to set up their profile, corresponding to the Use Case 1 presented in Table 5.2.

The screens are displayed in Fig.5.4 and follow this order:

1. Initial welcoming screen congratulating the user for starting the snus cessation journey.
2. Screen with input fields for the user's name, email, and a password that meets certain requirements. These fields are mandatory; the user cannot move forward without completing them. An error message is displayed if the user tries to proceed without filling in all fields.
3. Screen with input fields for the user's snus consumption and costs, allowing the choice of different currencies. These fields are also mandatory, and an error message is displayed if the user tries to proceed without completing them.
4. Screen with an optional test about snus addiction that the user can complete to better assess their addiction level and receive a tailored quitting plan. The test was developed by Karl Fagerström based on [105] and can be found in Swedish in: Snus test - Swedish version. If the user does not desire to complete this test, it can also be skipped using the 'Skip' button.
5. Screen with optional questions about the user's motivation to quit or reduce snus use. This includes setting a goal date to quit, a main motivation to quit, and a financial goal for money saved by not using snus. These motivations are displayed each time the user accesses the app and can be modified later in the profile settings.
6. By clicking on the 'Complete' button from the previous screen, this screen opens displaying personalized information based on the user's previous answers to further motivate them:
   (a) In all cases, the screen gives information about the amount of snus avoided, health benefits, and money saved after a month of quitting.
   (b) If the user has answered the snus addiction set from point 4 of this list, this screen includes tips of how to quit based on the calculated addiction level. For instance, if the addiction level is high, ExSnus suggests to quit snus gradually and complement the use of the app with NRT.

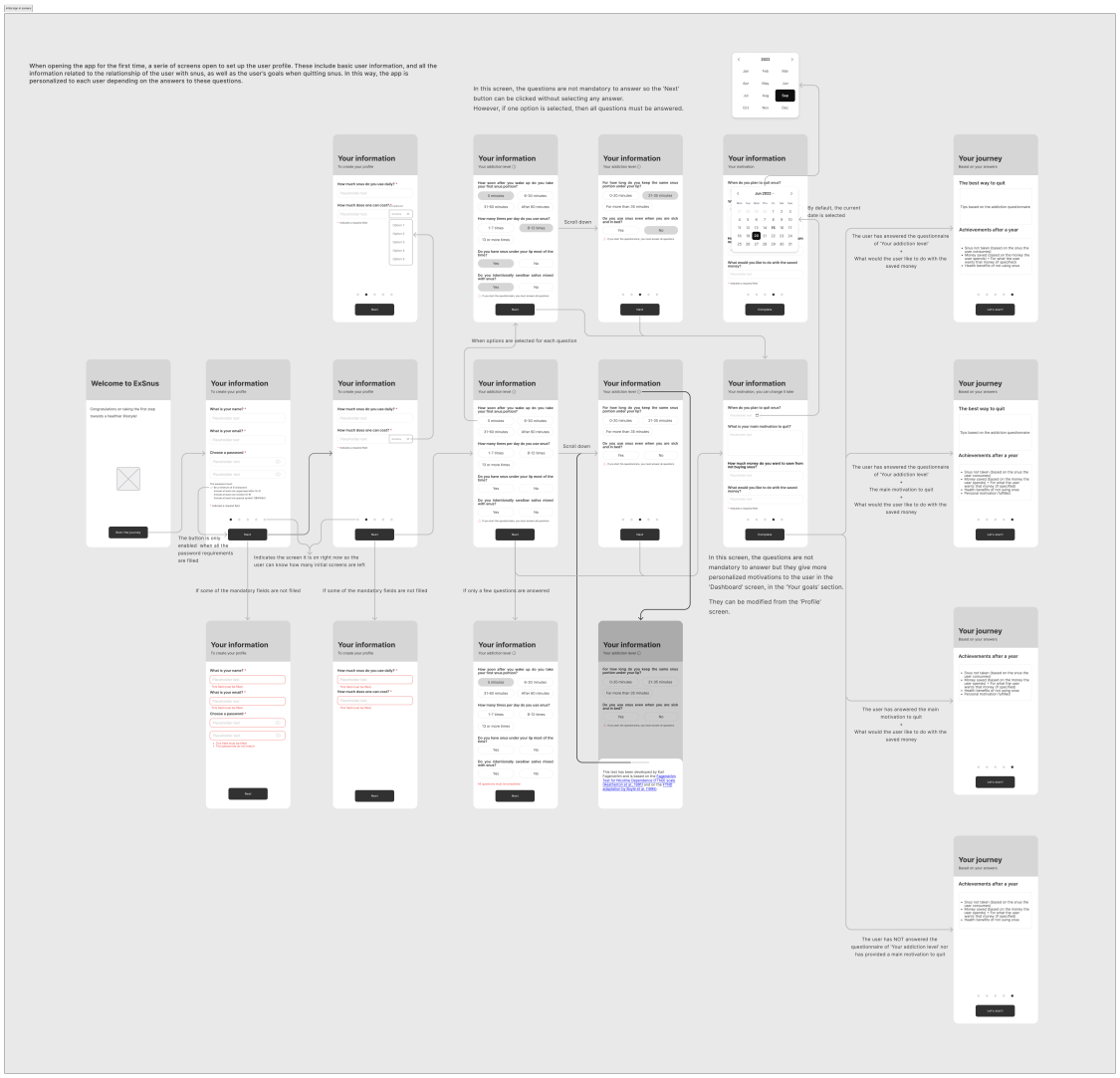


Figure 5.4: Wireframe section showing all the screens corresponding to the application functionalities of the Use Case 1, where the user sets the profile and enters information related to snus consumption and goals for the cessation journey.

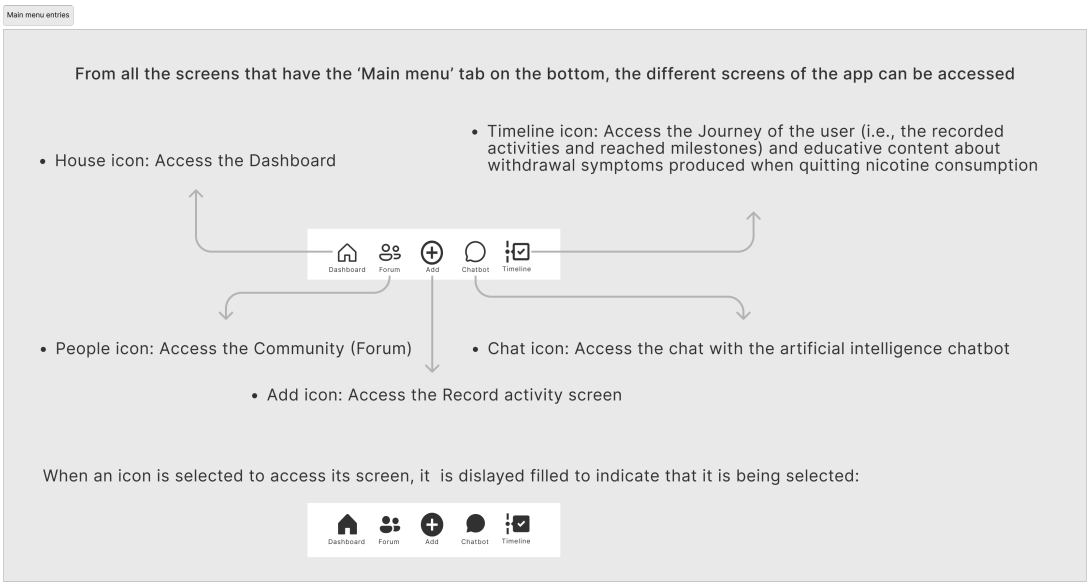


Figure 5.5: Wireframe section showing the main menu buttons and which screen they give access to, as well as how they look selected and unselected.

(c) If the user has set a main motivation, it is also displayed here as a reminder of the main personal reason to quit snus.

In this way, ExSnus personalizes the experience based on the user's answers, helping them start their snus cessation journey with motivation and a clear plan based on their addiction level.

5.5.2.2 Screens Corresponding to Use Case 2: Record Snus Usage and Use Case 3: Record Craving Overcame

Every time the user opens ExSnus after the initial setup, the default screen is the dashboard. This screen includes a main menu to access all other primary screens of the mobile application, including the forum, records of snus use or cravings overcome, the chatbot, and the timeline. The main menu functionality is shown in Fig.5.5.

Clicking on the 'Add' button from the main menu opens the screen to record both instances of snus usage and occasions when the user feels a craving but overcomes it. This functionality is shown in Fig.5.6. By default, the screen to register snus usage, called 'Snus use', is open. Here, the user can click the 'Save' button to record the activity, which will then appear in the statistics on the Dashboard screen (see subsection 5.6.2.3) and the Timeline screen (see subsection 5.6.2.4). The user can also add optional details by answering how they feel when using snus and what activity they are doing. There are four basic answers for each question, plus an 'Other' option for additional feelings or activities the user wants to register. These answers are then displayed on the dashboard as percentages to help the user identify the main emotions and activities that trigger snus use, aiding in recognizing and avoiding potential triggers.

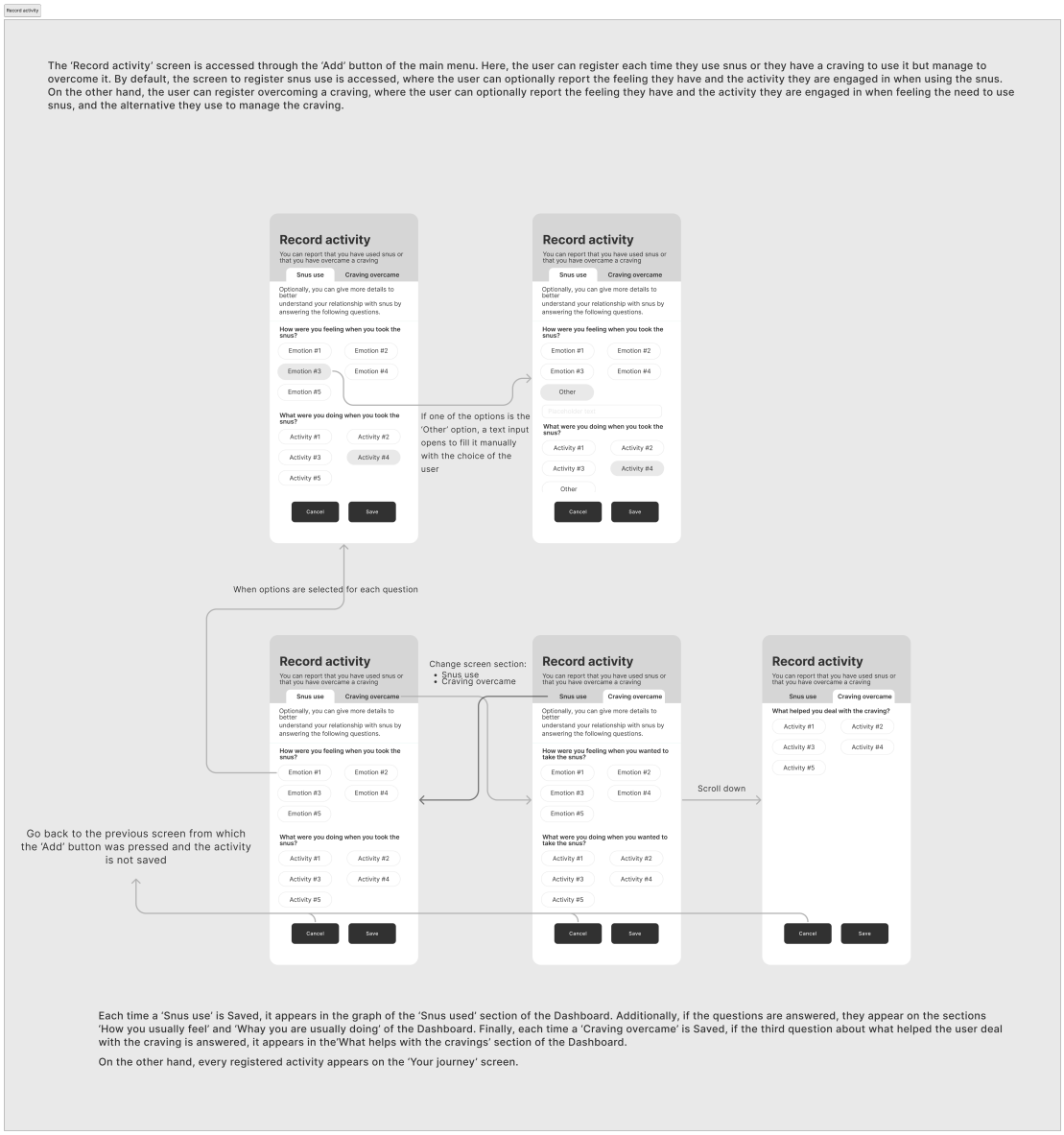


Figure 5.6: Wireframe section showing the screens for recording snus usage and cravings overcome.

