CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF ELECTRICAL ENGINEERING

DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

Bachelor Thesis

TimeToGo - Mobile app for navigation and time management

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Study Programme: Open Informatics
Branch of Study: Informatics and Computer Science
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Czech Technical University in Prague
Faculty of Electrical Engineering

Department of Cybernetics

BACHELOR PROJECT ASSIGNMENT

Student: Jan M u s i l

Study programme: Open Informatics

Specialisation: Computer and Information Science

Title of Bachelor Project: TimeToGo - Mobile App for Navigation and Time Management

Guidelines:

Create an application for mobile devices with Android OS that will help users manage their time during travel.
The application's goal is to help users reach target destinations in time and avoid delays that could be caused by bad time management or wrong route planning.
It tracks the user's GPS position on the map, his or her speed, the current time and the distance from target based on the given route. At the same time, it notifies the user whether it is necessary to hurry up and states the required speed to reach the destination in time.
While designing the app, focus mainly on ways the communication between the user and the app can take place in various scenarios. Present a solution that will achieve the best trade-off between the app's efficiency and user comfort.
During design and implementation, proceed in accordance with UCD (the "User Centered Design" methodology) and carry out formative usability tests of the developed application.

Bibliography/Sources:

[1] Jones M.,Marsden G.: Mobile Interaction Design. Wiley,2006.
[2] Weiss S.: Handheld usability. Wiley, 2002.
[3] Cooper A., Reimann R., Vronin D.: About Faces - TheEssentials of Interaction Design. Wiley, 2007.
[4] Kuniavsky, M.: Observing the User Experience: A Practitioner's Guide to User Research. Morgan Kaufmann, 2003.

Bachelor Project Supervisor: Ing. Zdeněk Míkovec, Ph.D.

Valid until: the end of the summer semester of academic year 2014/2015

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Dean

Prague, January 10, 2014

České vysoké učení technické v Praze
Fakulta elektrotechnická

Katedra kybernetiky

ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Student: Jan M u s i l

Studijní program: Otevřená informatika (bakalářský)

Obor: Informatika a počítačové vědy

Název tématu: TimeToGo - Mobilní aplikace pro navigaci a organizaci času

Pokyny pro vypracování:

Vytvořte aplikaci pro mobilní zařízení s operačním systémem Android, která bude pomáhat uživatelům s organizací času na cestách.
Aplikace má za cíl pomoci uživateli dorazit do cílové destinace včas a zabránit zpoždění způsobenému špatnou organizací času před cestou či špatným odhadem vzdálenosti a trasy.
Sleduje GPS polohu uživatele na mapě, jeho rychlost, aktuální čas a vzdálenost od cíle po dané trase. Přitom uživatele průběžně upozorňuje, pokud je potřeba přidat, a informuje, jakou rychlostí je nutné se pohybovat.
Při návrhu aplikace se zejména zaměřte na způsoby, jakými může probíhat komunikace aplikace s uživatelem v různých situacích. Navrhněte řešení, které by optimálně skloubilo funkčnost aplikace a pohodlí pro uživatele.
Během návrhu a implementace aplikace postupujte v souladu s metodikou UCD (User centered design) a provádějte průběžné formativní uživatelské testování vznikající aplikace.

Seznam odborné literatury:

[1] Jones M.,Marsden G.: Mobile Interaction Design. Wiley,2006.
[2] Weiss S.: Handheld usability. Wiley, 2002.
[3] Cooper A., Reimann R., Vronin D.: About Faces - TheEssentials of Interaction Design. Wiley, 2007.
[4] Kuniavsky, M.: Observing the User Experience: A Practitioner's Guide to User Research. Morgan Kaufmann, 2003.

Vedoucí bakalářské práce: Ing. Zdeněk Míkovec, Ph.D.

Platnost zadání: do konce letního semestru 2014/2015

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děkan

V Praze dne 10. 1. 2014

Acknowledgement

Special thanks go to my supervisor, Ing. Zdeněk Míkovec, Ph.D., for his practical insights into user experience and human-machine interaction and recommending various useful tools.

I would like to thank all my friends, colleagues and family members for their opinions on punctuality and lateness, participating in the tests, suggesting new features and finding bugs.

I would like to thank Ron Helpman, L.C.S.W, Diana DeLonzor, Jeffrey M. Conte, Ph.D. and other researchers for their exhaustive study of habitually late people that helped me shape the user research in the right direction and better define my mobile application.

I would also like to thank all respondents of my questionnaire study for taking their time and giving me lots of valuable information about their problems.

Prohlášení autora práce

Prohlašuji, že jsem předloženou práci vypracoval samostatně a že jsem uvedl veškeré použité informační zdroje v souladu s Metodickým pokynem o dodržování etických principů při přípravě vysokoškolských závěrečných prací.

V Praze dne 22.5.2015 ..... Podpis autora práce

Declaration

I hereby declare that I have completed this thesis independently and that I have listed all the literature and publications used.

Abstract

On Time[1] is an Android application that helps people, as the name suggests, be on time. It helps the user set a proper time when exactly to leave home and then supervises the user so that he or she really does stick to the plan. It gradually tracks the user's success rate of being on time and gives him or her practical advice on what to aim for and how to get better. User feedback is overall positive and more useful functions are expected in the future.

I would like my application to be not just a tool but also a coach. I would like the application to teach the user the principles of proper time management to make him or her start being on time naturally, rendering itself unnecessary.

Creation of the app was preceeded both by rigorous research of lateness causes from available sources, target group analysis using a questionnaire survey and an analysis of existing software solutions. The development itself was then conducted in stages with the use of formative usability testing techniques.

Abstrakt

On Time je aplikace pro Android, která pomáhá lidem chodit včas. Podporuje uživatele v tom, aby si správně nastavil přesný čas odchodu z domova, a následně jej hlídá, aby plán skutečně dodržel. Průběžně sleduje uživatelovu úspěšnost v chození včas a radí mu, na co se zaměřit a jak se zlepšit. Zpětná vazba uživatelů je vesměs pozitivní a do budoucna lze očekávat i nové užitečné funkce.

Rád bych, aby moje aplikace nebyla jen pomocníkem, ale také koučem. Rád bych, aby aplikace naučila uživatele zásadám správného time managementu tak dobře, aby začal chodit včas sám od sebe a tím pádem aplikaci přestal potřebovat.

Tvorbě aplikace předcházela důkladná analýza příčin opozdilosti z dostupných zdrojů, analýza cílové skupiny pomocí dotazníkové studie a analýza existujících softwarových řešení. Samotná tvorba aplikace poté probíhala v několika kolech za použití technik formativního testování použitelnosti.

[1] See section 4.4 for explanation why I had to change the application's name - it was originally named "TimeToGo".

Contents

1 Introduction

Most likely, everyone has been late at least once at some point in life. There are things we cannot predict, such as traffic accidents or unexpected personal or health problems, which can make us late. If these situations are rare for us and being on time is a norm, it is understandable. Unfortunately, some people are late much more often than that due to reasons that are hard to justify, such as bad time management, procrastination or bad discipline. For these people, lateness has become a bad daily habit comparable to smoking or unhealthy eating.

It appears to me that fighting chronical lateness is worthwile because the impacts of this bad habit are unpleasant, not only for the late people themselves but for others as well. Let me present the most significant reasons that make me think chronical lateness is a problem worth solving:

Stress: Failing to manage time in the morning and rushing to work or school late is the worst way we can start a day off. If this situation becomes a norm, the bad habit of running late can create long-term stress, which brings many problems such as chronic fatigue, weight gain, weakened immunity, and a shorter lifespan[1]. That is sad but a glimpse of optimism appears when we consider what psychologist David B. Posen M.D. said [64]: "...if we're the ones creating the stress, then we're in the best position to do something about it. We have more control than we think." I am optimistic that late people can fight their lateness and get rid of their stress, they just need a little bit of advice and also some push. Some people might seek a psychologist's help, some might go buy a book, e.g. book Never Be Late Again [42] from Diana DeLonzor, which is great and I will be citing from it often, and some might just look up a mobile application that they can just download and let it tell them what to do.

Dangerous driving: Besides hurting their own mental health, people who drive a car stressed and late on their way to work can harm other people. Speeding up to make up for the lost time and stress reduce a driver's ability to control his or her car and can lead to a disaster. Every day, a 3,287 people are killed worldwide in traffic accidents on average [8]. Road crashes are also the leading cause of death among young people ages 15-29. I am sure that many of these crashes could be prevented and hundreds of lives could be saved each day if people were able to manage their time better and did not rush so much.

Wasted time: Each time a punctual person has to wait for a tardy person, he or she wastes her time, especially if he or she is left waiting without any opportunity to use the time productively, for example, sitting alone in a restaurant or waiting nervously in front of a cinema. At a workplace, if there are multiple person left waiting for their top executive to start a meeting, the amount of productive time wasted is multiplied. For example, Merissa Mayer, CEO of Yahoo Inc., is infamously known for her lateness that sometimes reaches up to 2 hours [39]. Late people can also waste their own time if they fail to catch a bus

by a minute or two and have to either wait for another one or just walk.

Jobs: Lateness makes companies waste money paid in salaries for unproductive time and late people lose their jobs. A british study report that staff lateness costs companies staggering £9 billion per year [65]. While an employer might tolerate occasional lateness caused by external factors, such as surprisingly big traffic jams or unexpected personal problems, chronical lateness poses a deep problem at a workplace and truly costs the company extra money. An irresponsible coworker who is habitually late negatively affects productivity, discipline and morale of the whole team [62].

Relationships: I do not think that anybody wishes to be refferred to as "the tardy one". Chronically late people cause bad reputation for themselves and are considered as unreliable.

The question is, how many chronically late people are there? It seems to me that people tend to fall into one of two camps: the punctual ones and the tardy ones. I think that any reader can easily recall both punctual and tardy people they know, especially the tardy people. One employer revealed on an anonymous forum [46] that some of his employees are perfectly punctual while others totally fail to be on time: "Our E2 shop ERP system tracks attendance and I did a report today, 1 year to date. One guy had a 99% on-time rate, another was 83%, another was 38%, and the worst guy was 25% on-time with 169 days late." To give the readers exact numbers, my estimate is that the tardy group represents around 30% of people, judging from responses received in my questionnaire study (fully described in Chapter 3). The magnitude of the problem is variable - some of the respondents said to be late just a little more often than normal while some admitted to be complete failures who are late everywhere, everytime.

1.1 Idea of a mobile application

Before writing this thesis, I used to struggle to be on time myself. For example, I would lose track of time in the middle of some immersive work such as programming school assignments or would repeatedly misjudge the time left to go and miss the bus by just one minute. I hated it and I decided to do something about it. When I found out I am not the only one who hates being late and found out that many people I knew struggled even more, I realized that lateness was an interesting issue that mattered to a lot of people and deserved a fix. Having just finished my first Android application (an amateur remake of Snake from old Nokia phones), I got an idea that it might be also interesting to create a productivity Android application, designed to help with time management and fight lateness. After doing a few sketches, I was considering the following functions:

- Tracking the user's GPS position and speed, notifying when it is necessary to hurry up while walking / driving
- Setting a clear time when exactly to leave home, e.g. "Leave at 6:55 from your door", displaying the time left as a counter
- Alert - notification X minutes before it is time to go (in case the user usually "forgets" himself in the middle of work and needs to be alerted at the right time)

- Making an overview of activities that shall be done before leaving and seeing how much time they will take - e.g. Bathroom 10 mins, Breakfast 13 mins, getting dressed (5 mins.-15 mins., probably gender-dependent).

It is important to realize, though, that the functions themselves are not the only aspect that makes a successful application. What matters the most is whether the application will be able to solve the users' problems, will be easy to use and whether there will be any users willing to use it at all. Because of that, I decided to put users in the first place and develop the app in accordance with the principles of user-centered design [30].

1.2 Structure of the thesis

My plan was to to find out why people struggle with time management and fail to be on time, find solutions and implement those solutions in the form of an Android application. The goal was that the application would help users be on time more often and improve their time management skills.

The first and probably the most important step was proper research of chronical lateness and the problems people have. I examined websites of expert psychologists, read popular books on the topic of time management and also examined comments in internet discussions to create a comprehensive list of the most critical problems that lead to lateness and their possible solutions. To verify and extend my findings, I also decided to conduct a questionnaire study - as a return, I received over five hundred valuable responses that overall support the previous internet research. A total of 71 respondents also gave me their e-mail address for further testing and feedback.

Later on, I proceeded to define the application by choosing its target audience, target devices, creating first sketches of possible designs and functions and determining the user context.

The development then started with paper prototypes and a micro-usability experiment, also refferred to as Lo-Fi prototyping [44]. The paper prototypes went into a lot of detail and offered a certain level of interaction. The result was a lot of interesting insights and suggestions that helped better shape the application.

Based on the insights gained from Lo-Fi testing, I worked for a few weeks to create the first working version of the application on an Android device. This part turned out to be tougher than it originally seemed to be. After a lot of time, when the core functionality was finally achieved, I went to test the alpha version on a range of different Android devices to ensure cross-device capability.

Afterwards, created a working Hi-Fi prototype [44] with a basic user interface that enabled full control of the application. The goal was to test the application's interaction with the user in real-life scenarios.

Last, I finalized the app, wrote a formal technical description of the program and create a quick user's guide for an easy start with the application.

2 Research of lateness phenomenon

First of all, let me present you with the results of my research on the topic of lateness, the problem that I am aiming to solve with my mobile application. People are late for a variety for reasons. In this chapter, I will go into as many of them as possible and try to find a reasonable solution to each of them.

A number of professional and amateur researchers investigated the matter. The most notable sources that I will be refferring to include website Lateness.org [59] by Ron Helpman L.C.S.W, a psychologist and expert on lateness and procrastionation, and book Never Be Late Again [42] by Diana DeLonzor. All sources agree that lateness is a psychological issue and can be solved, which gives me optimism that creating a helpful mobile application makes sense.

Moreover, I have studied various internet articles on the topicc, most of which had a lot of interesting comments underneath, which were sometimes even more valuable then the article itself.

To verify the findings of my Internet research with real poeple and add even more insights, I talked about punctuality with my friends and also conducted an independent questionnaire study, which is described in detail in Chapter 3. I will be citing respondents throughout this whole chapter to demonstrate that the psychologists' studies and opinions of real people almost perfectly agree, which means that the analysis of user problems is solid and there is a good chance I will be able to come up with a solution.