Switching to the 'Craving overcome' screen allows the user to record when they successfully overcome a craving. Similar to the 'Snus use' screen, the user can record how they feel, what they are doing, and what helps them deal with the craving. This information is also shown on the dashboard, helping the user identify effective tools to use less snus. Both the registered snus use and cravings overcame appear in the Dashboard and Timeline screens, as mentioned before.

5.5.2.3 Screens Corresponding to Use Case 4: Visualize Dashboard

As mentioned above, the dashboard is the screen opened by default after the initial set up. Initially, when the user has not reported any activities, it appears mainly empty except for the reminder of the user's goals if they have been set, as shown in Fig. 5.7.

Once the user starts to record their snus use or their cravings overcome, the dashboard displays this information in different sections, as shown in Fig. 5.8:

1. A graph showing the quantity of snus used, displayed by month or week. Additionally, a button takes the user to another screen with a weekly report that updates at the beginning of each week. This report summarizes the weekly recordings, including the number of snus pouches used and cravings overcome, comparing this week's snus use to the previous week. Depending on the user's progress, the report includes a congratulatory message if usage has decreased or an encouraging message with advice on dealing with cravings if usage has increased.
2. A graph displaying the percentages of the registered feelings when using snus, highlighting the most common one.
3. A graph displaying the percentages of the registered activities when using snus, highlighting the most common one.
4. A graph displaying the percentages of the registered techniques used when successfully dealing with cravings, highlighting the most common one.

In this way, the user has all the important information to track their progress and better understand their relationship with snus on a single screen.

5.5.2.4 Screens Corresponding to Use Case 5: Visualize Timeline

Clicking on the 'Timeline' button from the main menu opens the timeline screen, which contains two different sections, as shown in Fig.5.9.

The default section is called 'Your progress' and it contains chronologically ordered entries for every time the user has recorded snus use or a craving overcome. Each entry includes the date and time, type of recorded activity (snus use or craving overcome), and the selected answers for emotions and activities, if any. Additionally, milestone achievements (e.g., one day, one week, one month, two months without snus) generate an entry indicating the milestone on the corresponding date. By

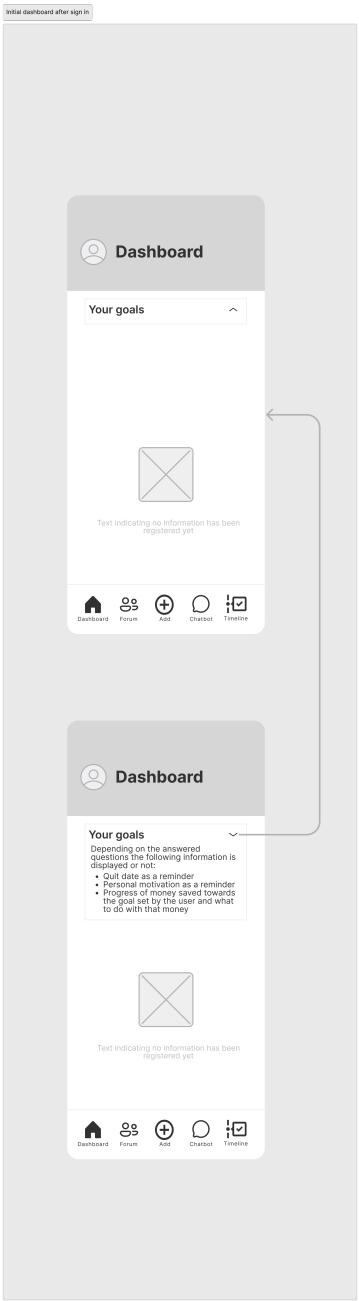


Figure 5.7: Wireframe section showing the dashboard screen's initial state when no activities have been registered yet.

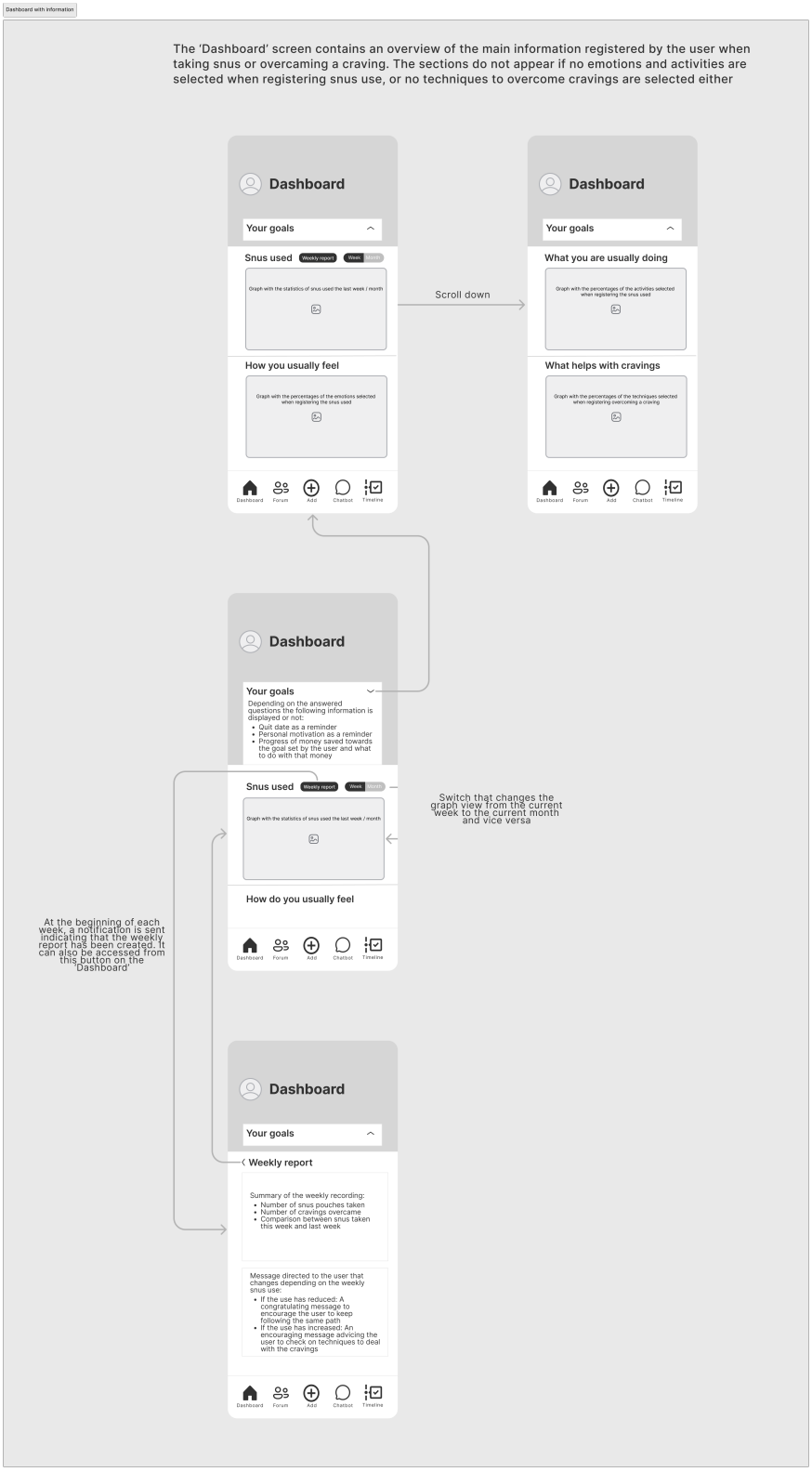


Figure 5.8: Wireframe section showing the dashboard screens.

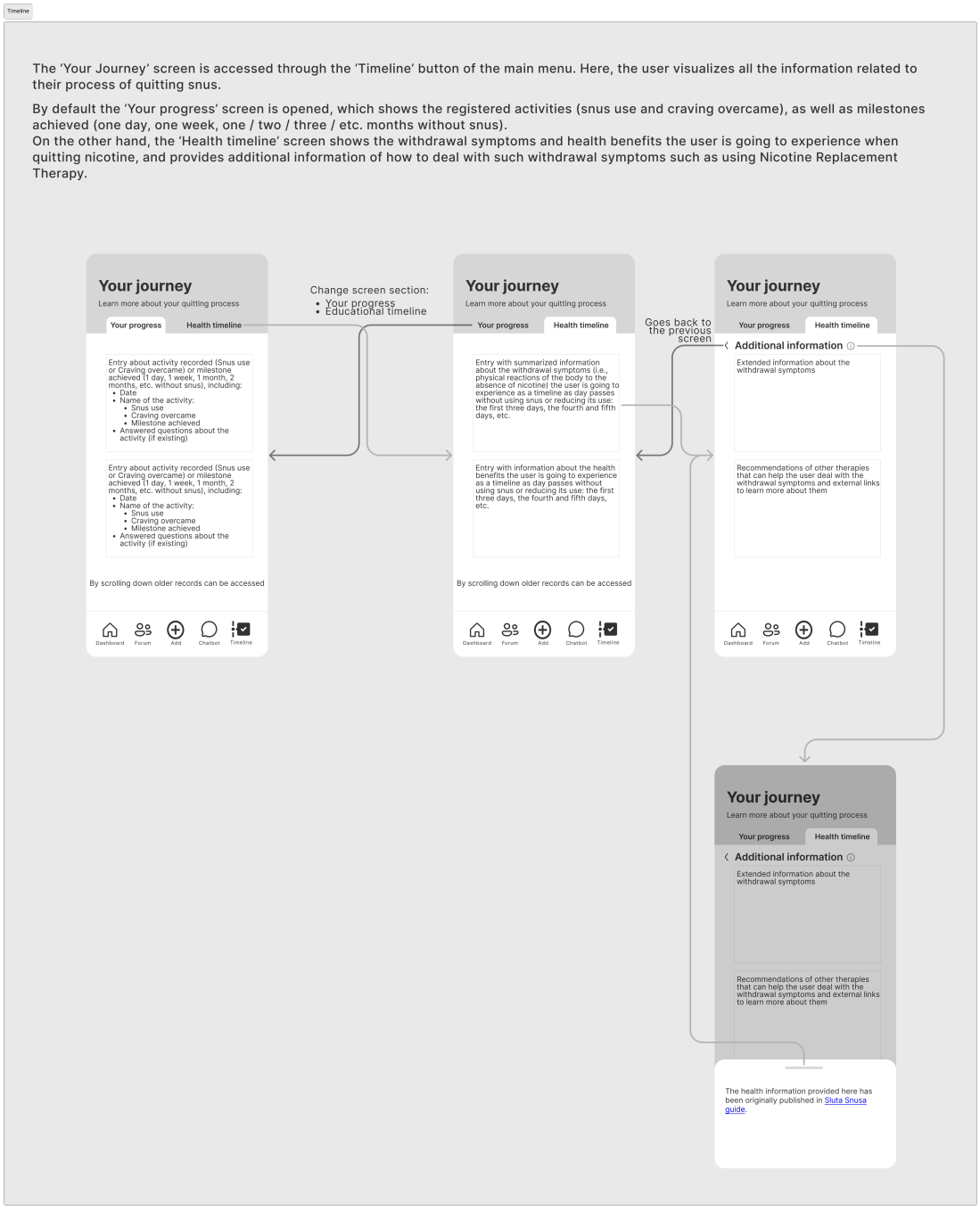


Figure 5.9: Wireframe section showing the timeline screens.

scrolling down, older recorded activities can be accessed.

The second section, 'Health timeline,' can be accessed by the user by clicking on its header. This section presents a chronological order of summarized withdrawal symptoms that appear when quitting snus, as detailed in Table 2.1, along with the health benefits obtained from quitting snus. Clicking on these entries provides more in-depth information about the withdrawal symptoms and recommendations for therapies, such as NRT or mindfulness, to help users manage them. The source of this health information is also provided to enhance its trustworthiness.

In this way, the 'Your progress' section helps users track their progress, similarly to the Dashboard screen, providing them with a comprehensive view of their journey and helping them identify patterns and triggers. The 'Health timeline' section educates users on the good and bad aspects of quitting snus, helping them be better prepared for the challenges of quitting and equipping them with tools to deal with withdrawal symptoms, thereby supporting their cessation efforts.

5.5.2.5 Screens Corresponding to Use Case 6: Engage with Social Features

Clicking on the 'Forum' button from the main menu opens the community screen, which contains two different sections, as shown in Fig.5.10. The main header provides access to forum notifications, a screen for creating a post, and a search bar for finding posts published in the forum.

The default section, called 'Feed', contains posts from all users of ExSnus, where others can interact by leaving likes or comments. Users can share posts or follow others to see their posts prioritized. Oppositely, posts can be hidden, users can be muted to avoid seeing their posts, and inappropriate behavior can be reported. In the 'Your posts' section, users can view and manage their own posts by sharing, editing, or deleting them. In this way, the community screen enables users to share their experiences during their quitting journey, provide tips, and create a sense of community, encouraging mutual support and engagement.

5.5.2.6 Screens Corresponding to Use Case 7: Profile Management

Unlike the other main screens, the user profile management is not accessed through the main menu buttons but by clicking on the user photo displayed on the header of the Dashboard screen. The profile screen, whose functioning is depicted in Fig.5.11, is divided into two main sections. At the top, the user can change their goals, including the goal quitting date, main personal motivation, and saving goals; that were answered in the initial set of questions when setting the user profile. Below, basic mobile application settings can be managed, such as turning notifications and dark mode on or off, changing the language, managing the email and passwords associated with the application, and logging out.

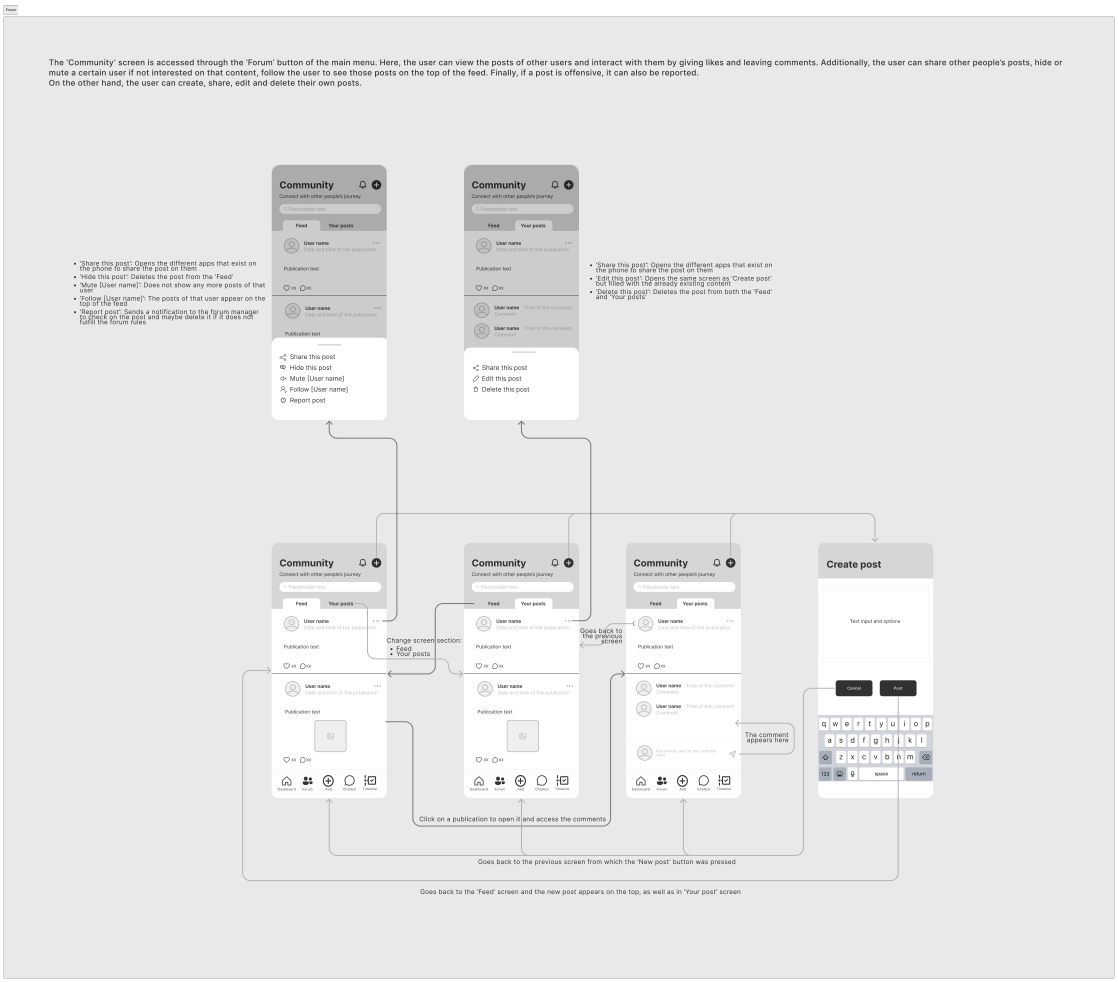


Figure 5.10: Wireframe section showing the forum screens.

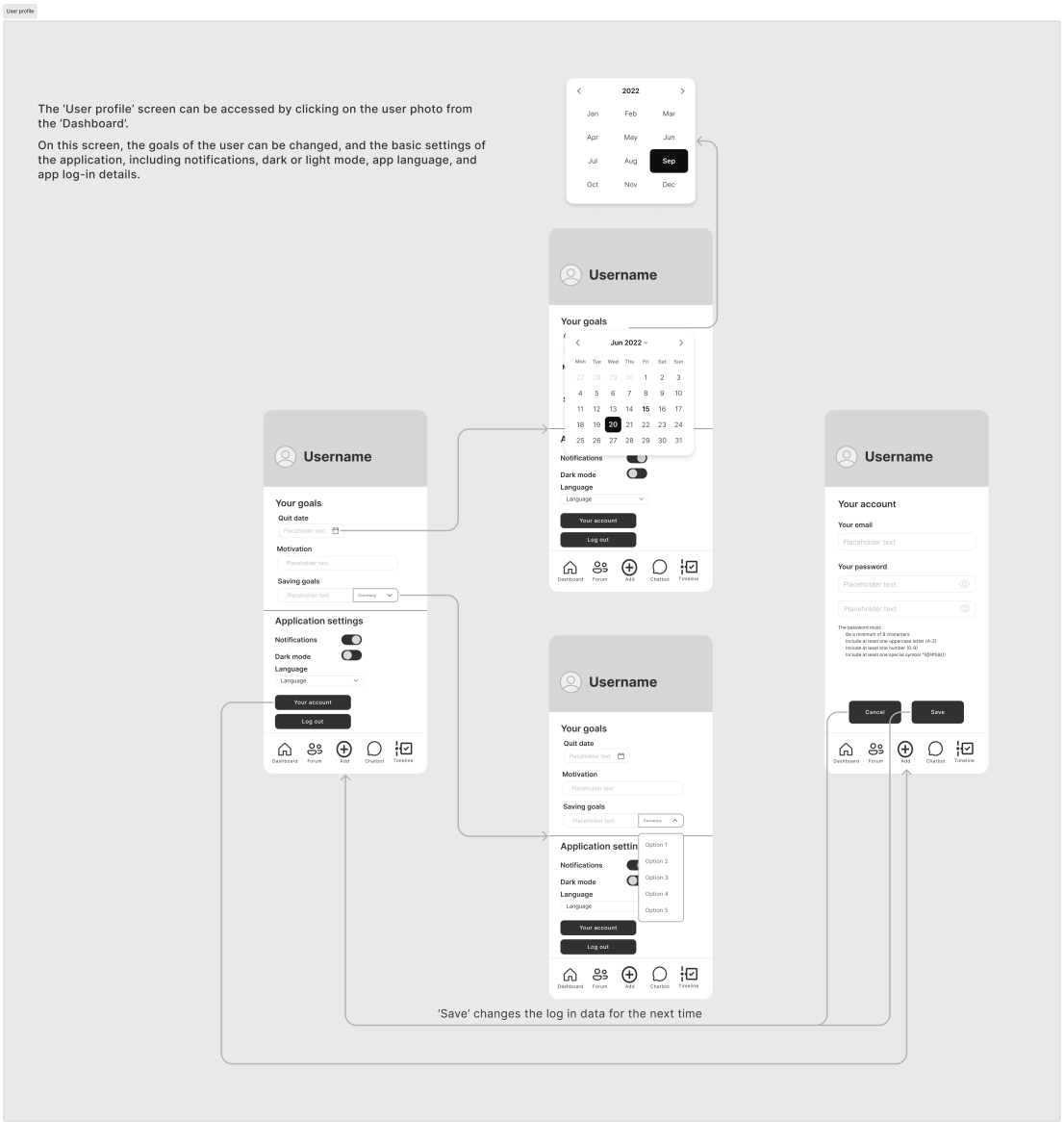


Figure 5.11: Wireframe section showing the profile screen.

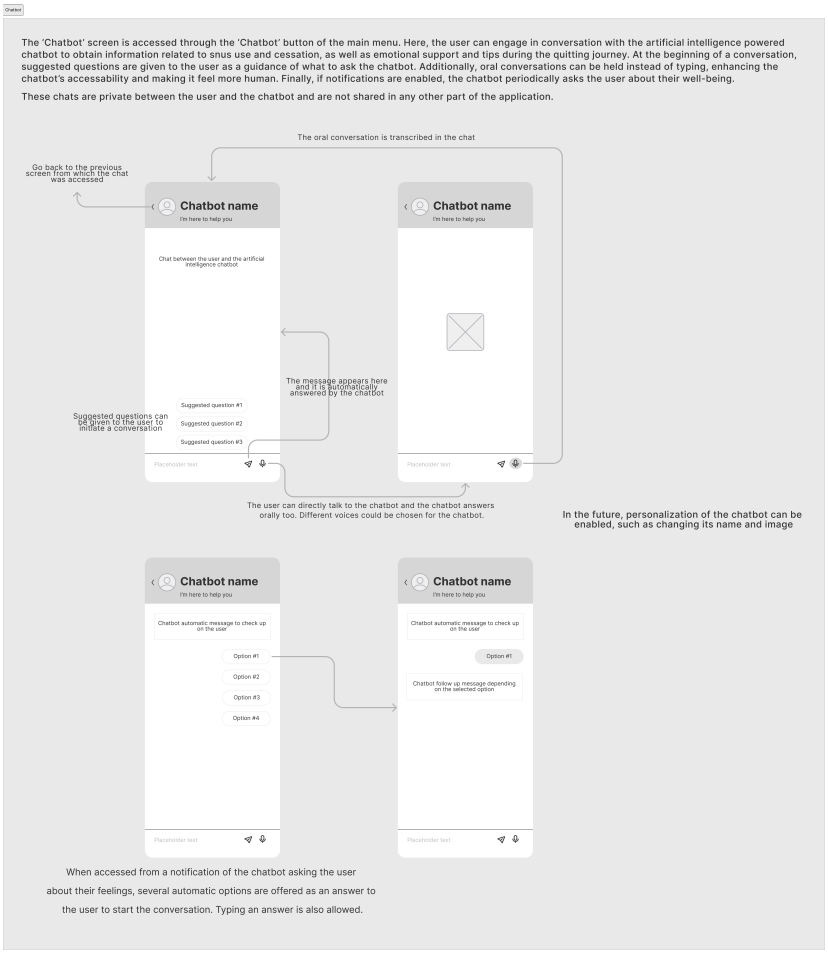


Figure 5.12: Wireframe section showing the AI chatbot screens.

5.5.2.7 Screens Corresponding to Use Case 8: Receive Notifications

This section is not part of the screens themselves, as the design will follow a basic notification design shown on the phone screen whenever the user is using another platform. In case the application notifications are enabled, these are sent in different occasions listed in Table 5.9.

5.5.2.8 Screens Corresponding to Use Case 9: Chat with AI Counselor

The chat with the AI counselor functions like a regular chat but with the unique feature that the user interacts with an AI algorithm designed to assist with questions or concerns during their quitting journey. In addition to normal typing, proposed questions are displayed to guide the user on what types of questions can be asked to the chatbot. Moreover, users can engage in an oral conversation with the chatbot instead of typing and choose a voice tone for it, thereby enhancing accessibility. If notifications are enabled, the chatbot periodically asks about the user's well-being. The user can respond to these notifications by typing or selecting from a few default questions to start a new conversation.