2.1 First glance

2.1.1 Late people wish they were punctual

Lateness can be likened to a bad habit, similar to smoking or unhealthy eating. As researchers found out, most habitually tardy people are aware of their bad habit and realize that it brings problems into their lives, yet they are unable to to stop it.

> DeLonzor [42]: "Yes, it's a rude act, but I've interviewed hundreds of people and the vast majority of late people really dislike being late, they try to be on time, but this is something that has plagued them throughout their lives. Telling a chronically late person to be on time is like telling a dieter, 'Don't eat so much.'"
>
> Helpman [59]: "Punctual people take for granted the skills they have which allow them to be on time and conclude that chronically late people are intentionally late. While this is sometimes the case, I have found that the majority of chronically late people are frustrated by their inability to be on time."

> One more example, a commenter on an internet discussion [55]: “I’m one of those people who’s always late and there’s one thing I can assure you: it’s not because I want to and it’s not because I don’t care. I suffer the most from this, both at work and socially. It feels like an enormous handicap and it’s driving me crazy, mostly because I can’t even explain it myself, let alone to others. “

2.1.2 It is possible to learn to be on time

While lateness seems like a bad habit, punctuality seems like a set of the right skills that can be learnt. It includes realistic, sometimes even pessimistic planning, thorough preparation, keeping focus and staying on schedule. Punctual people consider these skills normal, which might make them think that tardy people are late on purpose [59]. The truth is, as I have just shown in the previous section, the vast majority of late people would actually like to fight their habit and learn how to be on time. The question is, can people really fight this bad habit? I have likened lateness to smoking and quitting smoking is a very hard task - the vast majority of people fail and the reported success rates fall below 10% [31, 35].

Fortunately, fighting lateness, which seems to be purely psychological, looks easier than fighting physical addiction in the case of smoking. According to researchers, learning to be on time is feasible with enough effort and the right guidance. Both Helpman and DeLonzor present examples of clients who have successfuly overcome their habit:

> "I’ve always had a number of bad habits— procrastination and lateness among them— and I’ve struggled, usually without success, to overcome them. (...) Once I got on track, I began arriving at appointments and meetings early. (...) When I finally discovered the keys to overcoming my tardiness, I solved much more than I thought I would. Changing this lifelong habit gave me more self-confidence and control over my life. (...) Now as I sit back and watch other people arriving late, flustered and apologetic, I have a quiet laugh to myself, reveling in the feeling of being so responsible and dependable. [42]”
>
> “A chronically late client, who had made only limited progress after many discussions of this issue in therapy, became significantly more punctual after reading this site. Realizing that other people shared his problems and that it is possible to make changes made him less ashamed and more motivated to make efforts to be on time. [58]“

Lisa Peck, an American business coach, confirms in her video [53] that lateness is a bad habit. She also points out the fact that people have full control over their lateness and fighting it is essentially a question of how much effort they put into it:

> "The first part of changing the habit is to become truly committed to changing it, you have to really want it. The desire must come from you and not from anybody else."

2.1.3 Three categories of reasons why people are late

Given that we know that learning to be on time is possible, let me now go through the problems of late people in a bit more detail so that we know what we need to change. While most of the problems are closely related to each other across all possible categories, there seems to be a certain structure emerging from the long list. At first, I came accross the website Lateness.org [59] by Ron Helpman, who divides the causes of lateness in three main groups: Ineffective planning, Implementation and Motivation. The structure seemed concise and clear and I highly appreciate the work Mr. Helpman has done. Although I changed the category names, reorganized the problems a bit, added new ones and added the opinions of the respondents in my study, the basic structure truly does build on the one by Mr. Helpman. Let me briefly describe the categories:

1. Unrealistic planning - underestimating time, trying to get too many things done, not using buffer times, etc.

2. Going off-plan - procrastination and having difficulty sticking to plans and schedules, attention issues, being forgetful and getting distracted

3. Motivation - consiously or subconsiously viewing punctuality as something negative or not enough mental effort

2.2 Unrealistic planning

I called the very first category of lateness causes "unrealistic planning" because the biggest problem is the difference between expectation and reality. I will describe issues like underestimation of time, overbooking, lack of preparation, leaving out important items or making tight plans without buffer times as if everething in the world worked perfectly.

"Optimistic" would also be a good word because the prevalent aspect is that late people tend to be too optimistic in their predictions. While being an optimist has its perks, when it comes to time management and planning the day it usually pays off to be more of a pessimist.

2.2.1 Underestimation of time required

From what I have found out, one of the biggest problems of late people is that they constantly underestimate time they need to finish certain tasks. In other words, tasks take them more time than they planned, which makes them late.. Let me quote typical answers of my respondents who were asked to list reasons why they think they are late (translated from Czech without much editing):

- "I fail to estimate time required for preparation of things, when we're going out with friends I say to myself: 'I'll make it in 10 mins' but it's 20 mins actually and if something unexpected happens, it's half an hour and I'm already 15-20 mins late." (respondent 63)

- "bad (naive) estimation of time I will need for a given activity" (r. 427)
- "Performing unimportant activities and postponing the important ones, while I underestimate time required for the important ones and eventually run late." (r. 443)
- “Bad estimate of how long e.g. a journey is going to take me, I don’t have a good estimate” (r. 448)
- "I still have "enough time" and the journey takes me more than I assumed..." (r. 180)
- "I cannot schedule my time - I always (think to) have enough time and then I am running behind (...)" (r. 66)
- "Because I think I still have a lot of time but then the time runs out so fast.." (r. 406)

One internet commenter admitted to underestimate time 74% while reading articles: “I honestly could not give you a good guess about what time it is now, though I think I sat down to read my email at 7 a.m. (Glanced up to see it’s 8:01, when I would have guessed about 7:35.) [55]”

If we dig deeper into this matter, we will discover that underestimation of time has been a subject of study in psychology and that there have been several professional studies conducted to find out more about this phenomenon.

Daniel Kahneman and Amos Tversky introduced the term "planning fallacy", which is described on Wikipedia [32] as "a phenomenon in which predictions about how much time will be needed to complete a future task display an optimistic bias (underestimate the time needed)". In one of the scientists' studies, students were told to estimate the time it would take to finish their senior theses. While they estimeted 33.9 days on average, the actual completion time they eventually needed was 55.5 days. More subsequent studies demonstrated a similar pattern and also revealed another interesting fact: predictions of the very same tasks by outside observers displayed a negative, pessimistic bias.

A more recent study [34] by San Diego State University psychologist Jeffrey M. Conte examined differences between people with “Type A” and “Type B” personalities [29] to find out that the average estimate of one minute differs by 19 seconds between the two groups:

- “Type A" personalities are described as ambitious, achievement-orientated, well-organized, sensitive and concerned with time management. They estimated that a minute passed in 58 seconds.
- "Type B" personalities described in contrast to Type A: laidback, easy-going, less competitive less prone to stress but also less organized. These people estimated that a minute passed in 77 seconds. By the way, these people are considered more likely to choose creative careers - to connect to other researchers, I will mention that creativity is an aspect that contributes to lateness according to Mr. Helpman as well [58].

An implication of these results is the possibility that certain people are "programmed by default" to be late - because of their personality type, their sense of time is different (slower). The results of my questionnaire survey agree with that - some respondents specifically talk about personality, describing things like "my own laziness", "genes", etc.

Another aspect I noticed by studying the responses is what I call "false feeling of comfort". One can describe it as the state of mind when we calculate how much time we will need (not necessarily inaccurately), find out that we have still enough time left and feel assured that everyting is okay. Unfortunately, that feeling of having "enough time", feeling of safety, makes us a little bit less cautious, makes us check the clock less often and as a result, we are suddenly suprised to find out it is too late and we should have already been doing something else. The respondents talk about this issue in detail and thinking about it, I recall that this kind of thing happened to me a couple of times as well.

- "When I have enough time for something, e.g. I shall leave in 30 minutes, I sit down and then I rush out in the last minute and I am late" (respondent #147)
- "Lightheartedness up to the very last moment and subsequent realization that I really should arrive on time" (r. 67)

Although the issue is very complex and has been studied by many prominent psychologists for years, I think that a permanent solution to underestimating time is, in principle, very easy. In my opinion, people should accept the fact that they constantly underestimate and start overestimating. For example, they should always increase their estimates by 30 or 40 percent.

2.2.2 One-more-task syndrome

Having described the false feeling of comfort, I am slowly getting to another common issue: doing "one more task". Both researchers and my respondents suggest that sometimes the reason for being late is the urge to do one more thing, which eventually takes too much time. It seems that it is a common problem among people who emphasise productivity and time management.

In her book, DeLonzor breaks down late people into seven groups, one of which is called "The Producers" - people who try to be more productive than realistically possible. The "one more task" is one of their problems, among others [42]:

> "'If I just hurry, I can...' is a common refrain among producers. (...) If the drive to work takes twenty minutes and it's twenty-two minutes before 9: 00 a.m., do they leave the house? Are you kidding? They have two whole minutes. If they hurry, they can still take out the garbage, clean the bathtub or change the battery in the smoke detector."

My respondents also admit that the "one more task" is what makes them late. The phrase "Before I leave, I try to do one last thing, but that makes me late." was marked as typical by 35% of respondent and some of the answers in the open-ended section include:

- "(...) I still think I have enough time so I go finish something and suddenly I find out I am already running late." (r. 85)
- "Before leaving somewhere, I still do a lot of things - cleaning etc., then I set out tight on time but I for example miss one metro and I am late" (r. 446)

2.2.3 Overbooking, overestimation of own efficiency

Sometimes people overestimate their ability to be efficient and productive. They try to fit too many activities into their schedule and as a return, they are late for everything and constantly pressed.

- "Bad planning of activities.. I assume I am faster than I actually am." (resp. 448)
- "I schedule my time wrong, I set unrealistic targets and I also carry out activities that still have time" (r. 437)

People who overestimate their efficiency might also knowingly risk getting behind the schedule because they believe they will make up for the time they lost by switching to a higher gear. Psychotherapist Ron Helpman named this type of person as "Speeder" [60]: "Speeders overestimate how much time they can save by speeding up tasks." DeLonzor talks about a "Busy Syndrome" [42].

2.2.4 Leaving out items that take some time

There are short but not negligible tasks that people sometimes seem to leave out when calculating how much time they will need to reach their destination. For example, opening and closing the garage, starting the car (in winter, especially), walking to the car (if it is parked outside), taking the stairs, taking the elevator, walking from building entrance to office doors etc.

When the extra times that were not calculated for add up, the total delay might be significant and the person ends up late. Ron Helpman specifically noticed that his late clients frequently make this mistake and described it in detail[60]:

> "When I ask my chronically late clients how long it takes them to get to my office, rather than telling me how long it takes them for the whole journey door to door, almost all of them give me an estimate of the duration of the longest part of their trip. If they drive, they leave out the time it takes them to walk to my office. If they take public transport, they don't include the time to walk to the train or bus or the walk to my office."

2.2.5 Not preparing in advance

Common sense tells us that we should prepare early if we want to be on time. For example, preparing a school bag in the evening is way better than preparing in the morning. There is no need to be stressed, there is always extra time to take if the preparation takes us

longer - we just go to bed a few minutes later. In the morning, that extra five minutes can cost us the chance to catch our last bus. Moreover, some people are still sleepy and drowsy in the morning, which increases the chance that they forget something and subsequently waste time.

Several respondents (25,139,147,222,486) admitted to prepare too late or not prepare at all. The question is, why some people avoid preparation? Helpman gives some insights on this as he talks about people who experience negative feelings when they think of preparation tasks [61], either because they find them boring, uncreative, or they hate looking in the mirror and trying to choose the right clothes. A perfect example of the last type of person is respondent number 193 who answered: "well because I look in the mirror and I simply cannot leave the house THIS WAY..."

2.2.6 Not using buffer times

The world is not perfect. Trains get delayed, traffic gets stuck, sometimes we forget our phone or car keys at home... There is no certainty that everything will work exactly as expected. With that in mind, if we want to make (almost) sure that we arrive on time, we must use buffer times.

I know a friend who does that does take a reserve and never arrives late to work. Over the past three years, he has been late only once. How does he do it? He schedules his departure from home 20 minutes from the wake-up call. His morning routine normally takes 15 minutes but he always adds a 5-minute reserve for himself. If he is ready to go to work in the 15 minutes, he spends the extra 5 minutes on his sofa reading the news or browsing Facebook on his mobile phone. Then he goes to the bus stop and catches the bus without problems. It is interesting that he is so successful even though he needs so little time to get ready, many people have much more time in the morning and still arrive late. The key difference is that he has a perfect buffer time strategy.

A lot of my respondents who are late admit that they do not use buffer times:

- "I do not leave myself buffer times" (r.452)
- "I do not set myself buffer times and rely for example on public transport timetables but public transport almost never arrives on time" (r. 445)
- "(...) N buffer time for external factors (e.g. a traffic jam)" (r. 480)

What is the reason why some people do not use buffer time? DeLonzor talks about people obsessed with productivity [42]: "Producers never plan to be early. Instead, they try to time things so that they're exactly on time. Arriving early and having to wait is akin to squandering a precious resource, letting time slip through their fingers."

Besides obsession with productivity, another factor might be perfectionism. Helpman describes that on his website [60]: "Efficiency shouldists who rigidly believe that things should go like clockwork and that they themselves should always be perfectly efficient (...) Mastery seekers who believe that they can find a way to make things work perfectly"

It seems that people who have these issues should accept the fact that the world is not perfect and get used to using buffer times. I shall find a way how my application will encourage users to set their own buffers.

2.3 Going off-plan

Planning effectively is one thing, sticking to those plans is another. Here, we will discuss the various reasons why people fail to stick to their schedules and plans - we will talk about procrastination, bad self-discipline, difficulty keeping attention and forgetfulness. My credits go to Mr. Helpman, who describes competing motivations, procrastination tactics and attention problems on his website [59] under a category called "Implementation". Further research has led me to a conclusion that this category of problems is related to weaker or stronger forms of ADD and ADHD [54, 42].

2.3.1 Procrastination

Procrastination has become a very popular term recently. Wikipedia defines it as "postponing impending tasks to a later time, sometimes to the last moment before the deadline", caused by either "carrying out less urgent tasks in preference to more urgent ones" or "doing more pleasurable things in place of less pleasurable ones".

In my questionnaire, phrase "I postpone important things up to the very last moment.", designed to capture procrastination issues, was the by far most accepted one. It was marked as "very typical" of "rather typical" by 69% of respondents. There are also a lot of open-ended answers that mention procrastination, either directly or indirectly:

- "Bad timing, postponing deadlines, I don't like to arrive early" (r. 500)
- "Carrying out unimportant things and posponing the important ones" (r. 441)

Mr. Helpman has a couple of names for types of procrastinating people [60]: "Indulgers can't say no to, and can't let go of, pleasurable off-plan activities. They also find it difficult to curtail pleasurable on-plan tasks. Achievers go off-plan because they look forward to completing off-plan tasks. (...) Justers repeatedly delay getting on-plan by short increments of time."

The question is, how do people stop procrastinating? From the definition, it seems that the key is to realize they are procrastinating and clarify with themselves what tasks are urgent and what tasks are not. It is a question of priorities and self-discipline rather than a question of planning. Maybe my application can account for procrastination as well. However, I see a bigger opportunity in problems with attention - my application can solve such problems easily with timely alerts.

2.3.2 Attention problems

Sometimes people get side-tracked from their plans because they have difficulty keeping focus. They "forget" themselves in the middle of doing something highly immersive and

when they “wake up”, it is already too late. Let me cite some of the respondents that admit having this issue:

- "Absent-mindedness, not focusing on a certain task - (problem) setting out somewhere in order to make everything in time"(r. 312)
- "I immerse myself in work and do not pay attention to the time, then I find out I am late" (r. 342)
- Zaberu se do jedné činnosti, při které si nehlídám čas. ... (r. 480)

It might not necessarily be a problem if people like to immerse themselves in their work and fully concentrate on it. Unfortunately, for some the immersion is so strong that it makes them lose track of time. As Mr. Helpman describes [57]: "Immersives lose track of the time because they get "hyperfocused" on what they are doing in the moment." .

Other people have difficulty focusing on one task and get easily distracted. Diana DeLonzor, who studied people with attention issues decribes them in her book [42], calls them “The Absent-minded Professors”.

In my opinion, the risk of missing the time to go is further amplified in the morning when a person is still sleepy and not fully alert. (A better definition might be: "before drinking coffee".) In such a situation, what I think can help is an alarm that wakes the person up. After all, this is one of the main functions I am going to implement in my application.

2.3.3 Bad memory

People also say that they are often late because they forgot to do something at home. Of course, these things happen from time to time, but there is probably an easy way to minimize the frequency. Let us look at two typical answers:

- "When I have to come back for something (phone, wallet, keys)" (r.10)
- "Morning drowsiness, I forget something" (r. 402)

One relates to important items to carry (phone, wallet, keys) and one relates to bad sleep. Maybe the way to solve this issue is to always put important things in one fixed place so that they can easily be found at any time and to get a better sleep.

2.4 Motivation

Sometimes what people lack is proper motivation to be on time. Let us see what psychologists have found and if there were any respondents whose answers agreed.

2.4.1 Adrenaline rushers

According to researchers, there seems to be a certain group of late people who find it hard to get motivated unless it is too late. DeLonzor calls this type of people "Deadliners" [42] and describes that they love andrenaline and enjoy the feeling of "rushing to the final line". One respondent mentioned that in his answer: "I probably enjoy rushing and I like to stand out thanks to it. Stopping being late would mean ceasing to exist for me." (r. 316)

2.4.2 Preferring being late to waiting

An important question that some people ask is: "What shall I do if I arrive early?" If given a choice between taking the bus that arrives 10 minutes earlier and the next bus that enables tight arrival (without any time buffer), a lot of people would choose the former. They do not know what to do with the extra 10 minutes. One friend admitted that he subconsciously risks late arrival because he fears arriving early. This problem can be solved by carrying things to make use of the extra time productively, such as media for learning (a book / e-book, a video lecture).

2.4.3 Being late on purpose

Although most people strive to be on time, as shown earlier, a small minority of late people seems to be late on purpose.

DeLonzor talks about "Rebels" [42] who use lateness as an expression of their individuality and independence, as they feel like they do not have any opportunity to express it elsewhere. One of my respondents (number 246) admitted that she is a "Rebel": "It provides me with a (although somewhat silly) feeling of freedom, that it is me who decided when to arrive" Mr. Helpman also talks about "Masters" and "Top Dogs" [60] who use lateness to make themselves feel dominant. Unfortunately, this seems like an issue that my application cannot solve.

2.4.4 Culture

In some cultures, such as in Latin America, it is actually considered rude to be on time [12]. "Thirty minutes past the scheduled meeting time is considered punctual by Mexicans," says a global portal for diplomats [20].

One respondent (number 115) depicted how her attitude to punctuality totally changed after she studied for a year in Mexico. Before, she used to be careful and punctual. In Mexico, it was common that if some meeting was scheduled at 7:30, it was sure that the first person would appear there at 8. She adapted to it and started being late just like others. Unfortunately, after she came back to the Czech Republic, she has been unable to get rid of the habit.

2.4.5 Punctuality is normal, not positive

Positive motivation is considered better than negative motivation [23], which indicates that rewards work better than penalties. The problem is, people do not get any apparent reward for being on time, they only get penalized for being late. If they show up late for a meeting, their colleagues are angry, if they show up late for a bus, it is gone. In the opposite case, when they arrive on time, there is no positive feedback. The colleagues feel normal, the bus arrives as normal. We view the difference between "late" and "on time" as "negative" vs. "normal".

What late people need is to change this relationship to "negative" vs. "positive". My suggestion is that people should create the positive feedback themselves. For example, they can set their own reward system - each time they manage to arrive on time, they can eat a chocolate or whatever else they consider positive.

2.5 Health, fitness, sleep

Most studies of chronically late people have so far focused strongly on psychology - they mostly talked about the link between lateness and mental health. What they usually do not mention is physical health, which I also consider to be a major factor, as its link to mental health is well-known [40]. For example, physical exercise has been proven to increase blood flow to the brain and improve cognitive functions [45, 36].

In my own experience, ever since I started to exercise regularly every evening and do more sports, I have been more productive and also more successful in time management and being on time. Besides that, I was happy to find out the quality my sleep improved as well. A lot of my respondents relate to their sleeping problems, with the biggest problems being oversleeping or just low motivation to wake up, so exercise might be the thing they need:

- “(...) reluctance to getting up (morning duties) (...)" (r. 28)
- "(...) Later waking up than was planned" (r. 171)
- "I don’t like getting up in the morning, I forget myself chatting somewhere" (r. 251)
- "Late morning waking up (...)" (r. 311)

3 User research

In Chapter 2, I was often referring to the questionnaire study I conducted with potential users of my application. Let me now describe the questionnaire in detail and provide qualitative and quantitative analysis of the responses.

3.1 Questionnaire

The questionnaire was created with Google Forms [13]. I will now make an English translation of the questions, the original Czech version of the questionnaire is attached on the enclosed CD. In the first part of the questionnaire, I asked basic questions about the respondent:

- Age
- Gender
- Status - multiple choice - Student, Employee, Entrepreneur, Unemployed, Other (specify)

In the second part, I asked if they used specific functions of their smartphones:

- Social networks (Facebook, Twitter or others), Games, Calendar, Notes, Timetables (bus,train), Maps, navigation

In the third part, I gave 10 close-ended questions for quantitative analysis. Question 1 was designed to break down people into two groups - late people and punctual people - and also for determining what combination of other answers leads to more lateness (to more positive answers to question 1). Questions 2-6 investigate ineffective planning, questions 7-8 investigate going off-plan and questions 9-10 investigate low motivation.

- I arrive late (note: original Czech version is "Chodím pozdě.")
- Things take me more time than I planned.
- I usually have a busy schedule.
- Before I leave, I try to do one last thing, but that makes me late.
- I do not give myself buffer time in case I pick up a delay.
- I prepare things to go at the last moment.

- It happens to me that I immerse myself in an activity and forget it was already time to go.
- I postpone important things up to the very last moment.
- I do not like being early somewhere.
- I sometimes feel like people get too angry for a small delay.

In the last part, I asked a couple more open-ended questions for qualitative analysis:

- What problems do you think make you struggle to be on time?
- Where do you arrive late?
- Are you interested in testing a new mobile application? (The answer was an email address.)

A link to the questionnaire was posted on 25 selected pages and groups on Facebook [11] social network, including college groups and pages, sites for entrepreneurs or various fun pages. Over a span of two weeks, I received a total of 508 legitimate submissions. The average age of respondent was 23.7 years, with over 90% of people placed in the range of 15 to 29 years and nearly 80% placed in the range of 21-27 years. Over 80% of respondents, 424 in total, were students. There were also 199 employees, 35 entrepreneurs and 10 unemployed respondents. I did not receive any valid response from a retired respondent. (Pleas note that the social status wa a multiple-choice question.) Interestingly, nearly three quarters of respondents were women. The most frequently used applications among the respondents proved to be social networking apps and public transport timetables. Calendars, notes, maps or games were used occasinally. A full graphical overview of the respondents is attached in the Appendix section.

3.2 Quantitative section

Here I am going to use quantitative analysis with the help of Likert numerical scale [19]. The numbering is as follows: 1 = very typical, 2 = rather typical, 3 = neutral, 4 = rather untypical, 5 = very untypical. Question 1, "I arrive late" was designed to break down people by punctuality. The other 9 following questions each correspond to a certain type of behaviour that should contribute of lateness, according to theoretical research. The expectation was that marking such bad behaviour as "typical" would have a negative impact on respondent's punctuality (a higher chance of answering the question "I arrive late" as "typical" and a low chance of answering "untypical"), compared to marking the bad behaviour as "untypical". As you can see later in 3.2, nearly all questions do show such relationship and therefore prove that the theoretical research of lateness was right.

We can see that the respondents' biggest reported issues are procrastination (question 8) and time management (e.g. questions 1,6). Around half of respondents admit they underestimate of time and prepare things to go at the last moment, nearly two thirds

admit to procrastinate in general by postponing important things up to the very last minute. Attention issues (question 7) and issues with low motivation (questions 9, 10) are not as common.

In question 3, people also mostly agree on is that they have busy or normal schedules rather than relaxed schedules. However, as I will show later on, a busy schedule did not turn out to be a problem - people with busy schedules are late just as frequently as people with more relaxed schedules.

As for the question 5 about buffer times, people seem to mostly fall into one of two camps - either they use them or not. Only 12% have a neutral opinion on this and the standard deviation of the answers is highest across all questions. One can mark the distribution of answers as a "bi-modal distribution where there are clusters of responses on both the high and low ends of the response spectrum" [16]. Answers to questions 1, 4, 6 and 8 also turned out to have a bi-modal distrubution, as the percentage of neutral answers did not exceed 15%.

Here I am showing a full overview of all questions and answers before I compare late people to punctual people.

Sentence	Mean	σ	1	2	3	4	5
1. I arrive late.	3.41	1.38	13%	18%	12%	30%	27%
2. Things take me more time than I planned.	**2.66**	1.20	20%	30%	20%	25%	5%
3. I usually have a busy schedule.	**2.44**	1.02	21%	32%	30%	15%	1%
4. Before I leave, I try to do one last thing, but that makes me late.	3.21	1.33	14%	21%	13%	34%	18%
5. I do not give myself buffer time in case I pick up a delay.	3.24	**1.39**	15%	21%	12%	30%	23%
6. I prepare things to go at the last moment.	**2.75**	1.35	23%	26%	15%	25%	11%
7. It happens to me that I immerse myself in an activity and forget it was already time to go.	3.32	1.24	10%	19%	18%	35%	18%
8. I postpone important things up to the very last moment.	**2.32**	1.27	33%	30%	15%	15%	7%
9. I do not like being early somewhere.	3.06	1.23	14%	19%	25%	31%	11%
10. I sometimes feel like people get too angry for a small delay.	3.44	1.15	5%	19%	24%	32%	20%

Table 3.1: Answers among all respondents. All percentages are rounded to the nearest unit. Answer 1 stands for "very typical", 5 for "very untypical".

3.2.1 Late people versus punctual people

I will now break down people by their answer "I arrive late" into two camps:

- people who answered "very typical" or "rather typical" will be marked as "Late people"
- people who answered "rather untypical" or "very untypical" will be marked as "Punctual people".

As you can see in 3.2, the results overall support my previous research in part Lateness causes. Late people admit to underestimate time (question 2) twice more often than punctual people. "One-more-tasking" (question 4) and reluctance to use buffer times (question 5) are also typical for them. Preaparing things at the last moment (question 8 6) is also typical. Procrastination (question 8) is also very frequent, although a lot of punctual people admit it too. Motivation issues (question 9,10) are not that common.

To be completely accurate, looking back, I think I could have left out the "but that makes me late" part in question 4 and the "forget it was already time to go" part in question 7 to rule out any possible bias. On the other hand, I do not consider it to be a major problem, as both questions were supported by answers in qualitative sections, which agreed that "one-more-tasking" and immersion are frequent problems among late people.

Sentence	Late people	Punctual p.	Multip. for Late
2. Things take me more time than I planned.	73%	35%	2.1
3. I usually have a busy schedule.	52%	53%	1.0
4. Before I leave, I try to do one more thing, but that makes me late.	69%	13%	5.3
5. I do not give myself buffer time in case I pick up a delay.	63%	19%	3.3
6. I prepare things to go at the last moment.	75%	34%	2.2
7. It happens to me that I immerse myself in an activity and forget it was already time to go.	54%	15%	3.6
8. I postpone important things up to the very last moment.	82%	52%	1.6
9. I do not like being early somewhere.	43%	25%	1.7
10. I sometimes feel like people get too angry for a small delay.	39%	16%	2.4

Table 3.2: Comparing late people to punctual people

3.2.2 Age, gender and social status

Again, let us keep the names “Late” and “Punctual” from the last table and continue to compare people by their reported punctionality, this time by taking into account age, gender and social status, as shown in 3.3.

Group	Respondents	Late	Punctual
People 15-20 years old	70	30%	56%
People 21-22 years old	150	31%	61%
People 23-24 years old	140	**36%**	51%
People 25-27 years old	103	29%	55%
People 28+ years old	43	16%	74%
Men	132	**38%**	55%
Women	376	28%	58%
Students	424	32%	57%
Employees	199	32%	57%
Entrepreneurs	35	**43%**	46%

Table 3.3: Punctuality by age, gender and social status

Analysis of the relationship between age and punctuality revealed that the worst punctuality was reported by people at an age of around 23 or 24 years, who marked being late as typical in 36% of cases and being punctual as typical in 56% of cases. Other groups reported lateness less often and punctuality more often, as shown in 3.3. Older people over 28 years came out as winners with the lowest reported lateness and highest reported punctuality. It is important to note though that the majority of respondents were students, so I guess that the peak of lateness around 23-24 years might be caused by an increased amount of duties such as writing a diploma thesis, learning for final exams or more frequent job involvement alongside school.