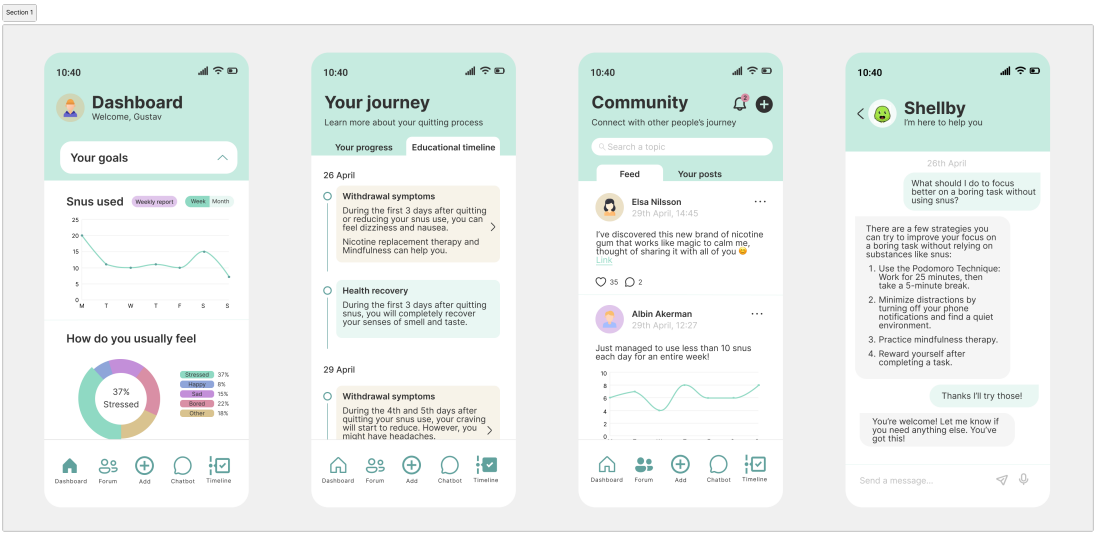


Figure 5.13: Example of some main screens from the app final design. From left to right: Dashboard, Timeline, Forum, and AI chatbot.

5.5.3 Iteractive Digital App Prototype

After placing all the functionalities of ExSnus in different screens and connecting them through the wireframe, a more detailed design was created for the main screens to be used in the usability testing. For this design, general tips to design healthcare apps were followed, such as choosing of colors that reduce anxiety and add credibility [58, 106], selecting text font to improve readability [106], and implementing visual hierarchy for different texts and images displayed on the screen [107].

Fig. 5.13 displays several main screens designed for this interactive prototype, based on the wireframe. Additional screens can be accessed through the link provided in Section A.3.3 of the Appendix, which allows the reader to interact with the connected prototype on their device. Most visual elements were chosen based on existing UI tips for both accessibility and visual appeal, such as font type and color [108], and the application's color palette [109, 110, 86].

5.6 Usability Test Analysis

This section presents an analysis of the usability testing conducted to evaluate the application's functionality and user experience. The analysis is based on the feedback collected from participants through questionnaires and interviews, as well as the results from the SUS questionnaire. The insights gained from this testing phase highlight both the strengths and areas for improvement in the design of ExSnus. By examining them, ExSnus is refined to better meet user needs and ensure a more intuitive and engaging experience.

5.6.1 Results from the Questionnaire and the Interview

Usability testing for ExSnus involved six participants aged 23 to 28, including four females and two males, all university students in Sweden. Their lifestyles and tech usage provide a comprehensive perspective on the application's functionality and user experience. Some participants have experience with snus and cigarettes, while most use alcohol occasionally. On average, they use their smartphones for four to six hours daily and are active on several social media platforms. Most have used other mobile applications to manage aspects of their health before, especially to track their physical activity. All participants have previous experience interacting with artificial intelligence chatbots, mainly to obtain assistance in their studies. Additionally, some have tried to change other unhealthy habits, usually independently and sometimes through seeking professional guidance, and have achieved notable success. This background gives them the necessary skills to understand beforehand the purpose of ExSnus and facilitate its use.

From the Think Aloud process, several key insights were extracted:

1. Users appreciated the initial questionnaire as it made them feel ExSnus would be personalized for them.
2. Initially, some users were unsure about defining a quit date since they had not started their quitting journey yet, so enabling its edition later is useful.
3. Users welcomed multiple-choice questions over written responses as they are faster and smoother to answer, making the initial questions feel shorter.
4. Reminders of goals and achievements motivate users, especially the monetary benefits of not buying snus.
5. Preferences varied on the display of timelines: some users wanted a combined view, while others preferred the current separated information.
6. Most users would engage more with the Forum if their friends were also using the app.
7. The Dashboard, which consolidates all information, was found useful by all users. Some noted it helps them compare different information.
8. Users should be able to decide the number of notifications and reminders from the chatbot to avoid feeling overwhelmed since some are not interested in frequent chatbot interactions.
9. Encouraging messages from the application were welcomed but should not be too long.

From the two questions asked to users after completing the given tasks, presented in the subsection 4.4 Usability testing, the key points were:

1. The Dashboard is the most used feature as users like to track their progress. Apart from the Dashboard, most users would also use the Timeline section to track progress and organize themselves, with the health information helping them understand what to expect in the coming days.
2. Between the Chatbot and the Forum, some users prefer the forum for interacting with real people, seeing their stories, and discussing specific topics like

emotions during quitting. Others prefer the chatbot for privacy on sensitive topics like snus addiction. Therefore, keeping both options is reasonable.

3. Communication preferences with the chatbot vary: some users prefer writing while others prefer voice due to its accessibility. Those who prefer writing often find talking to a 'machine' weird. Thus, user interactions with the chatbot depend on their view of AI assistance. Tools to personalize the chatbot are welcome by some users but considered unnecessary by others.

5.6.2 SUS questionnaire

The answers given to the SUS questionnaire generally indicate that the evaluated system has good usability, as depicted in Fig.5.14. First, on the left plot, the concentration of SUS scores represented as dots positioned in the high 80s suggest that most users found the system highly usable. The scores mainly fall within the 'Best Imaginable' and 'Excellent' range on the color-coded chart, which indicates a well-received user interface. The steep percentile curve, especially sharp around the 70-80 score mark, shows that these scores are significantly better than those typically seen in other SUS assessments. Finally, most response bars are dominated by green, indicating agreement with the system's positive attributes, particularly in questions 2, 4, 8, and 10, which are related to the system difficulty of use and if previous knowledge or assistance is necessary. However, there is a higher variability in responses to questions like 1, 5 and 7, which indicates mixed user opinions related to the frequency of how often the users would like to use the system, the integration of the system functionalities and whether the system would be easy to use by others. These highlights potential aspects for improvement.

5.6.3 Design Modifications Based on the the Feedback Obtained of the Usability Testing

After gathering the user feedback from the Usability testing through the Think Aloud process, the changes presented in Table 5.10 were implemented in the design of ExSnus. However, further modifications require additional exploration with more users due to mixed reactions. These potential changes include the personalization of the AI chatbot by changing its name and image, which was well received by some users but considered unnecessary by others. The design of the 'Community' screen should also be reviewed because although most of the users found its use quite intuitive, some perceived the manner of creating posts confusing. A similar situation exists with the 'Dashboard' screen; despite all users liking it, the presentation of information may need adjustments. Lastly, the application's messages need a comprehensive review to address issues with some specific messages that some users found confusing or overly lengthy.

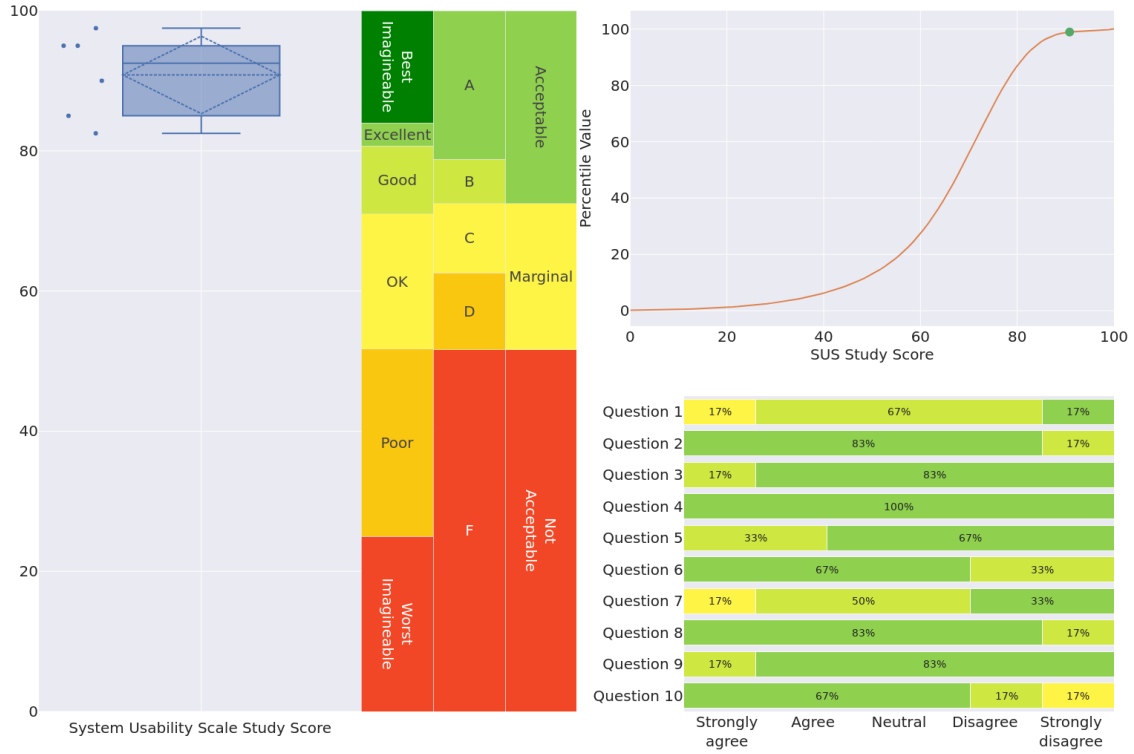
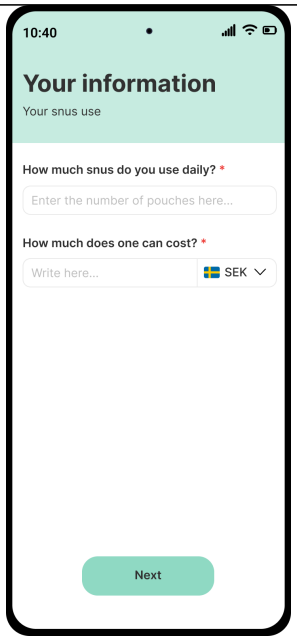
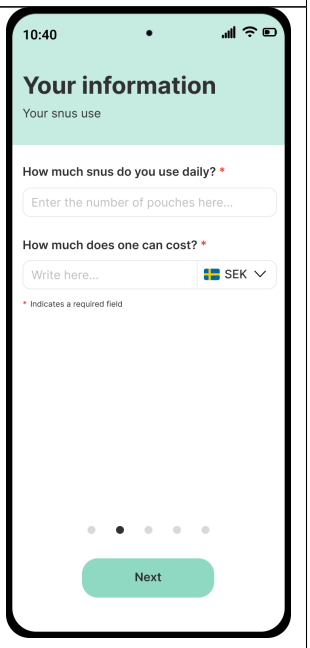
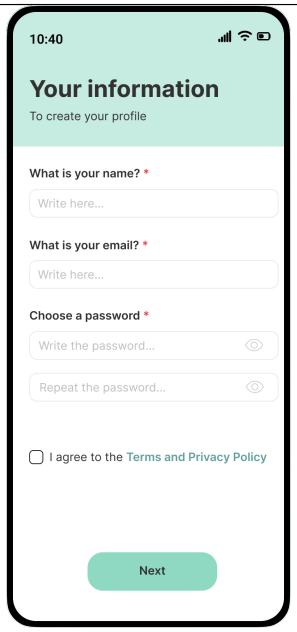
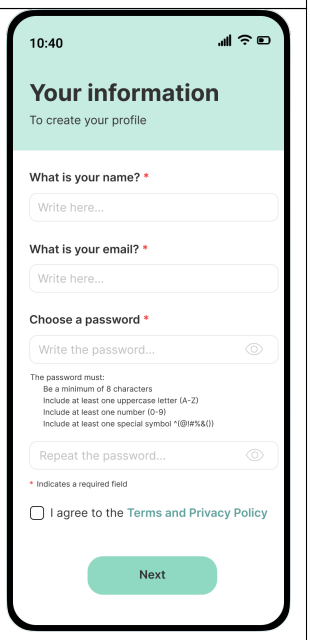
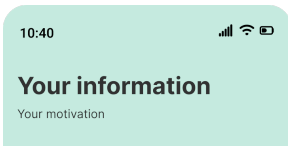
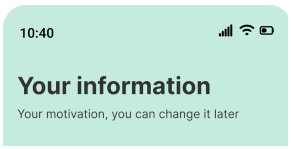
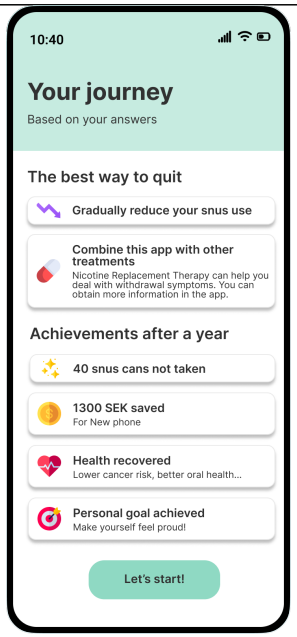
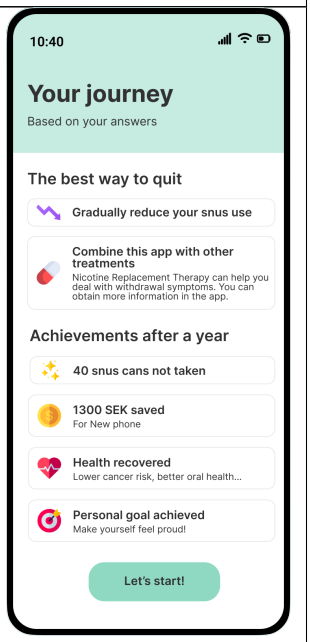
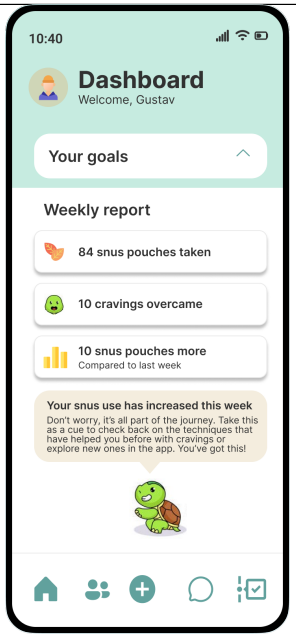
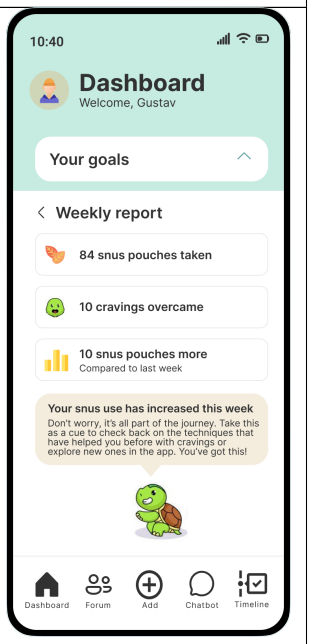
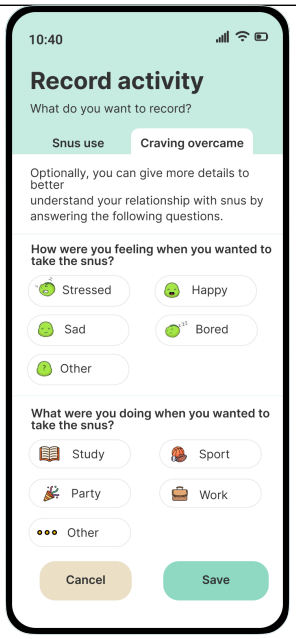
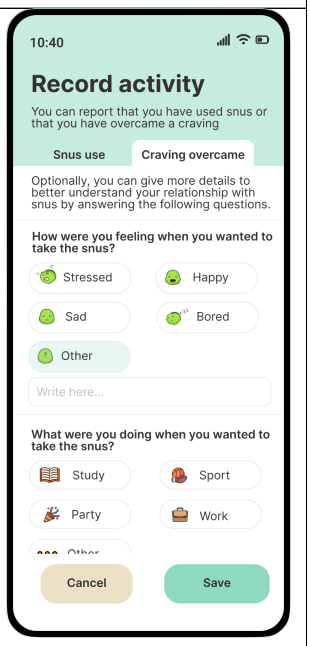