Men admit being late significantly more often than women, however, the percentage of men and women who report being punctual are roughly the same.

As for social status, students and employees have the same shares of punctual and late people. The only group that differs is the small group of entrepreneurs, who seem to be a bit more often late and a bit less often punctual. Please note that a lot of respondents checked more than one option. For instance, there are studying employees or employed entrepreneurs. The group of unemployed people was not included in the comparison table, as it is way too small.

3.3 Qualitative section

The first open-ended question was: "What problems do you think make you struggle to be on time?" Out of 508 respondents, 181 provided an answer. Overall, they gave me rich and useful information that helped me further verify which problems they have. I will now divide the answers by type of issue with regard to previous research of lateness causes, as described in Chapter 2.

3.3.1 Unrealistic planning

The most frequently mentioned issues were underestimation of time or overbooking. A lot of people also admitted not to use buffer times or prepare things at the last moment. (In my opinion, last-minute preparation is related to procrastination as well). Some people mentioned that they did not like leaving when some work is not yet finished. Some people only mentioned bad time management in general. Overall, bad planning was the most often specifically mentioned issue.

3.3.2 Going off-plan - procrastination and attention issues

Procrastination was also often mentioned, although inderectly as "carrying out unimportant activities and postponing the important ones" (resp. 439) or preparing things at the last moment. Attention issues were also frequently mentioned.

3.3.3 Motivation

People also admitted to have issues with motivation to be on time related to their genetics and overall laziness. One respondent (316) also admitted to be addicted to adrenaline and being late. However, these issues were not mentioned as often as reasons related to planning or going off-plan.

3.3.4 External factors

Some people have stated the reason for their lateness was public transport that is never on time. On the other hand, if that is the daily routine of the public transport in their city, they should adapt and start, for example, taking the earlier bus. Saying "Buses are never on time and that is why I am late," is, in my opinion, the same as saying "I know that the bus I take is always late and I know I need to start taking the earlier one but instead I will not, I will keep taking the same late bus, arriving late and blaming it on the bus."

3.3.5 Situations where respondents are late

Having examined the various reasons why respondents are late, let us explore also the situations in which they are late. The second open-ended question sounded: “Where do you arrive late?”

The answers show a general consensus among respondents that people are late for informal events more often than for formal ones. The importance of an event seems to have a massive impact on the person’s punctuality. There are only a few people who indicate to be on time for everything and a couple of people late for everything (described in the next subsection).

Events where respondents report being late frequently include: meeting with friends (especially of other friends are also known to be late), school lectures or seminars (if attendance is not checked or if late arrival does not lead to a penalization or absence) .

Situations where some respondents say to be rarely or never late include business meetings with important people, job interviews or a doctor's visit.

3.4 Chronically late respondents

There are a lot of respondents who admitted in the questionnaire to be late chronically - everytime, everywhere. These represent typical users of my application. Let me present just a few of them:

- Respondent 316 is the most serious example of a chronically late person. He admits to be addicted to adrenaline and he cannot imagine his life without being late. At the same time, he suggests that lateness is his curse. He has been late everywhere: "school, job, I was late for every driving lesson, for his maturita exam and unfortunately also for my dad's funeral. I was told to be late even for my own funeral".
- Respondent 115 has been late ever since she returned from Mexico, where she studied for a year and had to adapt to the fact that everybody was at least half an hour a late. She now cannot get rid of this habit.
- Respondent 37 says: "I am a lazy sloven". She is late "everywhere - for a date, for a pub, for work..."
- Respondent 55 says: "I hate waiting. I am lazy to kick myself out of bed." He is late "everywhere", for "school, job, date, pub, party, meeting with friends".
- Respondents 64,65 both say to be late "everywhere" and say the main reasons is their genetics or laziness.
- Respondent 193 says to be late "everywhere" and her reason is: "I am absent-minded."

4 Analysis and design

Now that the initial research of users' behaviour is complete, I can start defining my application. I decided to invest a lot of effort into this part - I analysed my potential user base, analysed existing software solutions for better punctuality and time management, brought up functions that my application could provide (for potential future development), created first sketches of designs and suggested various examples of user context using situational comics.

4.1 Target audience analysis

4.1.1 Psychographics

For defining the target audience of my application, psychographics is probably more important than demographics or other factors. Wikipedia [25] defines it as the "study of personality, values, opinions, attitudes, interests, and lifestyles". I am mainly targetting people who have moderate to serious problems due to thair habitual lateness and bad time management. The user's attitude is essential - he must realize for himself that his or her lateness is a problem and decide to learn how to be more punctual. Otherwise, he or she would not seek my application. The conclusion is that people who will be using my application will already be motivated to learn to be on time (or, at least try). Therefore, I will not need to explain the users **why** to learn to be on time - only **how**.

Another way to look at psychographics could be to look at the psychological problems people have (as described in Chapter 2) and think about possible solutions that my application could offer to fight these problems:

- **Underestimation of time** - Having an overview of how much time each activity requires will be beneficial to user who constantly underestimate. A useful function that comes into play is a stopwatch with historical charts that show the average elapsed time of each activity.
- **Procrastination:** Knowing exactly when the best time to go is shall eliminate procrastination. With a clear plan (visible clearly on the screen and reinforced by notification) will discourage the user from postponing the plan beyond the possibility of arriving on time.
- **Attention problems** - My notifications will "wake up" users at the right time. It will be helpful to people who often "forget" they were supposed to go because something else drew their attention.

- **Leaving out items that take time** - I will force the user to write down all activities (breakfast, bathroom, packing the bag etc.) and journey blocks (walking, bus, stairs/elevator) and the estimated time that each activity/block takes. This way, they will not mentally leave out any item that takes time, which is one of the reasons why people constantly arrive late (see section Lateness Research).
- **Lack of positive motivation** - I will try to motivate people to change their behaviour and be on time. For example, I will include productivity tips and explain why it is better to be punctual (avoiding stress, better impression on people etc.).

4.1.2 Demographics and Geographics

As for age, the questionnaire proved my assumption that older people are more organized. It was especially apparent for people more than 28 years old, who were much more punctual than the average respondent. That leads me to the conclusion that I shall be focusing on people 28 years old or younger. To be completely accurate, there shall also be a bottom margin, which I decided to set at 15 years. The argument can be that at this age, people get their first ID cards here in the Czech Republic and can be considered at least a little bit responsible.

As for gender, the application shall be designed for both. Although men reported being late more often in my questionnaire, I cannot see any reason why not to include women, given that they showed more interest in my app. (Nearly three quarters of respondents were women.)

As for transport type, I see no reason to filter my audience by the means of transport they use to reach their destinations. In my opinion, anyone can be late - people can start their car too late just like they can walk to the bus too late. The common pattern is that people simply set off for their journey too late, which is not necessarily dependent on means of transport.

As for geographics, I selected a target audience based wholly in the Czech Republic, as it was necessary to contact the testers on a daily basis and organize physical testing. The app will be tested and launched in Czech language, although I will design it with possible future translation in mind.

4.1.3 Technical

Finally, I have to decide what type of Android devices that I am going to target and also what minimum Android version shall be supported.

Considering the context in which the user is going to use my application, I will target only smartphones and not tablets. The user should carry the device with him or her all the time, in his or her handbag or pocket. Moreover, my app does not require much screen space as the functionality is rather simple. The trick is in the user-device interaction.

As for the Android version, I had to consider both the current distribution of Android versions [6] and the availability of certain functions on these versions. Originally, I wanted

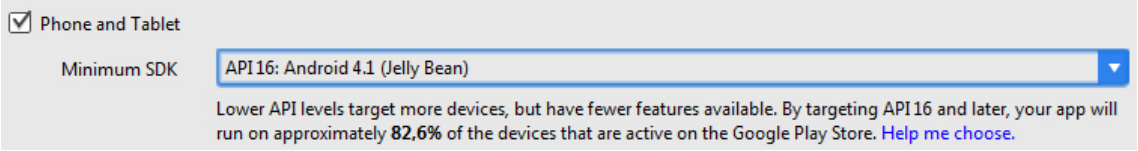

Figure 4.1: Android Studio describing how many devices support API 16 onwards

to target as many devices as possible, even old devices with Android 2.3 (API 9). Unfortunately, it turned out that certain essential features would have to be dropped if I insisted on API 9. Most significantly, several important methods in the current and recommended Notification library [50] require API 16 (Android 4.1) or higher to be called. The question was, how many devices have API 16 or higher? Fortunately, as shown in 4.1, Android Studio [49], the official Android IDE, reports that 82.6% of all devices now have API 16 (Android 4.1) or higher (last checked on May 18, 2015), which still represents a big majority of devices. All things considered, I indeed decided to set the minimum required version at 4.1.

4.2 Existing solutions analysis

I have researched the Internet and found a couple of existing applications that could potentially help late people. Three of them seem to synchronize with Google Calendar and use GPS. Let me test them with a simple scenario:

- Now it is 8:00 A.M. I am currently located at a house around 20 minutes away from the local main square - at least I know very well from my own experience that the journey takes at worst 20 minutes, usually 18-19 minutes.
- I set an example event called "Board Meeting" which starts at 9:00 A.M. at the main square.
- I will be walking there. The question is, when should I leave the house?

4.2.1 Time2Go - Android application

I have been notified of this app by one of my testers. Time2Go[1] [43] is an Android application from 2012 that offers one of the features I had originally in mind - departure reminders. It issues a notification when it is the right time to leave for a certain event. Events are loaded automatically from Google Calendar. That means the user sets his events outside the Time2Go application - its job is just to notify of the upcoming departure. The application is very simple and it looks like it is sufficent for a lot of users, as its current user ranking is quite high (4.2, as of May 18, 2015). It uses two times:

[1] Please note that this app was the reason why I had to drop the originally intended name "TimeToGo".

- Departure time - the time when the user should leave their home. If the location of a Google Calendar event is set, the app can calculate departure time based on route (most likely, Google Maps API is used) in four modes - driving, biking, walking, public transit.
- Warning time - interval before departure time that the notification should be issued. The user can select one of predefined times: 5, 10, 15, 20, 30, 45 minutes and 1 hour, 1.5 hours, 2 hours.

Result of my test: Walking mode must be set from the Time2Go application. GPS must be set on at all times, otherwise the application will not know where the user is and how to calculate the route. If it is turned on, the notification (as seen in 4.2) is issued, although not exactly at the right time. I chose to receive the notification 10 minutes before departure and I received it at 8:16. The leaving time was set by the app at 8:26 and the travel time was calculated to be (a bit over) 33 minutes. That is way over the expected duration (around 20 minutes). When I clicked on the notification, I could get to Google Maps, where the route was displayed - surprisingly, Google Maps said the route took 22 minutes. It seems that there is something wrong with the way Time2Go calculates the travel time. All right, let me now review the app in general.

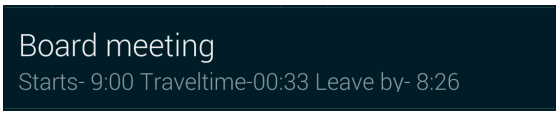

Figure 4.2: Time2Go displays a confusing notification - route shall take around 20 minutes, not 33.

The number one limitation is that the user must have GPS on all the time (so that departure destination is known at the right time) or a nofication will not be issued. The user also has to fill in a Google Maps location for each of their events. The problem is that people typically do not fill in the location information so most of the time, the route calculating algorithm will not be used. I use Google Calendar but never set up an event location information myself and people who I spoke to do neither. Maybe I would start to if I wanted to make full use of the app. However, the list of limitations does not end here.

Even if the users do fill in the location information, there is one more limitation - the route calculation algorithm. As I will discuss later in Summary section (after all apps are examined), even the current best free navigation algorithm (Google Navigation) is not reliable, especially in cosmopolitan areas. Another problem is that the user cannot combine various modes, such as walk (to the bus stop), public transport (bus to school) and one more walk (to school entrance).

Another limitation is the fact that only one travel mode can be set for all events. There is a quite painful workaround though, which relies on naming the events in Google calendar in a special way - for instance, when setting up event XY in Google Calendar, the user can name the event "XY -walking". This way, Time2Go knows that departure time shall be calculated using a walking route, even if driving is selected as default in the app. Anyway, the user does not see any information on how the route is calculated.

If the user decides not to fill in locations in Google Calendar and use a fixed travel time interval, he or she comes across one more problem - it is not possible to set a custom travel time for each event individually - there is only one global fixed time interval for all events. Example: if the user has two types of events with different travel times, such as Work (40 minutes) and School (20 minutes), he or she cannot use Time2Go, as it only allows one custom travel time.

4.2.2 Google Now

Google Now [47, 52] is a very promising application. Using smart cards, it keeps the user updated on the things he or she cares about. How it does it work? When the user clicks on the Google icon on the device screen (on Android or iOS), a Google search window is opened. The search box is displayed at the top but that is the only thing that looks the same for all users. Underneath, the application automatically shows various smart cards, based on what it finds currently most important for the concrete user. For example, I am usually being shown weather cards, notifications about upcoming football matches or played footbal matches results. When I have GPS on and an upcoming event is set in Google Calendar with a given location, the application shows me a card with the estimated leaving time.

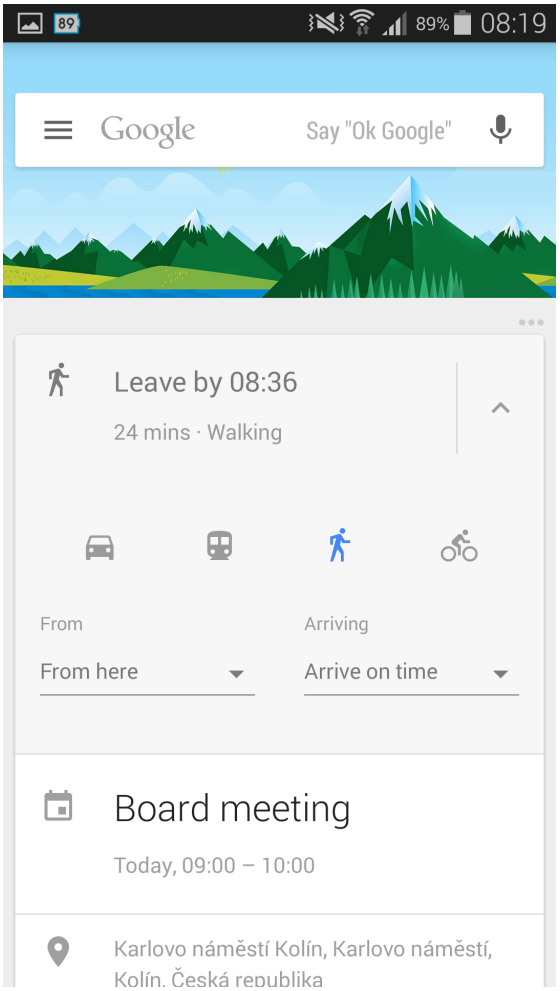

Figure 4.3: Google Now displays an interactive smart card for departure and route information

Result of my test: Walking mode had already been set from earlier. GPS was on. As shown in 4.4, I received a notification at 8:21, 15 minutes before scheduled departure, which was set at 8:36. As the event started at 9:00, Google Now was saying the walk should take me 24 minutes. This information was way more accurate and convenient than what Time2Go provided.

Overall, I think that after the latest update, the Google Now has gotten very smart. As shown in 4.3, the user can choose whether his current GPS position shall be used as a starting point (denoted by option "From here") or from his or her home (another option "From home") or from a specific

address. As the application can load a saved address (either Home, if the user has already told Google before where he or she lives or any other address), the user does not need to have GPS on for the app to determine the route and travel duration. That is a major advantage over Time2Go, which requires GPS to be on all day.

As i said, the events are synchronized with Google Calendar. The good feature is that if the user is working on his or her computer and has Google Chrome open, the "Leave now" notification opens as a dialog in Chrome as well.

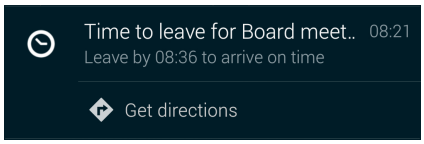

Figure 4.4: Google Now issues a notification 15 minutes before departure

Probably the only two limitations are the Google Navigation itself (can be inaccurate, as discussed later) and the fact that the user cannot change the default 15-minute interval of notification before departure. Although I still do not consider Google Now a solid solution for chronically late people, it seems to be way better than Time2Go and Bounce.

4.2.3 Bounce - Android application

Bounce [68] appears to be an Android application similar to Time2Go and Google Now. According to the description, it shall track the user's event in Google Calendar and automatically calculate the travel time just like the other two applications, with the additional possiblity of setting up custom buffer times.

Result of my test: I was looking forward to testing it but unfortunately it did not work at all. My GPS and Wi-Fi were on. The Bounce application failed to send any notification. Even when I launched it and clicked on the event to force calculating the travel time, it would say "Calculating travel time" and stay silent for 5 minutes. Moreover, not only did it not calculate any travel time, I realized it did not even ask me what means of transport I was going to use. If I walked, I would have had to leave house at 10:10, if I drove a car, I would be okay to leave at 10:24. That is absolutely uncomparable.

4.2.4 Am I Late? - Android application

"Am I Late?" [41] is a simple yet useful time management application for Android. It was designed for children and the reviews section reveals that parents are very satisfied in the way it teaches their children the basics of morning routine. They say children enjoy the app and are very motivated to "beat the clock". The user sets up a list of activities that shall be done sequentially in a determined order and sets an exact duration for all of them. The application than displays a giant clock that represents the total time, which reminds me of a pie or a pizza. Each activity is represented by a smaller or bigger "slice", depending on how much time it should take. In 4.5, I am showing an example morning routine of a potential user: Toilet (6m), Shower (10m), Clothes (3m), Breakfast (15m) and Brushing teeth (3m). When the user presses the "Play" button, the clock starts ticking and the clock hand starts to move. Everytime it reaches an end of an activity, it makes a sound to notify the user.

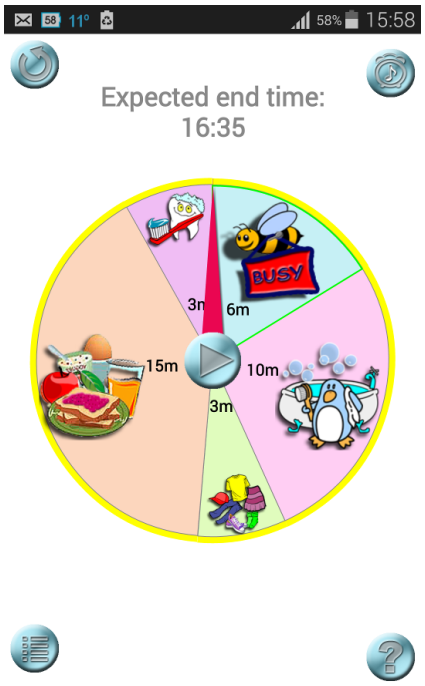

Figure 4.5: Screenshot from application Am I Late? - Example morning routine

I like this app a lot. Maybe my adult respondents could use it as well to create a good morning routine and get more organized. In my opinion, the app is very persuasive to teach the user the right behaviour. The trick is that the user is encouraged to finish each activity in the required time just before the bell sounds and then immediately move to another one in the list. The sound reminds the user to stay on plan. If the he or she falls behind the plan, he or she is motivated to hurry up so that the clock does not "win". Moreover, as the activities immediately follow one after each other, the user has no time to "think" and get distracted, which could serve as a great cure for procrastinators, at least in the morning. Actually, this could be used at any time of day for any sort of routine.

4.2.5 Twist - iPhone application

Twist [66] is said to be an iPhone application that checks the user's position on the map and updates his or her colleagues on how many minutes he or she is going to be late. In other words, it was designed to share the user's ETA (elapsed time of arrival). An interesting fact is that the application brought up a capital of 6 million dollars [63]. Unfortunately, I could not find this app in the iTunes App store [33] - maybe it is not supported here in the Czech Republic.

4.2.6 Summary - limitations, missing functions

As for automatic navigation and the calculation of distance and time, there are still too many problems. Google navigation often lies. For walking navigation, especially in cosmopolitan areas, it is still unsatisfactory and relying on it is not recommended. For example, as shown in 4.6, it does not know that there is a pedestrian underpass that people can use to get from Dejvická tram 26 station to Zikova street, it "thinks" the user has to go all the way to the right and turn back. In other cases, it can instead show a route through an area that is inaccessible to pedestrians due to temporary roadworks which Google's system is not aware of. It also does not account for possible delays like long waiting on pedestrian crossings or upward terrain slope. It also does not consider the user's age or fitness - walking speeds can differ. It also leaves out important items that take time - for example, Google does not recognize that it takes time to get down to the metro. It thinks you can hop on as soon you get to the subway station entrance. But that is not true - the reality is that it takes 3 to 5 more minutes to get through moving staircase, corridors, etc. That 5 minutes can other delays add up quickly and can be very costly if the user relies on the navigation (despite all the disclaimers). In my opinion, Google's navigation is not only unsatisfactory for chronically late people, it might even do more harm than good. Unfortunately, there does not seem to be any better alternative at the moment, or at least not here in the Czech Republic.

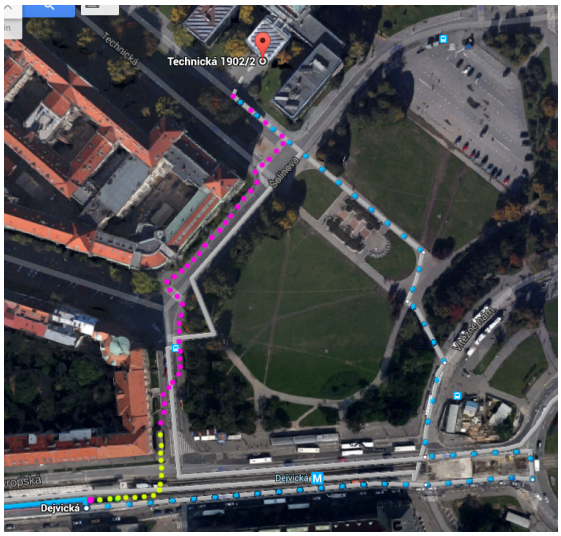

Figure 4.6: Google Navigation is unaware of pedestrian underpass. Correct route drawn in purple and yellow (underpass).

As for loading data, Time2Go, Bounce and Google Now are trying to synchronize with the user's Google Calendar events. This approach has both its pros and cons. Loading events automatically might be more comfortable than having to type in the events separately in the lateness application everytime he or she wants to add a new event. On the other hand, I do not expect the user to add new events often - I aim for users that are late repeatedly for repated avents such as school, work etc. A big limitation is also caused by the fact that the user has to input an exact GPS location for each event in Google Calendar. It seems that it is not common for users to do so. Another limitation is the fact that the user has to have GPS turned on the whole time so that the apps "know" how to calculate the route. In my opinion, chronically late people do not need any route calculation at all - they are usually late repeatedly for repeated events such as work or school - they already know how long a journey approximately takes them - their only problem is that they do not leave early enough or do not set buffer times.

Having mentioned buffer times, no apps except Bounce seem to offer this functionality (Bounce even did not work properly for me).

As for customization of plans, Time2Go has a strange system - it enables to choose a travel mode manually, but only one mode for the whole journey (walk / public transport / biking / driving) - it does not take into account the possibility that the journey consists of a number of different modes, e.g. walk-car-walk or walk-bus-walk. If the user wants to enter a custom travel time for each event specifically he or she cannot - there is only one flat interval for all events alltogether. It does not allow for any manual customization of the route either. It even does not show the exact route on the map.

Limitations of existing apps:

- Automatic route calculation is unreliable, especially for walking: inaccurate estimates, no account for important details such as terrain elevation, waiting at traffic lights or pedestrian crossing, user's fitness, complete unawereness of pedestrian underpass
- Constant need to have GPS on (drain on battery life)
- Event loaded from Google Calendar but their GPS location is usually not set by the user
- Illogical or non-existent customization of plans

Good features existing the apps have:

- Departure notifications (Time2Go, Google Now), good idea, it is just a pity they are not issued at the right time and they are difficult to set up
- Morning routine (Am I Late?), motivation to "beat the clock" and waste no time

Missing features:

- No way of measuring exact route duration (walk to bus) or activity duration (breakfast, shower) manually - the user can use a system stopwatch though - but it has no measurement history
- Buffer times not offered or app not working (Bounce)
- No self-evaluation of the user's lateness - e.g. success rate statistics
- No relevant tips or suggestions for fighting lateness

4.3 List of my planned functions and their purpose

After I analysed existing solutions and drew first sketches, I proceeded to create a list of functions that could be possible to be implemented in my Android application. Let me briefly describe the way they should work and the way they shall be helpful to the user.

4.3.1 Upcoming departure alerts (reminders)

My application will definitely be able to issue notifications accompanied with a sound alert that will remind the user that the departure time is approaching. The text could look like this: "Don't forget - you are leaving the door in 20 minutes" or "Get ready - 20 minutes to go". Existing apps (Google Now, Time2Go) offer this functionality as well. Nevertheless, I see some room for improvement - Google Now does not allow the user to choose the notification interval (15 minutes before departure by default) and neither app enables multiple notifications (such as 20 minutes before and 5 minutes before). In my opinion, it will not be difficult to implement that in my application. As for users' benefits, this function is designed to fight:

- Procrastination, last-minute preparation - the user will be pushed to start getting ready
- Attention issues - it will "wake up" the user if something else drew his or her attention

4.3.2 Departure time visible on the screen

It is good to have an overview over when the right time to leave is and how many minutes are left. Each time the user checks the phone, he or she shall be able to see the scheduled departure time. Example: "Scheduled departure 7:30 (in 30 mins)", "Scheduled departure 7:30 (in 29 mins)". For this purpose, I can build an ongoing notification that will stay on the notification drawer and get refreshed every minute. It is also important to note that an ongoing notification has an icon on the system bar, which could also show some information, even if the notification bar is not opened. This function is designed to fight:

- Underestimation of time - the user will see exactly how many minutes are left
- Motivation - the user might be motivated to succeed and "beat" the plan (as with application Am I Late)

4.3.3 Statistics of being on time / late

After each scheduled arrival time, the app can show a dialog asking whether the user arrived on time or not. The user will select either "Yes"or "No". Maybe after choosing "No", he or she could also tell how long the delay exactly was (in minutes). After a while, the use shall be able to view his or her statistics - either as percentage success rate (80%) or ratio (4 on-time arrivals : 1 late arrival). This function could be very motivational.

4.3.4 Stopwatch for measuring how much time each activity takes

As I found out in the research part, users have difficulty estimating time - their estimates tend to be too optimistic. Maybe they should take a stopwatch and measure how much each activity really takes so that they realize that how far their estimates are from reality. To elaborate, the users might want to measure each activity repeatedly (as the duration

can differ from day to day) and see the highest, lowest, average or recommended time. As for activities, the users would measure preparation tasks, such as breakfast, shower, preparing a schoolbag, getting dressed (for women). Moreover, they could measure their real travel times, such as the time it takes to get from their door to the bus stop. Drivers could also measure how much time it takes them to drive from their parking spot to the parking lot at work. I think this function will help massively with:

- Underestimation of time - the users will see exactly how much time they need for each task or journey
- Overestimation of efficiency, overbooking - the user will know exactly how much time they can save by hurrying up if they look at the lowest time in which they were able to finish the task
- Leaving out items that take time - the user will be encouraged to measure everything, from walking to the car to finding a parking spot to walking the stair. I think the user will be surprised when they find out that their journey actually takes much more time than they thought when all activities are measured properly.

4.3.5 Planning activities before journey (optional)

As in application Am I Late, where the user sets up his or her morning routine, I could help the user create a list of activities that have to be done before the journey, possibly with the option to fill in the time each activity takes. The user could track his progress in real time. However, I am not completely sure how to be original with this functionality - Am I Late already provides a good enough solution.

4.3.6 Planning a journey (optional)

The user could build their journey interactively using different building blocks corresponding to each travel mode (Walk, Elevator/Stairs, Bus, Tram, Metro, Car, Bike). My application could automatically set buffer times (editable and removable) between the journey blocks. This function would be very interesting, however, I am not sure if I will be able to implement this in time as it seems to be a very complex task. I will either have to connect to some API that works with public transport timetables (very complex to implement) or force the user to switch between my app and an external public transport application (uncomfortable). I am optimistic though that I will somehow find a way to introduce this feature as well.