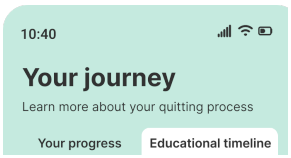
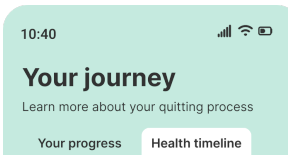
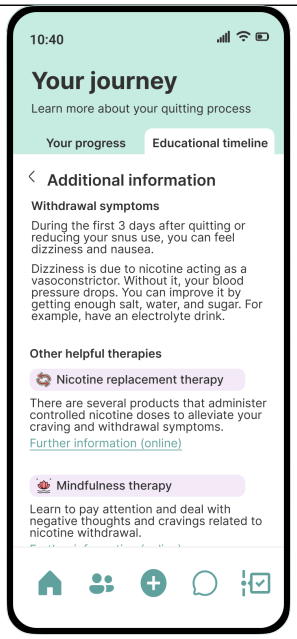
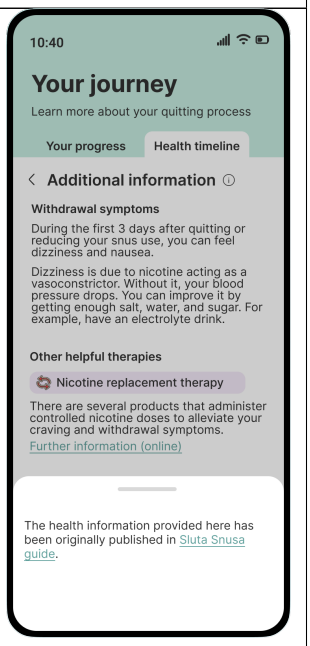
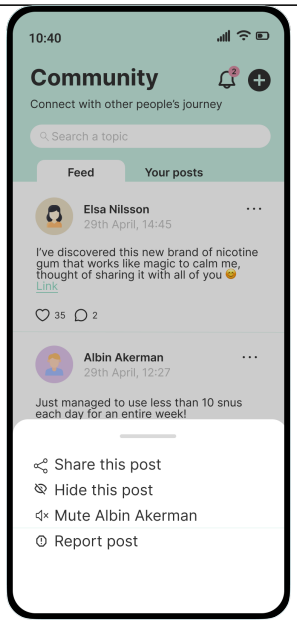
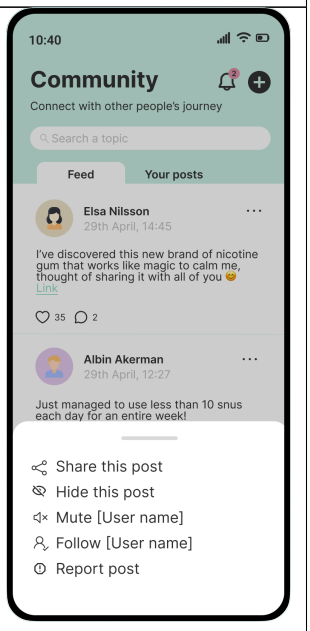
Figure 5.14: Usability Evaluation of ExSnus Using System Usability Scale (SUS)

Table 5.11: Changes Made in the Design of ExSnus after the Usability Testing

Description of the change made	**Original design**	**New design**
On the initial questions to set the user's profile, add how many screens with questions are left and add a reminder of which questions are mandatory on each screen.		

Description of the change made	Original design	New design
Add the password requirements.		
The questions about the user's motivation are not mandatory and can be added or changed after through the user's profile. Indicate this information in the initial screen to the user.		
Do not apply shadow to screen items that are not buttons because users think they are clickable elements.		

Description of the change made	Original design	New design
On the main menu bar, indicate which button is selected by just filling that button. In this way, the user knows on which screen is currently on. Additionally, write a word describing what each button is as some of them are confusing.		
Add some 'Back' options to return to the previous screen, as the navigation between some screens was confusing. For example, to return from the weekly report to the dashboard.		
On the screen to record activities, clarify that the user can register either a snus use or a craving overcame, and add an input text when the 'Other' option is selected.		

Description of the change made	**Original design**	**New design**
Change name of the 'Educational timeline' screen to 'Health timeline' because the new name is more explanatory for users.		
Add the sources of where the addiction questionnaire and the medical information from the 'Health timeline' come from. For instance, on the 'Health timeline' screen, this information is accessed by clicking on a new 'Information' icon next to the 'Additional information' header.		
On the Community screen, add the option to follow users to see their posts at the beginning of the screen when accessing 'Your feed'.		

6
Discussion

6.1 Research Questions and Answers

In this discussion section, the initial research questions that guided the project are revisited to evaluate how effectively they have been addressed. By systematically reviewing each research question, this section aims to provide a comprehensive understanding of the outcomes, highlighting any unexpected insights and identifying potential areas for further investigation.

6.1.1 How can a social snus cessation mobile application, with an integrated AI function, be designed to address the main factors that influence potential end users' behaviors towards snus?

How to design a mHealth application for snus cessation among young individuals was driven by a review of existing cessation methods and the advancements in mHealth technologies. These technologies have proven successful in other health areas, such as mental health. Additionally, given the widespread use of smartphones, especially among the target demographic, a mobile application provides an efficient and cost-effective means to deliver cessation support directly to users. This approach aligns with the current shift in the health field from traditional healthcare provision to self-management [111], focusing on prevention rather than healing.

During designing ExSnus, a service design process was adopted and tailored into four main steps, as depicted in Fig.4.1. This approach enabled thorough user research to identify the factors influencing users' relationship with snus and their motivations for quitting. These insights were then translated into the features of ExSnus. The fundamental structure of the mobile application was influenced by the existing mHealth applications for snus and smoking cessation. The design incorporates effective functionalities from these applications and introduces new ones, mainly the social part and AI integration, to better address user needs represented in the project's persona. Key design elements include:

1. Personalized support: ExSnus provides personalized tips to plan the cessation journey, coping strategies, and motivational messages tailored to each user's specific needs and progress. Additionally, the AI chatbot answers the specific questions of each user.

2. Social components: Features such as achievement sharing and forum discussions foster social connections and community support, leveraging social influence mechanisms to motivate users.
3. Self-monitoring: Users can track their snus usage and progress, gaining insights into what strategies work best for them. This feature is crucial for self-awareness and behavior modification.
4. Educational content: ExSnus provides scientifically-backed information on the health risks of snus and benefits of quitting, addressing cognitive biases and enhancing user engagement.

By integrating these elements, the designed mobile application would not only support users in their cessation journey but also empower them to take control of their health, fitting seamlessly into their daily lives and existing habits.

6.1.1.1 What are the main factors that influence snus use and how can a mobile application be designed to combat them?

From the literature review, it was found that snus exerts several physiological and cognitive effects that contribute to its addiction. The primary component of snus, nicotine, is highly addictive and induces relaxation, aids concentration, and enhances mood, resulting in a cheerful feeling. This effect typically lasts around half an hour, depending on the nicotine level. Additionally, snus consumption is associated with certain beliefs and cognitive distortions that reinforce dependency, such as the notion that snus helps relieve stress or cope with challenging emotions, and that it is less harmful than smoking.

From user interviews performed during the literature study, it was found that snus helps users focus on study or work, makes them feel more relaxed, and eases the anxiety they feel when not consuming it. Snus is regarded as a normal social activity or even a part of Swedish culture, integrated into daily habits, and not regarded as a real risk for health.

The design of ExSnus addresses these factors through different functionalities. First, ExSnus is designed to provide tips through the Forum (see Fig. 5.10), the AI chatbot (see Fig. 5.12) and the 'Health education' section of the Timeline (see Fig. 5.9) on how to focus better or deal with complex emotions without the use of snus and to offer alternatives such as NRT to quit nicotine steadily. In this way, ExSnus is designed to give users tools to deal with withdrawal symptoms and replace the benefits of snus with other alternatives.

Secondly, ExSnus is designed to educate users on the health risks related to snus use and the health benefits of quitting it through the 'Health timeline' screen (see Fig. 5.9). The decision to include this educational content was motivated by interviewees lack of knowledge of the health risks associated with snus use. It is believed that it would be an useful feature, motivated by the shift in the information behaviours over the last decade. Individuals now seek to understand better and improve their health [112]. Their motivations include understanding their health issues, gaining

a realistic idea of prognosis, learning about available services and sources of help, finding reassurance and coping strategies, and learning how to prevent further illness [112], among others.