4.3.7 GPS tracking with speed and location check (optional)

Originally, before writing this thesis, I was thinking about checking the user's GPS location and speed and recommending to hurry up if necessary. I described this function in my thesis task. I already have this function developed using Google Maps API [48]. However, when I consulted this function with some potential users and tested its prototype, it also turned

out that poeple did not want to have GPS on, as it consumes a lot of the phone's battery. The "hurry up" notifications also appeared to be quite annoying, especially if the user had to wait for a minute or two at a pedestrian crossing. Moreover, later I also examined the various limitations of Google's current route calculation and I started to be afraid that the app would be too unreliable. All things considered, I do not think that it is worth continuing with development of this functionality anymore. What is more, other functions on this list could provide better solutions for my target audience so they should be placed higher in the order of priorities.

4.4 Naming the application

Let me explain why the application name is now "On Time!" and not "TimeToGo", as the name of this bachelor thesis suggests. My first idea was "TimeToGo". It sounded good, so I checked Google Play Store for that name. Unfortunately, because of the way Google Play's search works, a look-up for that name did not reveal app "Time2Go" from 2012, which is a very similar time management app. It was discovered by one of my colleagues too late when it already was not possible to change the thesis name. Still, I could not keep the app's name "TimeToGo" as the idea (departure reminders) would be very similar to Time2Go and I could be accused of plagiarism. It even turned out that people thought the actual spelling of my app was "Time2Go" when I told them the name "TimeToGo".

I was forced to brainstorm a new name. My new ideas seemed to fall in one of four different groups: **positive** (I'm on Time, On Time, BeOnTime, bOnTime, EarlyBird, TimeMaster), **action seeking** - Hurry up!, Let's Go, Get Going, Come On), **not negative** - (NeverLate, NotLateAgain) and **negative** (Late Again, TardyMan).

Having assessed those names and discussed them with friends, I dedided to opt for a positive name as positive motivation is usually better than negative motivation [23]. Moreover, I wanted the users to identify with the app. Its name was supposed to represent the right behaviour the user shall achieve and keep - the desired words were "(on) time", "early" or "punctual". Action-seeking names were also good, but my idea was that the app should not push the user all the time but instead change the user's long-term behaviour in a way he or she stops having the need to use it. Eventually, I chose a short, positive and self-explanatory name "On Time".

5 Prototyping

Let me start with a quote by Mark Twain: “Supposing is good, but finding out is better.[69]” In the previous stage, I worked on my own to introduce some functions and draw first sketches of possible designs. However, I knew that it would be unwise to start with full (and time-consuming) development straight away, as there was no guarantee that users would find the functions and designs useful. If they did not, I would have wasted weeks of development time for nothing.

It is necessary to first focus on the application's usability. Usability is characterized as "the effectiveness and efficiency of the user interface and the user's reaction to that interface" and factors that matter include, for example, the ease of learning, the perceived task performance or the user's subjective satisfaction [51]. In other words, usability is the ultimate rating criteria of a successful mobile application. To test it, I will use a popular technique called formative usability testing [70], which can help the developer quickly find out whether the application's workflow is valid and if the users can achieve their goals. It can be applied very early in the design process when the application is just a prototype. According to the level of the prototype, experts talk about either lo-fi testing (with an early paper prototype) or hi-fi testing (with a partially interactive electronic prototype) [44].

5.1 Lo-Fi prototype

I decided to start with a lo-fi paper prototype first, as it is considered very cost-effective - it can be built cheaply and easily in order to detect and fix major problems early. [38]. I was inspired by Mike Kuniavski's book "Observing the User Experience: A Practitioner's Guide to User Research" [56]. In chapter 2, Kuniavski describes a micro-usability test that anyone can easily do with his or her family and friends to get a quick feedback on his or her product. In my case, the product is the Android application for chronically late people. My work should be done in five steps:

1. Find out about audience and their goals - The answer is: users want to fight their lateness, become more organized and start arriving to their destinations on time

2. Create tasks addressing those goals - In sections 5.2 and 5.3, I will describe the testing scenario and the tasks the participants had to do

3. Get the right people - I selected 5 people from the target audience (people aged 15-28 years who have some issues with time management and are trying to become more organized and punctual).

4. Watch them perform those tasks - Described in 5.4
5. Review what you have found - Described in 5.5

5.2 Real-life test scenario for Lo-Fi test

At first, I prepared a real-life scenario that represented a typical context in which a user would use my application.

The user is a chronically student (let us call him Mark) who lives in Prague at a family house at the following address: Nová Šárka 468/36, 161 00 Praha. (Please note that the address was selected randomly after looking for suitable locations on Google Maps and Street View. Neither testers nor I have any relation to that house.) He studies at the Czech Technical University in Prague at Faculty of Electrical Engineering at address Technická Technická 1902/2, 160 00 Praha 6.

He has problems with time management and is always late for his Monday seminar at school, which starts at 7:30 at Technická 2. At 7:08, he is supposed to be at station Divoká Šárka, which is an 8 minutes' walk from his house, in order to get on tram line 26 and travel to Dejvická station. Unfortunately, he always misses the tram by a minute or so. Then he has no chance to arrive on time, as the next tram makes him around 5-6 minutes late for his seminar. The tutor got really angry last time for Mark's chronical lateness and if Mark arrives late again, he will fail the course.

Now it is Sunday. Mark has just downloaded my app and he wants to make himself start going to Monday seminar on time. This is what his journey looks like:

1. Quick walk (around 8 minutes, 650 meters) to a tram stop Divoká Šárka. The student somehow always misses the tram by a minute or so - when he is on the wrong side of the road, the tram is already closing its doors and leaving.
2. 7:08 - 7:21 Tram ride (13 minutes) via line 26 from Divoká Šárka to Dejvická
3. Walk (5-6 minutes, around 350 meters) from tram stop to to school doors at Technická 2. The classroom is a 2 minutes' walk from the school doors.

5.3 Creating an interactive Lo-Fi paper prototype

After some sketching, I created paper screens for the testing - I made them out of hard paper with dimensions 8.35 cm x 14.85 cm, a little bit bigger than real phone screens. (My Galaxy S5's screen has dimensions of 6.35 cm x 11.28 cm and it is a pretty large phone.) The reason was that the smallest font I could possibly write with my black marker was still a little bit wider than real font on phone screens. I aimed for high interactivity, so I accompanied screens with cards that simulated change of content on the screens (when laid over the paper screen, covering the old content) and pop-up dialogs. The whole paper prototype is attached in the Appendix section. All screens are labeled and I will be referring to them when describing the participants' behaviour.

The test consisted of four tasks, which are further described in the subsections underneath.

During pilot testing, the tester did not have any major difficulty getting the tasks done so no significant changes to the prototype seemed necessary. Nevertheless, there was some room for improvement - for example, I realized some screens were not necessary while others were missing. I also improved the design of several screens.

5.3.1 Test A - Input of an event and a departure plan the day before

The first part of the test takes place on Sunday afternoon. Mark has launched the app for the first time. He should realize that he is supposed to enter a new plan (be at school on time) for Monday. At first, he will enter the name of the plan, the arrival time and a short decription of the exact point at which has to be at that time. Why the description? The goal is to make Mark plan accurately. As I found out in the research part, some users leave out important items that take time. In our case, such users might connect "7:30" and "at school", thinking "at the school doors". That would be wrong. The problem is that it takes 2 more minutes to get from school doors to the classroom, which the user would eventually reach at 7:32, 2 minutes late. A correct combination is either "7:28"+"at the school doors" or "7:30"+"at the classroom".

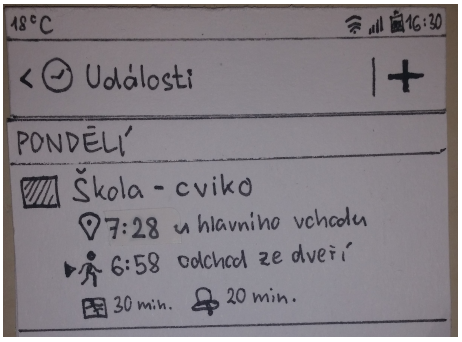

Figure 5.1: Lo-Fi, events overview

When the arrival time is set, Mark needs to set the departure time as well. There are two ways to do it. Mark can:

1. Calculate the departure time using an interactive planner, which enables him to build a journey from various travel blocks (e.g. Walk 8 minutes, Tram 26 7:08-7:23, Walk 5 minutes) and adds buffer times automatically (as shown in 5.2). To calculate the route, it offers him to launch various external navigation or timetable apps. When the journey is set up, Mark will see the necessary departure time.

2. Enter the departure time manually, e.g. 10 minutes before the tram shall leave (considering the walk usually takes him 8 minutes)

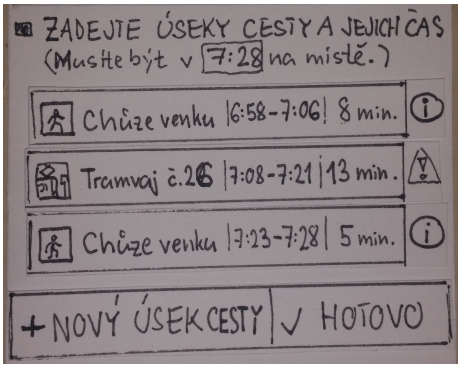

Figure 5.2: Lo-Fi, travel blocks

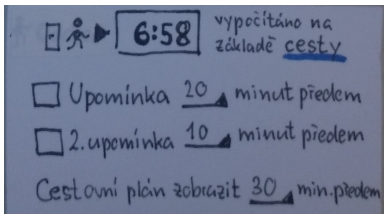

Figure 5.3: Lo-Fi, choosing when to display (up to 2) departure alerts and the ongoing notification

As shown in 5.3, after determining the exact departure time, Mark can choose when he wants the ongoing notification, such as the one in 5.4, to be displayed (obligatory) and when he wants to get an upcoming departure alert, such as the one in 5.5, to make a sound and notify him (optional).

Then he can save his plan and return the the events overview (as shown in 5.1), where the event is displayed with the desired departure plan. Mike will, for example, see the following information: School - Monday - Arrive at 7:28 at the school doors - Leave home door at 6:58. The full prototype is very large, it is attached in the Appendix section as two images - links here: 7 and 7.

5.3.2 Test B - Watching the plan in the morning

The next part of the test takes place on the following day, on Monday. Mark wakes up in the morning and based on the plan he or she set up the previous day, he will be able to see the departure time on the screen (as shown in 5.4) and will also receive timely alerts about the upcoming arrival (as shown in 5.5) . The task is easy: "Do what you can to get to the tram stop on time."

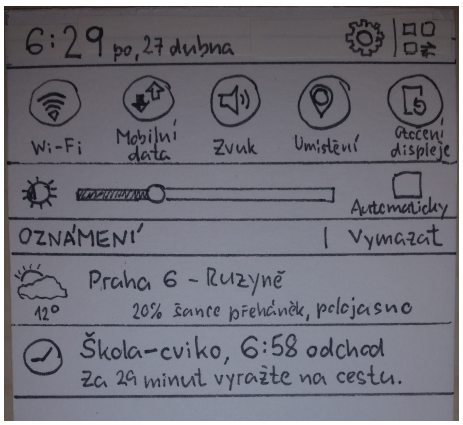

Figure 5.4: Lo-Fi, ongoing notification displaying time left until departure

With each participant, I specifically asked when exactly they would wake up if they were in Mike's shoes.

I asked what activities they would do, where would they phone be placed at each time (on the table, in a pocket etc.), when would they check the phone, and based on that information, I edited the information on the screen.

Each participant received the notifications at different times, in accordance with the exact settings they used to set their own plan in Task 1. For example, I laid cards with times "6:40", "6:45", "6:50" on the paper screen to represent interactivity of the system clock. I also had paper and scissors ready and sometimes I created new paper cards when it was necessary. The full paper prototype for test B is attached together with Test C in the appendix section, link here: 7.

5.3.3 Test C - Answering Yes/No to question "Did you arrive on time?"

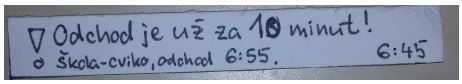

Figure 5.5: Lo-Fi, single alert about upcoming departure time

After Mark arrived at school, another notification (as shown in 5.6) was issued 1 minute after the scheduled arrival time (some participants had it set at 7:30, some at 7:28 with the 2-minute reserve). The text of the notification stood "Did you arrive on time?" and the participant was expected to click on it and in the opened screen, click on "Yes" or "No" to save their result.

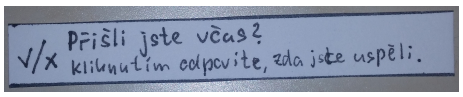

Figure 5.6: Lo-Fi, dialog inquiring whether the user arrived on time

5.3.4 Test D - Measuring activities using stopwatch

The last part of the test takes place on Tuesday morning. Mark likes the application and also wants to try out the stopwatch function to measure how much time his breakfast takes and how much time he spends walking to the tram stop.

The task is very simple - in the morning, he measures both activities. The task was to just quickly test the workflow of the stopwatch. However, if Mark used the app regularly to measure the duration of his breakfast for a few days, the measuring section could look as shown in 5.7. The full paper prototype for test D is attached in the Appendix section - link here: 7.

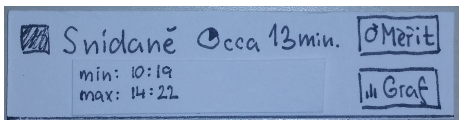

Figure 5.7: Lo-Fi, measuring activities

5.4 User testing of the Lo-Fi prototype

5.4.1 Participant 1

The first participant was a 15-year-old student of grammar school.

At the beggining of Test A, when he "launched" the application, he suggested that the app could show a pop-up dialog informing the user that it is the first launch and giving some tips on how to uset the application. When setting up his plan, he wrote name "School" but underneath (as shown in 5.8) left the time at 8:00 (forgot to change it to 7:30 or 7:28 according to the test scenario). Then he thought about the text note field

- he was thinking he was expected to enter some sort of a GPS location, not just a text note. When he clicked on it, I said the field only allowed simple text. He seemed confused. Eventually, I had to explain that he is only expected to write a short text note - e.g. "at school doors". Then he realized he forgot to change the time and set it to "7:28".

To set the departure time, he chose the "Calculate" option (in 5.10). In the interactive planner, he first set a "Walk" travel block that took 8 minutes. Then he set another block, this time "Tram" - he understood that to fill in the tram information (line, departure, arrival) he had to launch an external timetables application (as shown in 5.9). He said that if he remembered (as the scenario student Mark) the exact time, he would not open any external apps, and if he did not, he would probably prefer to find the exact tram on his PC, for example on Czech public transport site Idos [18]. When he set up the three blocks (Walk, tram, walk) he could see the blocks as in 5.2. He was surprised that there were 2 minutes buffer times added automatically between the travel blocks (E.g. walk started at 6:58, took 8 minutes and tram left at 7:58) , but he noticed the icons that appeared on the right and upon clicking on one of the icons, he was shown an explanatory dialog saying "2 minute buffer time added automatically. Delete? Edit? OK?". He liked that feature. When he saved the route, the departure time (from Mark's home door) was set at 6:58.

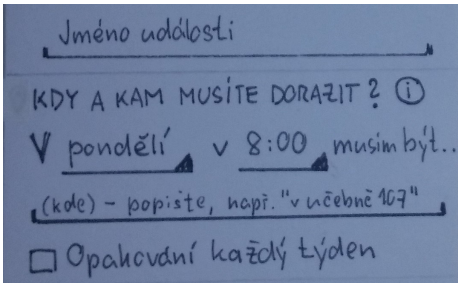

Figure 5.8: Lo-Fi, part of setting a new event

In 5.3, he set two notifications at 10 and 4 minutes before departure. After a moment, he changed his mind and changed the notification times to 5 and 2 minutes before departure. Then se set the ongoing notification to appear 20 minutes before departure (but said it would depend on when he would wake up).

In test B or C ("in the morning"), he liked all features. As the notifications appeared at 6:53 and 6:56, 5 and 2 minutes before departure, I asked him if it would be sufficient to be notified 5 minutes before departure, he said that the 5 minutes were all he needed to get out of the house in time. The success inquiry dialog seemed interesting to him. In test D, he considered everything as "normal".

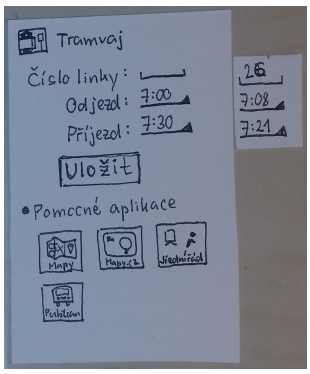

Figure 5.9: Lo-Fi, tram travel block

5.4.2 Participant 2

The second participant was a 23-year-old entrepreneur.

In test A, he was proceeding normally without problems up to 5.8, where he said he would like to see checkboxes / toggle buttons for all days of week e.g. ("Mon"-"Tue"-... all the way to "Sun") so that he could set the event for multiple days. He also said he would

not like to fill in the description (did not find it necessary).

In 5.10, he said: "Why would I calculate the time when I can enter it manually?" Eventually, he decided to try aut the "Calculate" option and got into the interactive planner. There, he was at first glance dissatisfied to find out that it is not connected to timetables and the user needs to launch external applications. It was confusing for him to such a point that he said he would close the application and delete it. Or, he would simply find the route on his PC and enter the departure time manually. Anyway, he gave it a try, entered the walk, the tram and the other walk. When setting up the tram information, as shown in 5.9, he has some insights about the layout of the fields the user has to enter. Overall, he liked the feature of automatic buffer times (as in 5.2), he also clicked on the information icon like tester 1. On the other hand, he said the setup of the travel blocks is too uncomfortable and he would probably use his PC for findind a route instead. He asked if I am planning to connect the planner with all API's - timetables, maps, navigation - in such a case he would find it more useful.

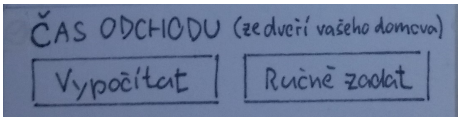

Figure 5.10: Lo-Fi, the option to either calculate the departure time based on route (left) or enter departure time manually (right)

In 5.3, he was at first confused about what the difference between the "alerts" (5.5) and the "travel plan" (5.4) (as written in Czech on the prototype) was. Eventually, he set two notifications at 60 minutes and 10 minutes before departure. He would want the ongoing notification to display on the evening of the previous day - the app only offered minutes to be chosen so he eventually set also 60 minutes before.

In test B, he liked the notification features and there was no issue. When the scheduled departure time (6:58) came, he was suprised that the ongoing notification disappeared. He said it could stay up to the time of arrival and say things like: "Now you should be walking for the bus" or "Now you should be on the tram". In test C, he found no problems. In test D, he said the stopwatch functionality was useful. The only thing he would change is the three buttons - he would make the design clearer with only two buttons.

5.4.3 Participant 3

The third participant was a 23-year-old college student.

In test A, he found no issues and proceeded quickly as expected, he entered a text note "at classroom " at 7:30 in accordance with the test scenario I presented. In 5.10, he selected "Enter manually" to set the departure time manually, so he did not get to the interactive planner. He set 6:55. Underneath, with a screen content looking similar to 5.3, he used two alerts, 15 minutes before and 6 minutes before. He was unhappy that he could not add one more alert, 20 minutes before. However, he was confused about what "display travel plan" meant. When I explained the functionality, he recommended to call it as "counter" or "countdown". Eventually, he set his plan properly.

In test B, we were talking about what his morning routine was and what he would do at each point the notification would be fired. I simulated that on the paper prototypes and

he found everything logical. It turned out that thanks to the notifications, he would have no difficulty at all leaving the door at 6:55.

In test C, he was surprised and was amazed at the statistics functionality. However, we found out that the he would not want to get the "Did you arrive on time" message exactly one minute (7:31) after the arrival time. The reason was that he sometimes forgets to switch sounds off and the sound of the notification could annoy other people and the teacher.

In test D, he found the design all right but he gave me a few tips on how to measure activities better - for example, he said the application could enable him to measure multiple activities in a sequence - the user's only task would be to click a "Switch" button to let the application know that the current activity has finished and it is possible to start immediately measuring the next activity in the sequence. This reminds me of the application Am I Late (see here:4.2.4).

5.4.4 Participant 4

The fourth participant was a 25-year-old entrepreneur.

In test A, he set the event name, he checked the "repeat"checkbox and entered text note "at school", meaning "in front of the door" to arrive at 7:28. He chose to calculate the route and in the planner, he did something unexpected: He only set up one route segment (walk, 8 minutes) and clicked on "DONE". The application said "Leave the door at 7:20" (unexpected - he forgot to enter the tram and the other walk). Unfortunately, there was no "edit" button to alter the plan (add two more segments). He had to click on the system "Back" button and start over. When the route was finally set, the recommended departure time was 6:58. The participant set one alert 5 minutes before and was thinking about the second one. It turned out that he wanted to use the notification as an alarm clock. Eventually, he chose 28 minutes as he wanted to be woken up at 6:30.

In test B, this participant was the only one who would click on the upcoming departure notification at 6:30. I did not have any paper ready for that, as there is no extra functionality that the notification should do. Maybe the user shall see some sort of an overview of his or her plan, but the plan is apparent anough from the notification text itself. Anyway, after reading it, he would swipe the notification to remove it (normal behaviour). Overall, it turned out that he would not prepare at the last moment and set off late, which he would do if there were no alerts and notification. In test D, there were no issues and no comments.

5.4.5 Participant 5

The fifth participant was a 23-year-old employee.

In test A, he entered the event name, time and description (7:30,"classroom") and then he said he would navigate out of my application to launch Pubtran [67], the popular Czech public transport timetables application to find out about the tram. I had 2 paper prototypes of a generic timetable application and an overview of currently running applications ready (as I expected someone to use it) and simulated that functionality. The participant

found out that the tram left at 7:08, so he returned back to my application and entered 6:55 manually, giving himself 13 minutes time with some buffer (the walk takes around 8 minutes, according to the scenario). He set only two notifications, 3 and 15 minutes before departure. He did not, to my surprise, want the ongoing notification to be displayed. At first glance, he thought the "travel plan" would use Internet access and drain his battery - given that I did not provide any option to switch it off (no checkbox), he set 0 minutes.

In test B, he was left without the ongoing notification, but it turned out that the two alerts were sufficient for him. He would have no difficulty getting ready and setting off for the journey.

In tests C and D, he proceeded as expected and he did not have any particular comments.

5.5 Results of Lo-Fi testing

5.5.1 What worked well

In general, the whole real-time interaction of the application with the user in was considered successful. Participants liked the upcoming departure alerts, the countdown ongoing notification and the dialog for storing statistics of the user's punctuality. The stopwatch functionality was also considered all right.

5.5.2 What did not work well

The problem was with setting up all the real-time interaction in advance. The number one misunderstanding came in Test A - not everybody understood the text decription of the arrival location. Some people thought they should enter GPS coordinates (experience from other Android applications). Another issue was that the user could not easily set multiple days for the event - for instance, if the user had school from 7:30 every Monday, Tuesday and Wednesday. The interactive planner was also problematic - it seemed uncomfortable because it did not offer maps or GPS navigation, travel times had to be calculated separately in external apps and then entered in my app. In 5.3, the text for the single alert notification stood "alert" in Czech, which was clear. What was not clear was the text "Display travel plan at..", which referred to the ongoing notification that shows the remaining time until departure and gets refreshed every minute up until the departure (as shown in 5.4). People thought that "travel plan" had be related to some maps, which is not what they expected.

5.5.3 Unexpected findings

The lo-fi testing also provided me with new and somewhat unexpected insights. For example, I did not expect that some people (participant 4) would use my alerts as an alarm clock. I also did not anticipate that some users would not want to see the ongoing notification with remaining time and only use the single alerts.

5.5.4 Decisions made after paper prototype testing

1. When entering an event, the user shall see 7 toggle buttons that will allow to select multiple days on which to repeat the event.

2. Launching the ongoing notification shall not be refferred to as "Display travel plan" as it is confusing - it looks like there are some maps involved. A clearer name could be something like "Launch countdown" or "Start showing remaining time" - it is only related to the time of departure, not to any route or map.

3. More than two upcoming departure alerts shall be possible (the prototype allowed only up to 2)

4. It must be determined what activity the user shall see if he or she clicks on the alert notification (as in 5.5). For example, some general overview, like: "You need to be on time for event ABC. You should leave house in X minutes (at HH:MM)." Alternatively, I can state that clicking on the notification shall do nothing, as all information the user needs is already contained in the text of the ongoing notification (as in 5.4).

5. The "Did you arrive on time?" notification shall either have no sound or shall not be fired exactly one minute after scheduled arrival time (in case the user does not manage to turn sounds off in time and the sound annoys other people).

6. I decided to drop the interactive planner. Two participants said they would prefer their PC to find the route anyway. Two did not get to the planner at all, as they simply chose to set the departure time manually (using the right button in 5.10). According to the participants, the interactive planner shall either be completely connected with everything (use timetables API and maps API) or not be used at all. As programming such a fully connected planner with such complex functionality might take up to 10-20 weeks of development and most users still probably would not use it (preferring their PC and web public transport timetable), I decided to keep it only as a potential upgrade.

5.6 Hi-Fi testing

I was eventually able to test the application on real devices in the form of a functional high-fidelity (hi-fi) prototype [24] in time. The prototype already had a basic GUI and enabled the user to experience the main functionality on his or her own Android device.

The reason why I opted for a very high-level prototype was the risk that another low-level prototype would take up too much time. There was around a month left after lo-fi testing and it turned out that the development part and bug fixing would take me a lot more time than I expected (an excellent example of Underestimation and planning fallacy, as described in 2.2.1). Fortunately, I gave myself enough buffer time (buffer times were described in 2.2.6) in order to finish and test the hi-fi prototype just in time. After writing

this thesis. the development will continue for many more weeks with alpha testing folowed by a public release (more in).

During development of the hi-fi prototype, I gradually tested the application on a variety of real and emulated devices to ensure cross device compatibility [10]. There were a few issues that had to be solved, such as cluttered UI elements on small screens or sound not being played. The application was tested on the various real and emulated devices (emulated devices made use of the AVD manager [14] in Android Studio). When these issues were solved and the core user experience was secured, I proceeded to test the application with users on real devices in real context.

The prototype allowed the user to add a plan (enter the name, days, time of arrival, textual note about arrival place, time of departure from home), choose which types of notifications they wanted to receive (ongoing counter, 1-2 single alerts). Later, at the time they set, they experienced the interaction of the application through notifications. When adding the plan, there were two hint dialogs that could be opened by clicking on the questionmark buttons to explain the functions of the respective notification types.

5.6.1 Participant 1

Participant 1 (male, employee and student) tested the prototype on his own Zappo smartphone (with Android version 4.1.2). He voiced some doubts about the effect of the application. He mentioned that people might be too lazy to use it, to which I can reply that he is not a typical user and that people who will download the app will represent those who did find at least some effort and already decided to do something about their lateness.

In real context, he would use the app with destination set only to his bus stop (5 minutes' walk) even though he goes all the way to Prague to school using bus, tram and one more walk segment.

His answers are attached on the CD together with the answers of two other testers.

5.6.2 Participant 2

Participant 2 (male, entrepreneur and student) tested the application on his Android 5 phone, as shown in 5.11 where the first technical test is displayed. He later discovered a bug when adding a plan with time lower than the current time. In real context test, he used the following combination when editing a plan (from above): "Work",Mon-Tue-Wed-Thu-Fri,6:00,"base",5:00, 15, 15, 2.

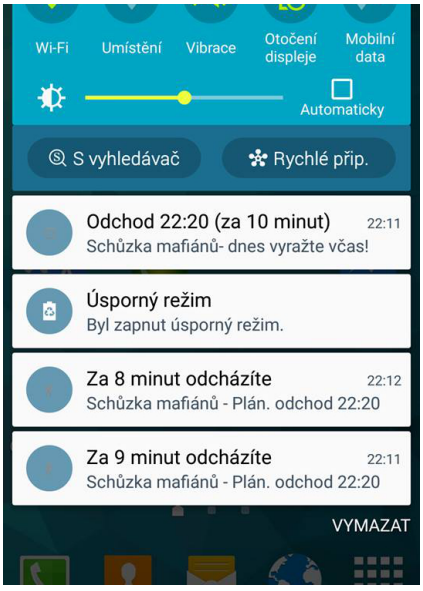

Figure 5.11: Notification on participant's Android 5 phone

5.6.3 Participant 3

Participant 3 (female, student) wanted the app to be tested on her own Samsung Galaxy S3 mini (scre. dimensions 480x800). Surprisingly, after

I sent her the .apk file, something really strange happened. After clicking on a downloaded .apk file, all phones display dialog like "Complete action using... Packagemanager ... or Verify and install (Google)". Surprisingly, her phone offered two different absolutely unrelated options: "Complete action using... (one Czech mobile banking application) ... or Microsoft office". It was strange, she had unofficial apps installation on and in the emulator, on a 480x800 screen phone with API 16, everything worked normally. She had to test the app on my Samsung Galaxy S3 then.