Thirdly, the social aspect of snus consumption is also addressed through ExSnus, but it is further discussed in the review of the next research question.

Finally, the monetary motivation stated by interviewees to quit snus and also found in the literature review was also included. It encourages quitting snus by showing how much money can be saved, which might be important for budget-stressed students.

6.1.1.2 How can a social snus cessation mobile application be designed to incorporate a persuasive technology framework?

The functionalities of ExSnus were designed following the PT framework [115], with a strong emphasis on social components. Key features that foster social connections and community, such as sharing achievements and participating in forum discussions, leverage social influence mechanisms to motivate and support users throughout their cessation journey. For users who might feel a lack of support in their real environment, the forum provides a platform to connect with others experiencing similar challenges. This social support is crucial in helping individuals break the habit of snus consumption.

Apart from the social part, other PT design principles incorporated in the application include:

1. Personalization: Information is tailored for each user to enhance relevance and engagement.
2. Rewards: Users receive rewards for achieving milestones, reinforcing positive behavior.
3. Reminders: ExSnus provides reminders of the user's motivations to quit, maintaining focus and commitment.
4. Self-monitoring: Users can register their snus use (see Fig.5.6 and then visualize it through the Dashboard (see Fig.5.8 and Timeline (see Fig.5.9. These self-monitoring features allow users to track their snus use and progress, which also aligns with CBT principles because it helps users understand their behavior patterns and identify effective strategies for quitting. By tracking what works (e.g., overcoming cravings) and what does not (e.g., snus use), users gain insights into their behavior and learn to avoid triggers while enhancing supportive environments.
5. Scientifically-backed information: Providing scientifically-backed information is another crucial PT feature. Users need to trust the information to follow the medical advice given [114], so ExSnus includes credible sources for snus-related information.

Future work could further explore other PT framework points, such as incorporating

expertise from healthcare organizations or addiction specialists to improve content quality and offer referral options if necessary.

6.1.1.3 How can a snus cessation mobile application be designed to incorporate an integrated AI function?

This design of a snus cessation mobile application incorporates an integrated AI function through a chatbot, designed to support users throughout their quitting journey by following different design guidelines::

1. Users can interact with the chatbot through normal typing or engage in an oral conversation, enhancing accessibility. The chatbot allows users to choose a voice tone for oral interactions, making the experience more personalized.
2. Proposed questions are displayed to guide users on what types of queries can be asked. This feature helps users who might be unsure about how to engage with the chatbot, ensuring they can make the most out of the interaction.
3. If notifications are enabled, the chatbot periodically checks in on the user's well-being. Users can respond to these notifications by typing or selecting from a few default questions to start a new conversation. This proactive approach helps in maintaining user engagement.
4. The AI algorithm would be trained to provide personalized assistance, offering tips, coping strategies, and motivational messages tailored to the user's specific needs and progress. This personalized approach ensures that the support is relevant and effective.

By integrating these functionalities, the chatbot supports the user with their needs, whether they are concrete questions related to snus and its cessation, or more emotional concerns such as feeling anxious or not being able to focus properly without using snus. The chatbot serves as an always-available companion with which users can talk without fear of being judged or misunderstood.

6.1.1.4 How such designed app is perceived by potential end users?

The usability testing results generally indicate that the evaluated system has good usability. Users agree with the system's positive attributes, particularly in areas related to ease of use and that previous knowledge or assistance is not needed to be able to use the app. However, there was higher variability in responses to questions about the frequency of system use, the integration of functionalities, and the ease of use for others. These mixed opinions highlight potential areas for improvement.

From the Think Aloud process, several key insights were extracted. The most appreciated characteristics of the application included the initial questions when using the application for the first time, which made users feel that ExSnus would be personalized for them. Additionally, they preferred multiple-choice questions over written ones, finding them faster and easier to answer. Reminders of goals and achievements, especially monetary savings, were motivating for users. Users had mixed preferences on combining versus separating timelines, but the Dashboard, which

consolidates all information, was found useful by all users for tracking progress. The Forum was more appealing if users' friends also used the app, enabling them to share progress.

Users wanted control over the number of notifications and reminders, as too many could be overwhelming. Some preferred interacting with real people in the forum, while others valued the privacy of the chatbot, suggesting that keeping both options available is advisable. Communication preferences with the chatbot varied, with some users favoring written interactions and others preferring voice, depending on how they perceived the AI. Short encouraging messages were welcomed by all of them.

Overall, ExSnus was well-received, but some areas, such as the placement of certain screens and some texts wording, need further review with more users to ensure the app meets all user expectations and needs.

6.2 Health Information Presentation

Apart from the initial research questions posed, another interesting aspect was explored during the project development: how health information should be presented to a non-expert audience. ExSnus adheres to best practices outlined in [113]. Considering health journeys as self-educating [114], the cognitive bias present when individuals search information about their health are addressed. These biases include:

1. Confirmation bias that involves seeking and filtering information to support existing beliefs.
2. Loss aversion, which is the tendency to try to reduce perceived losses by seeking information to understand or mitigate severe risks.
3. Anchoring that involves concentrating on prominent information points instead of considering all relevant perspectives.
4. Pessimism or optimism, which refers to biased beliefs in outcomes that may not be probable based on previous attitudes.

These biases are considered in the information presented in the Timeline screen and should be further addressed when training the AI chatbot to provide effective health assistance. This approach not only enhances user engagement but also ensures comprehensibility, which is crucial for effective health communication. Ultimately, safety rules and minimizing the risk of a health seeker making the wrong choice is the guiding design principle when presenting information [111].

6.3 Future Work

Looking towards future enhancements, the addition of a moderated forum and the advancement of AI functionalities can foster a more supportive user experience.

These improvements, along with the development of features aimed at managing and preventing relapse, can enhance the long-term effectiveness of ExSnus.

Incorporating user feedback is crucial for the continuous improvement of ExSnus. Based on the usability testing results, certain features such as the placement of specific screens and the wording of some texts require further review. Additionally, this feedback has revealed that while the application is intuitive for younger users, it may be less accessible for elderly people. To address this, future testing phases should incorporate a broader range of users to refine and improve the usability of ExSnus across different age groups, ensuring that it can benefit a wider audience.

7
Conclusion

This thesis aimed to design a prototype of a social snus cessation mobile application with integrated AI for university students in Sweden. This idea emerged due to the increasing use of snus among Swedish youth, whose associated health risks call for effective cessation tools. In this situation, mobile health applications are quickly growing as an accessible and cost-effective alternative to traditional therapy and have already shown promise in supporting individuals manage their mental health and quitting smoking.

The research identified key factors influencing snus use, including social influence, cultural normalization, and health concerns. These insights were gathered through literature review and user interviews to detect the main user pain points and address them in the design of the application. The application integrates principles of persuasive technology to enhance user engagement and support, with a particular emphasis on social interaction.

The main findings of this study demonstrate that both social and AI components contribute to the app's effectiveness as a snus cessation support tool. On the one hand, the social features of the app are integrated into a forum that provides users with a space to create a community and share their experiences, which is essential for their motivation. On the other hand, the AI counselor offers personalized support, addressing users' specific needs and questions, thereby enhancing the overall user experience. Usability testing with potential end users revealed positive feedback, indicating that the app's design effectively meets the needs of its target audience.

In conclusion, this project's app is successful as a prototype for a social snus cessation mobile application that integrates AI. The designed features, including the AI assistance chatbot, the social forum, progress tracking, and education content about health; provide effective support for users during their quitting journey. Future work should focus on further refining the app based on user feedback and exploring the potential of AI in delivering even more personalized cessation assistance. This approach can be incorporated into cessation methods to reduce snus use among Swedish youth and improving public health outcomes.

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A

Appendix

A.1 A 15-point checklist of criteria for good thematic analysis

Extracted from [74].

1. Transcription:
   (a) The data have been transcribed to an appropriate level of detail, and the transcripts have been checked against the tapes for 'accuracy'.
2. Coding
   (a) Each data item has been given equal attention in the coding process.
   (b) Themes have not been generated from a few vivid examples (an anecdotal approach), but instead the coding process has been thorough, inclusive and comprehensive.
   (c) All relevant extracts for all each theme have been collated.
   (d) Themes have been checked against each other and back to the original data set.
   (e) Themes are internally coherent, consistent, and distinctive.
3. Analysis:
   (a) Data have been analysed —interpreted, made sense of — rather than just paraphrased or described.
   (b) Analysis and data match each other — the extracts illustrate the analytic claims.
   (c) Analysis tells a convincing and well-organized story about the data and topic.
   (d) A good balance between analytic narrative and illustrative extracts is provided.
4. Overall:
   (a) Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over-lightly.
5. Written report:
   (a) The assumptions about, and specific approach to, thematic analysis are clearly explicated.
   (b) There is a good fit between what you claim you do, and what you show you have done — ie, described method and reported analysis are consistent.
   (c) The language and concepts used in the report are consistent with the epistemological position of the analysis.

(d) The researcher is positioned as active in the research process; themes do not just 'emerge'.

A.2 Persuasive Systems Design Framework: Design Principles

Extracted from [115].

1. Primary Task Support
   (a) Reduction: A system that reduces complex behavior into simple tasks helps users perform the target behavior, and it may increase the benefit-to-cost ratio of a behavior.
   (b) Tunneling: Using the system to guide users through a process or experience provides opportunities to persuade along the way.
   (c) Tailoring: Information provided by a system is more persuasive if it is tailored to the needs, interests, personality, usage context, or other factors relevant to a user group.
   (d) Personalization: A system that offers personalized content or services has a greater capability for persuasion.
   (e) Self-monitoring: A system that keeps track of one's own performance or status supports the user in achieving goals.
   (f) Simulation: A system that provides simulations can persuade by enabling users to observe immediately the link between cause and effect.
   (g) Rehearsal: A system providing a means by which to rehearse a behavior can enable people to change their attitudes or behavior in the real world.
2. Computer–Human Dialogue Support
   (a) Praise: By offering praise, a system can make users more open to persuasion.
   (b) Rewards: Systems that reward target behaviors may have greater persuasive powers.
   (c) Reminders: If a system reminds users of their target behavior, the users will more likely achieve their goals.
   (d) Suggestion: Systems offering fitting suggestions will have greater persuasive powers.
   (e) Similarity: People are more readily persuaded through systems that remind them of themselves in some meaningful way.
   (f) Liking: A system that is visually attractive for its users is likely to be more persuasive.
   (g) Social Role: If a system adopts a social role, users are more likely to use it for persuasive purposes.
3. System Credibility Support
   (a) Trustworthiness: A system viewed as trustworthy will have increased powers of persuasion.
   (b) Expertise: Incorporating expertise will have increased powers of persuasion.
   (c) Surface Credibility: System credibility is based on a firsthand inspection.

(d) Real-World Feel: A system that highlights people or organizations behind its content or services will have more credibility.
(e) Authority: A system leveraging roles of authority will be more persuasive.
(f) Third-Party Endorsements: Third-party endorsements, especially from well-known and respected sources, boost perceptions of system credibility.
(g) Verifiability: Credibility perceptions will be enhanced if a system makes it easy to verify the accuracy of site content via outside sources.

4. Social Support
   (a) Social Learning: A person will be more motivated to perform a target behavior if he or she can use a system to observe others performing the behavior.
   (b) Social Comparison: System users will have greater motivation to perform the target behavior if they can compare their performance with the performance of others.
   (c) Normative Influence: A system can leverage normative influence or peer pressure to increase the likelihood that a person will adopt a target behavior.
   (d) Social Facilitation: System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them.
   (e) Cooperation: A system can motivate users to adopt a target attitude or behavior by leveraging humans' natural drive to cooperate.
   (f) Competition: A system can motivate users to adopt a target attitude or behavior by leveraging humans' natural drive to compete.
   (g) Recognition: By offering public recognition for an individual or group, a system can increase the likelihood that a person/group will adopt a target behavior.

A.3 Design of ExSnus

A.3.1 Sketches

See Figs.A.1, A.2, A.3, A.4, A.5, and A.6.

A.3.2 Wireframe of ExSnus

The whole wireframe can be accessed in Figma through: Wireframe of ExSnus in Figma.

A.3.3 Interactive Prototype of ExSnus

The application's prototype can be accessed in Figma through: Prototypeof ExSnus in Figma. Here, the prototype can be opened on a phone to interact with it as if it were a real mobile application. However, some functionalities are limited because only the main screens were designed, and there is no actual code. For example, text inputs cannot be entered.

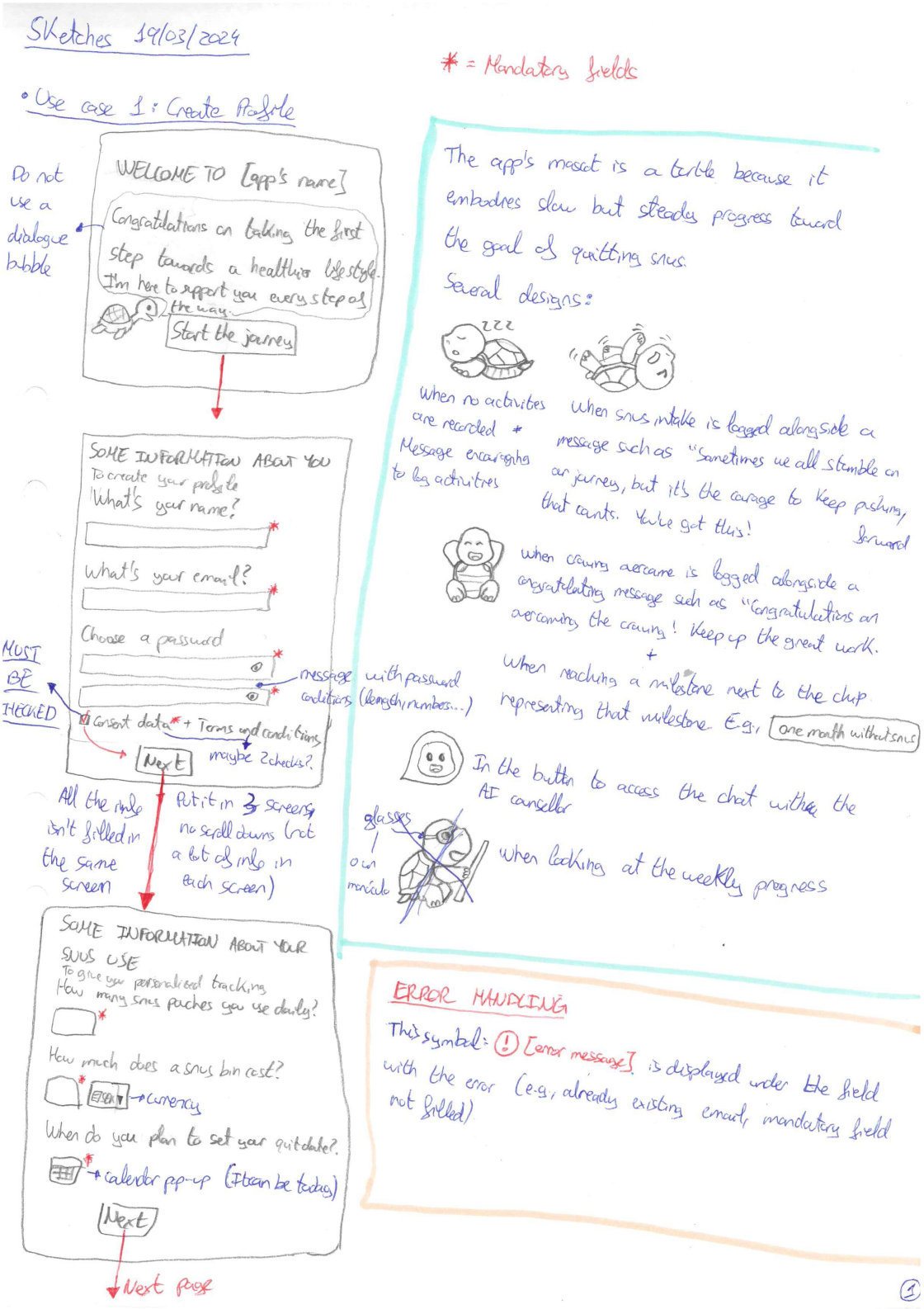

Figure A.1: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

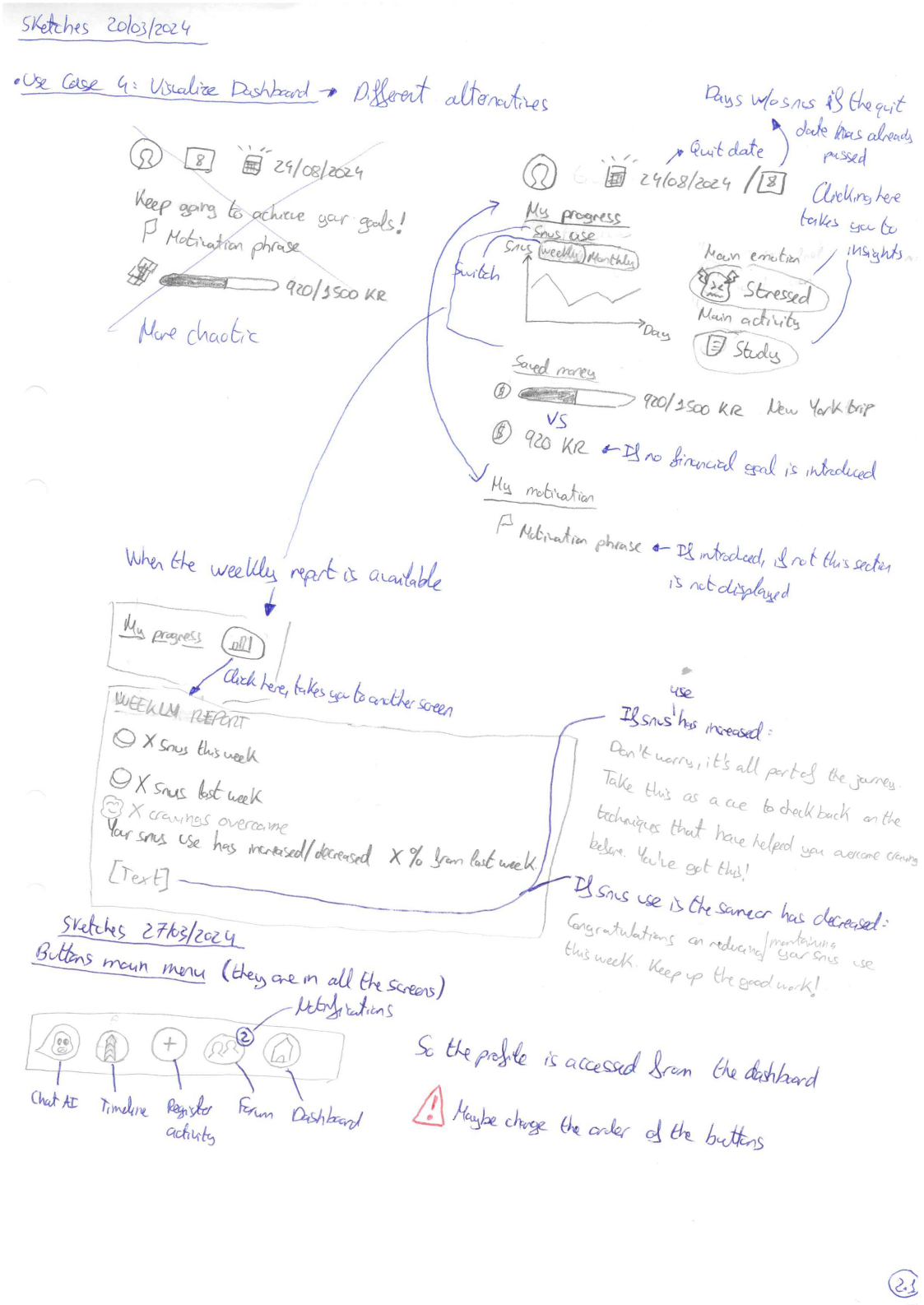

Figure A.2: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

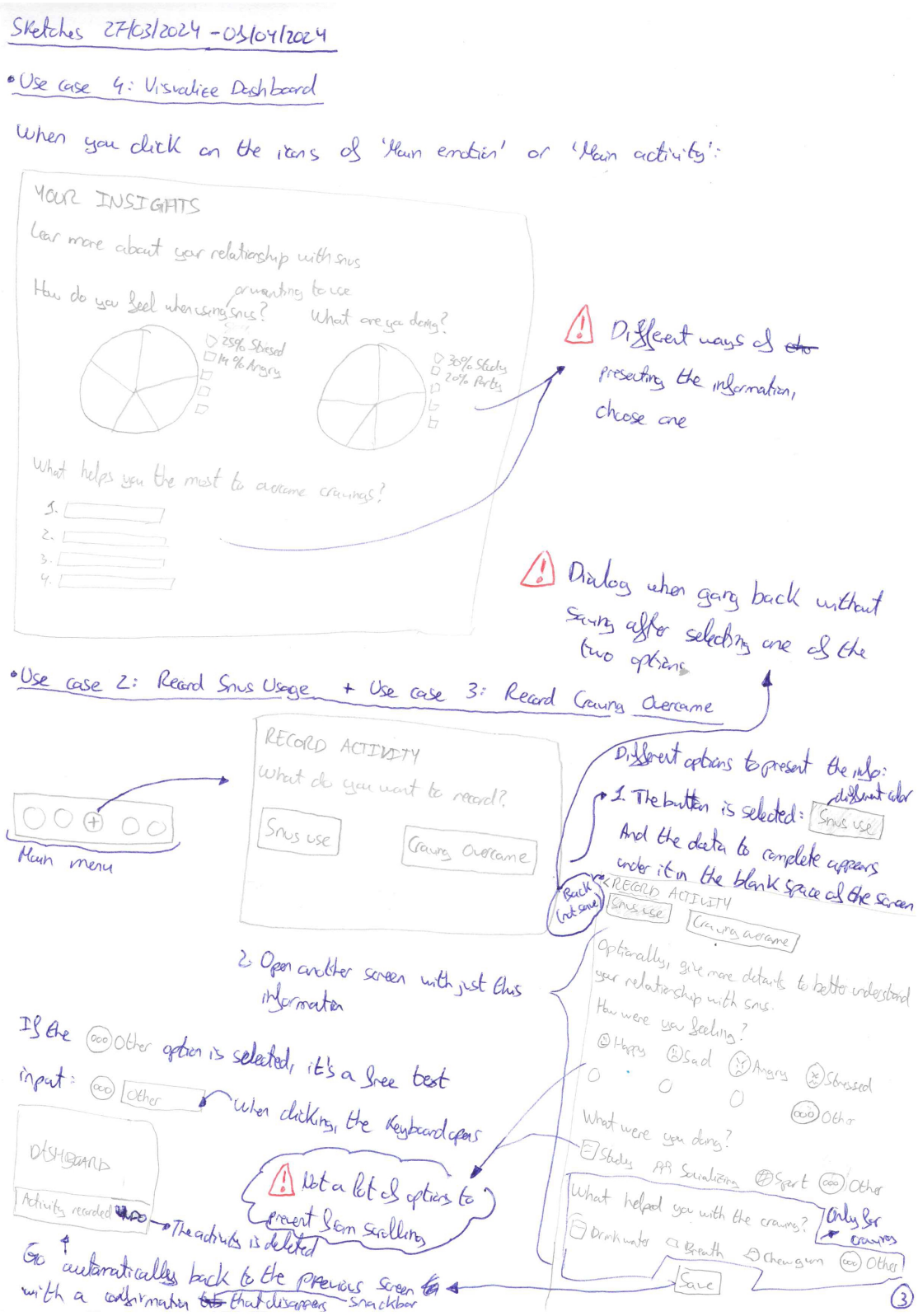

Figure A.3: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

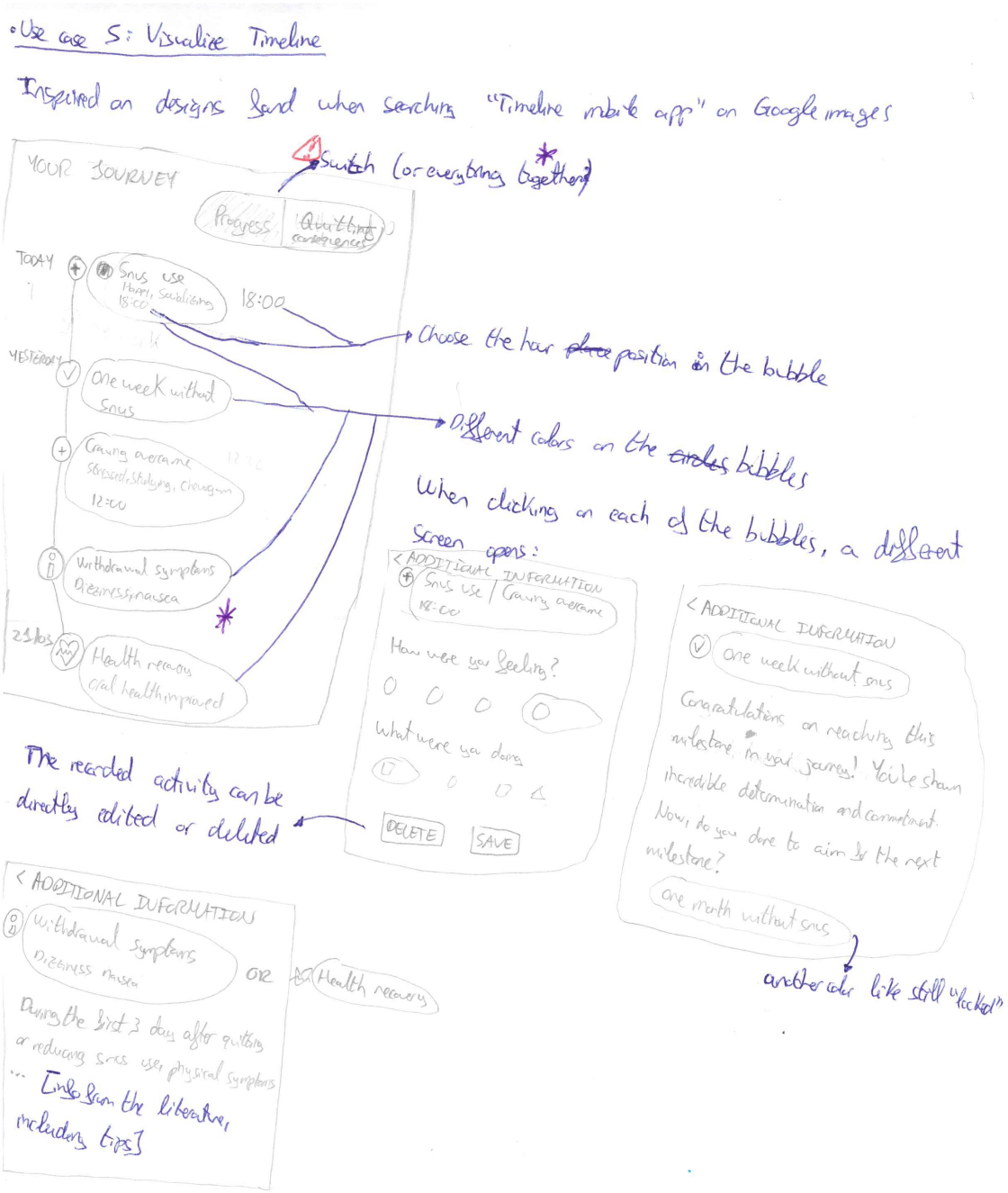

Figure A.4: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

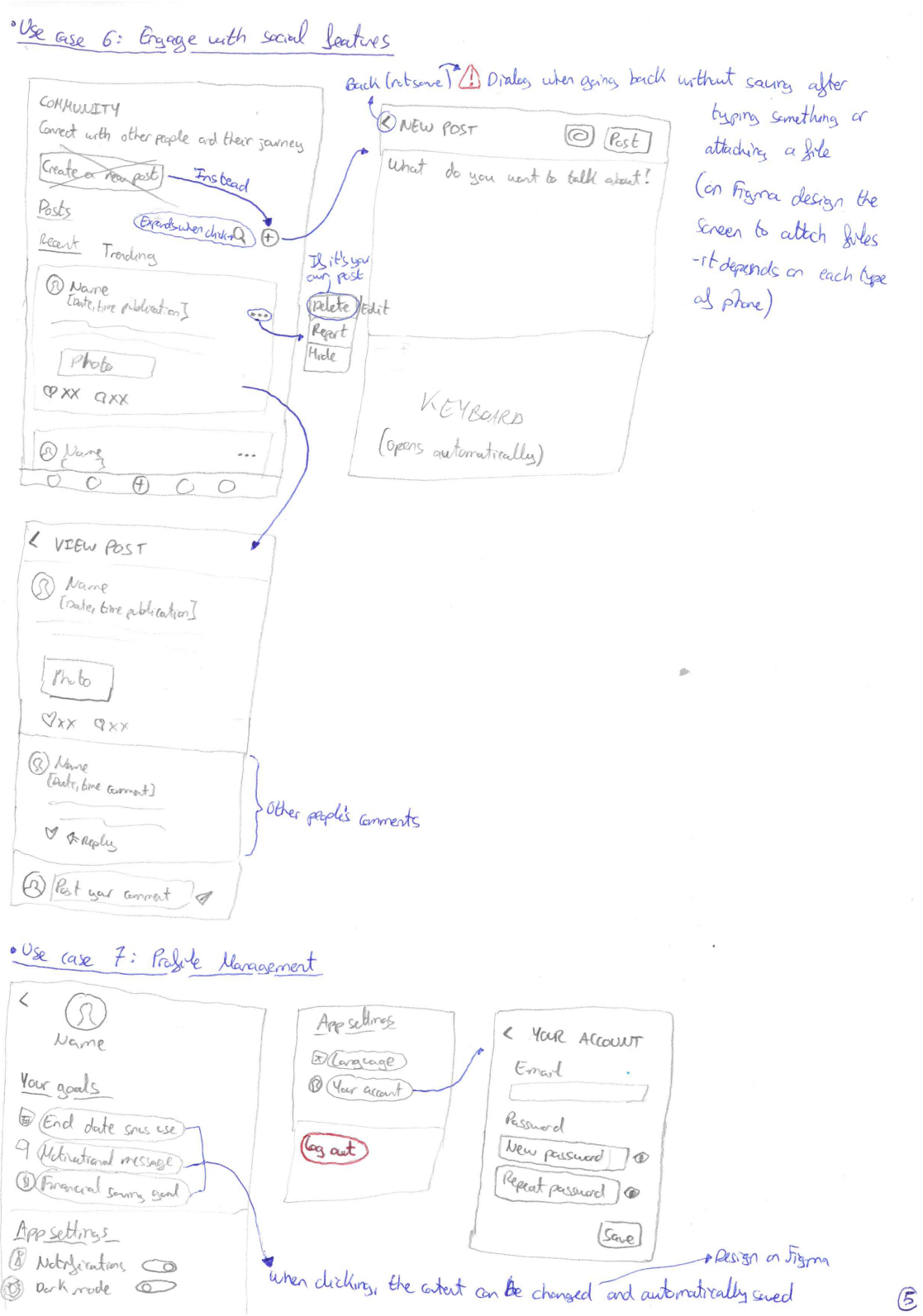

Figure A.5: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

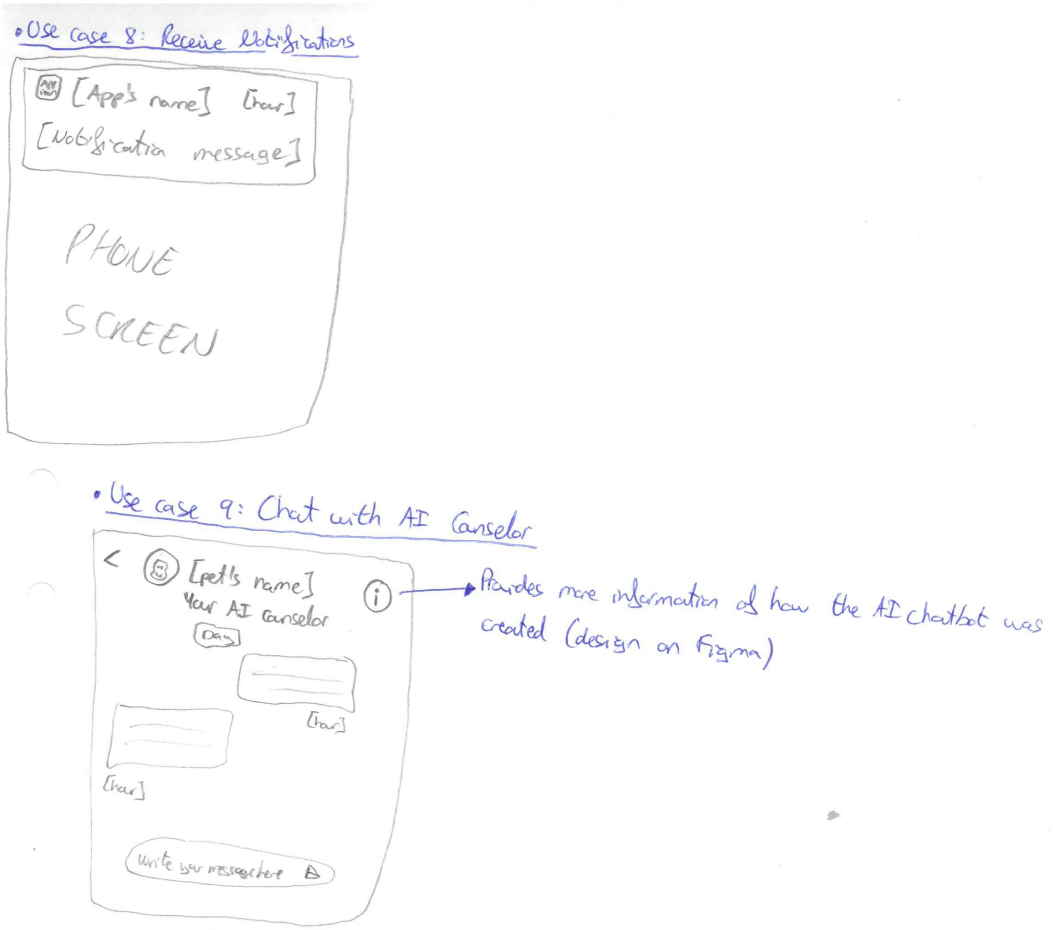

Figure A.6: Example of an initial sketch containing some of the application's main screens and functioning, based on the defined use cases.

A.4 Usability Testing

A.4.1 Consent and Information Form

During this usability test, I agree to participate in testing a digital prototype of a mobile app. Throughout the session, only my voice will be recorded. I will be asked to navigate through the application's prototype to complete several tasks previously explained, answer questions, and verbalize my thoughts. Subsequently, I will be interviewed with follow-up questions and required to complete a usability questionnaire.

I understand and consent that the test leader, Alba Puyuelo Citoler, will utilize the obtained information in an anonymized way for her master's thesis and will not distribute them further. I acknowledge that my participation in this test is voluntary, and I agree to raise any concerns I may have.

Please sign below to confirm that you have read and understood the information provided in this form and that any questions regarding the session have been addressed.

Place:	Signature:
Date:	Name clarification:

A.4.2 Initial Questionnaire

1. How old are you?
2. To which gender identity do you most identify to?
   - ☐ Female
   - ☐ Male
   - ☐ Other
   - ☐ Prefer Not to Answer
3. Have you ever used snus or other addictive substances (such as cigarettes or alcohol) on a daily or weekly basis?
   - ☐ Yes
   - ☐ No
4. How many hours per day do you use your phone?
5. Are you active on social media?
   - ☐ Yes
   - ☐ No
6. Have you ever used mobile apps to manage your health, such as tracking your food, physical activity, or mental status?
   - ☐ Yes
   - ☐ No
7. Have you ever interacted with artificial intelligence chatbots to assist you with any task or to obtain information on any topic?
   - ☐ Yes
   - ☐ No

8. Have you ever tried to change a habit you consider unhealthy? If so, what methods did you use and how successful were they?

A.4.3 Tasks to Perform

As a participant of this test, now you are asked to perform several tasks on the digital prototype given to you while expressing out loud your thoughts. To do so, please articulate your thought process while you interact with the application and indicate what you are clicking on to help know where your focus is.

Case 1
You just download the app and want to register that you are using snus right now. Additionally, you want to learn what happens when you start quitting snus to be prepared for the effects of not having nicotine on your body.

Tasks:
1. Fill the initial questions to create your profile.
2. Click on the 'Add' button and select the option to register snus use.
3. Fill the questions and click on 'Save'.
4. View the registered event on both the Dashboard and Your timeline.
5. Access the 'Educational timeline' section to learn more about the first days without snus.

Case 2
You are feeling kind of stressed today and you receive a notification from the application asking you how your day is going and if you have used some snus yet. You don't want to use snus to relax and focus better, but you need some help to know how to do it otherwise.

Tasks:
1. Answer the chatbot's questions.
2. Find a way on the app to obtain the tips you need to focus better without resorting to snus. You might achieve this in several ways:
    a. Asking the chatbot.
    b. Asking on the forum community or searching for similar topics discussed there.
    c. Reviewing the educational content about withdrawal symptoms and therapies to deal with them.

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