She said the idea of the application was not bad but was not sure if it would make people really come on time - she pointed out that people have to first start by changing their own attitude. I replied that the people who are going to use the application will already fullfil this requirement because if they did not want to change their attitude to lateness, they would not download the application in the first place.

She also suggested that the design could be more interesting in other colors. She set both types of notification - she liked the silent ongoing countdown until departure but did not like the alert notification as she prefers not to be annoyed. To be completely honest, she is late only from time to time and not completely chronically - maybe real chronical latecomers would prefer to be annoyed (and forced to arrive on time). But that does not matter - the user is free to uncheck the alert notification checkbox and make do with the ongoing notification only.

5.6.4 Formative evaluation

The participants were subsequently sent a brief questionnaire in which I asked 4 questions for close-ended rating of 1(best), 2, 3, 4 or 5 (worst). The total overall score in the close-ended part was 2.53, slightly to the positive side.

- Idea; average rating 2.67
- Potential practical benefits of the application; average rating 3.00
- Plan input - Design; average rating 2.33
- Quality of interaction using notifications; average rating 2.33

I also asked a couple of open-ended questions such as what they liked, what they did not, how the application could be improved an so on.

Overall, it seems that participants liked the idea and the design .

However, some testers of were not completely sure about the practical benefits, but that might be due to the fact that they were not really chronically.

5.6.5 Insights from hi-fi testing

There were a improvement suggestions including:

- Making the alert dialogs clearer
- Pre-filling the colon sign (":") in text fields so that typing "1","0","0","0" is enough to input "10:00".

I also confirmed my opinion that the interactive planner for planning long journeys was not such a great idea. In the scenario of participant 1, it was apparent that there is basically no need to plan the whole journey all the way to school (walk, bus, train, walk to school) - the only thing that mattered to the user was the first part - walking to the bus stop. If he manages to get there on time, he is safe.

The hi-fi prototype also revealed two bugs - one when adding a plan that has depature before current time and one with a notification alert - will be fixed very soon in upcoming version.

This testing could have been more thorough if I had more time left but the upcoming versions will be tested thoroughly. It will include many more functions - maybe it will be more interesting and I will be able to bring more participants. For information about the current version of On Time!, read appendix section User Guide - 7.

6 Implementation

6.1 Used tools

The application was written in Java programming language [17] (Java SE version was 1.8.0_45-b14) with the use of libraries that are included in Android SDK tools [4]. The minimum SDK was set at 16 (Android 4.1 Jelly Bean, API 16) and the target SDK that the project was compiled with was set at 22 (Android 5.1 Lollipop, API 22) [6]. For development, I used the free IDE Android Studio [5], provided by Google. Most USB debugging was done with my old phone Samsung Galaxy S3, some was made in the Android Studio emulator [14] on several emulated devices with various distinct API version and screen sizes.

6.2 Database model

Figure 6.1 shows the current hierarchical database model of the application, made with free online tool Creately [9]. Let me explain what each object represents:

- Plan - holds unique information about a departure plan, e.g. "School", arrival 7:55, departure 7:35, days:Mon,Tue,Wed,Thu,Fri, . It is described by class **Plan** in package **data**.
- AlarmX - It holds information about a single repeated alarm that shall wake up the device to send a notification at a given time. The reason why I am using this object is that when my application schedules an alarm, it must use a unique ID (here denoted as **android_id** field) for that alarm and remember it, otherwise it will not be possible to remove the scheduled alarm back from the system. More in section 6.3. It is connected to **Plan** by foreign key **plan_id**. It is important to note that the

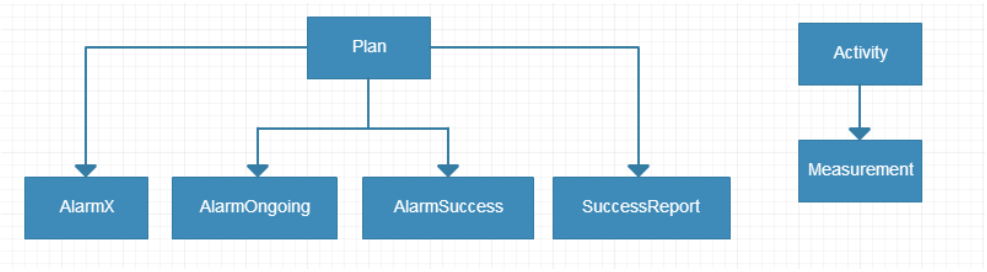

Figure 6.1: Hierarchical model of the database

alarm shall be repeating, so a plan that has 5 days activated will create 5 AlarmX objects in the database, no need to add 5 more for each week. The repeating has no finite duration. When the user decides to delete the plan, all 5 alarms shall be removed, together with all possible repeating.

- AlarmOngoing. Again, this object serves for storing a unique **android_id**. This time, it represents the alarm that starts an ongoing notification. It is described by class AlarmOngoing in package data.
- AlarmSuccess Again, this object serves for storing a unique **android_id**. This time, it represents the alarm that starts an ongoing notification. It is described by class AlarmSuccess in package data. Please note that the hi-fi prototype did not yet make use of this object.
- SuccessReport - This object provides information about a single success or fail in being on time for a given plan. After the time of arrival passes, the application will show a dialog asking the user whether he or she was on time. After clicking on either Yes or No, the application will store a SuccessReport with column on_time set as either 1 or 0. Please note that the hi-fi prototype did not yet make use of this object.
- Activity - Denotes a daily activity the user decides to measure (such as "Breakfast", "Shower", "Mowing the lawn", "Laundry"). Please note that the hi-fi prototype did not yet make use of this object.
- Measurement - Denotes a single measurement of the time it took a user to finish a given Activity, captured either by stopwatch function inside On Time application or entered manually by the user (if he or she measured it elsewhere). The application will load all measurements for a given activity when the user decides to calculate Please note that the hi-fi prototype did not yet make use of this object.

The Java code of a database handler that works with the database is written in class **DBHandler** in package **data**. Android uses a Please note that only classes Plan, AlarmX, AlarmOngoing were fully implemented and successfully tested at the time of finishing this thesis.

6.3 Scheduling notifications and background work

An activity [2] usually represents what the user can see on the screen an interact with inside an application. When creating a new plan, the user is inside EditPlanActivity. After the user sets a notification (e.g. an ongoing notification) and saves the plan, the activity does some database work and finally calls an object of class AlarmManager [3], which schedules a PendingIntent. Let me cite its description [22]: "By giving a PendingIntent to another application, you are granting it the right to perform the operation you have specified as if the other application was yourself (with the same permissions and identity)." The Pending-Intent contains information about the plan the user has set and is opened at the pre-defined

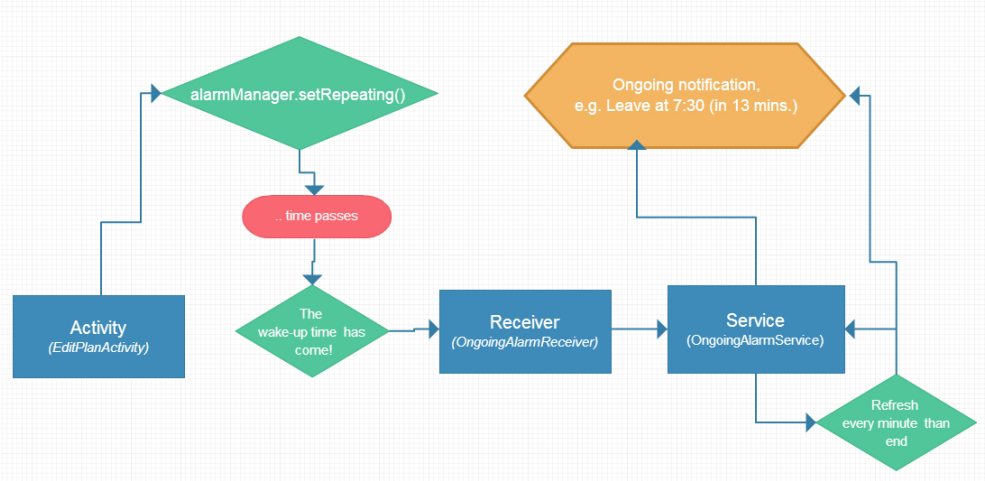

Figure 6.2: A simplified flowchart of the background work that is done with ongoing notification

time (in milliseconds) by the system. The PendingIntent then calls a BroadcastReceiver (represented by class OngoingAlarmReceiver) which immediately calls a Service [26] (OngoingAlarmService), which issues the ongoing notification using Notification.Builder [21]. A part of the code that issues the notification is shown in 6.1.

Algorithm 6.1 Issuing a notification

```
mNotificationBuilder = new Notification.Builder(context);
mNotificationBuilder.setContentTitle(contentTitleFixedPart+contentTitleVariablePart);
mNotificationBuilder.setContentText(contentText); mNotificationBuilder.setTicker(tickerFixedPart
+ tickerVariablePart);
// ..left out code, setting the icon, priority etc.
// Starting the ongoing notification in the foreground
Notification n = mNotificationBuilder.build();
n.flags = Notification.FLAG_ONGOING_EVENT; startForeground(notificationOngoingID, n);
```

It is essential that the OngoingNotificationsService runs in a thread separate from the main application. Suitable classes for that purpose include Handler and Runnable [15].

Algorithm 6.2 Portions of OngoingNotificationService.java code

```
/* At the end of onStart() method, the OngoingNotificationService initializes
a Handler that will refresh the notification every 60 seconds (5 mins left ...  4 mins
left ...  3mins left ...)  */
mPeriodicEventHandler = new Handler();
mPeriodicEventHandler.postDelayed(doPeriodicTask, PERIODIC_EVENT_TIMEOUT);
} // end of onStart() method of class
/* Definition the doPeriodicTask runnable that is launched every 60 seconds
as a variable of OngoingNotificationService class */
private Runnable doPeriodicTask = new Runnable() {
public void run() {
// ..  left out code ..  refreshing the notification text, decrementing remainging minutes
count etc.
```

6.4 User Interface

An Activity [2] can be understood as a screen and the interaction on it. Each activity needs to have a defined layout. It can either have a layout stored in an XML file, for instance, the layout of EditPlanActivity is defined in src/res/main/activity_edit_plan.xml ot it can be created programmatically from Java code. The Java code can also manipulate with layout loaded from XML file and edit it dynamically. In 6.3, you can see

The strings (text parts) are not hard-coded in the Java code. Instead, all UI strings are defined in an XML file in directory src/res/main/values/strings.xml, as suggested in6.3, In accordance with common conventions. They are called with method getString (example in 6.4). The questionmark buttons near the notification settings in 6.3, when clicked, show an AlertDialog [27] that informs the user how the notifications work.

Algorithm 6.3 Portion of strings.xml file

```
<!-- Activity titles -->
<string name="title_home_activity">On Time!</string>
<string name="title_activity_view_plans">Plány odchodu</string>
<string name="title_creating_plan">Nový plán odchodu</string>
<string name="title_editing_plan">Upravit plán</string>
```

Algorithm 6.4 Example usage of strings, portions of SingleAlarmService.java

```
contentTitleFixedPart = getString(R.string.notif_single_title1);
// ....
// example:  if 5 or more minutes, Czech people say "5 minut", if there were 2-4min.  they
say "minuty"
contentTitleVariablePart += getString(R.string.notif_in5min); // returns "minut" in Czech
version
```

6.5 Credits

My credits belong to all professional Android developers who invested their time in providing comprehensive material that increases the speed of learning for beginners like me. For example, I can recommend a book for beginning Android programmers [37] by Barry Burd. I also highly recommend portals Stackoverflow [28] or AndroidCentral [7], where I sometimes received answers to my questions and where I also learned a lot by studying answers to questions that other developers had.

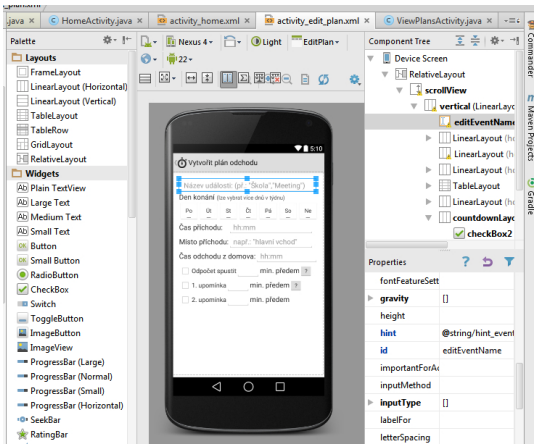

Figure 6.3: Designer within Android Studio enables comfortable editing of XML layout.

7 Summary

I invested a lot of time in finding roots of lateness and its solutions and I think I now have a lot of material to work with.

Development of the mobile application got to the stage where the user can experience the core functionality. More functionality is going to be added very soon in the upcoming alpha testing version.

There is a lot of future work to be done - users' feedback in lo-fi testing and hi-fi testing was overall good, which gives me motivation to continue with the application further and soon publish it on Google Play for general public. What I can focus on right now is improving design (I am considering cooperation with a professional designer), making the application more user-friendly and adding more functions.

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Appendix A - List of Abbreviations

ADD Attention Deficit Disorder

ADHD Attention Deficit Hyperactivity Disorder

API Application Interface

app application

CEO Chief Executive Officer

IDE Interactive Development Environment

GPS Global Positioning System

Hi-Fi High Fidelity

Lo-Fi Low Fidelity

SDK Software Development Kit

UCD User-Centered Design

UI User Interface

Wi-Fi (Indirect meaning) Local area wireless computer networking technology

Appendix B - User guide

Images

Installation guide

Participants of hi-fi testing were provided with an .apk installation file of the prototype, which is attached on the included CD together with its source code. A new more advanced version will be released for alpha testing, folowed by a public version. Underneath you can see the access URLs:

Jak používat aplikaci

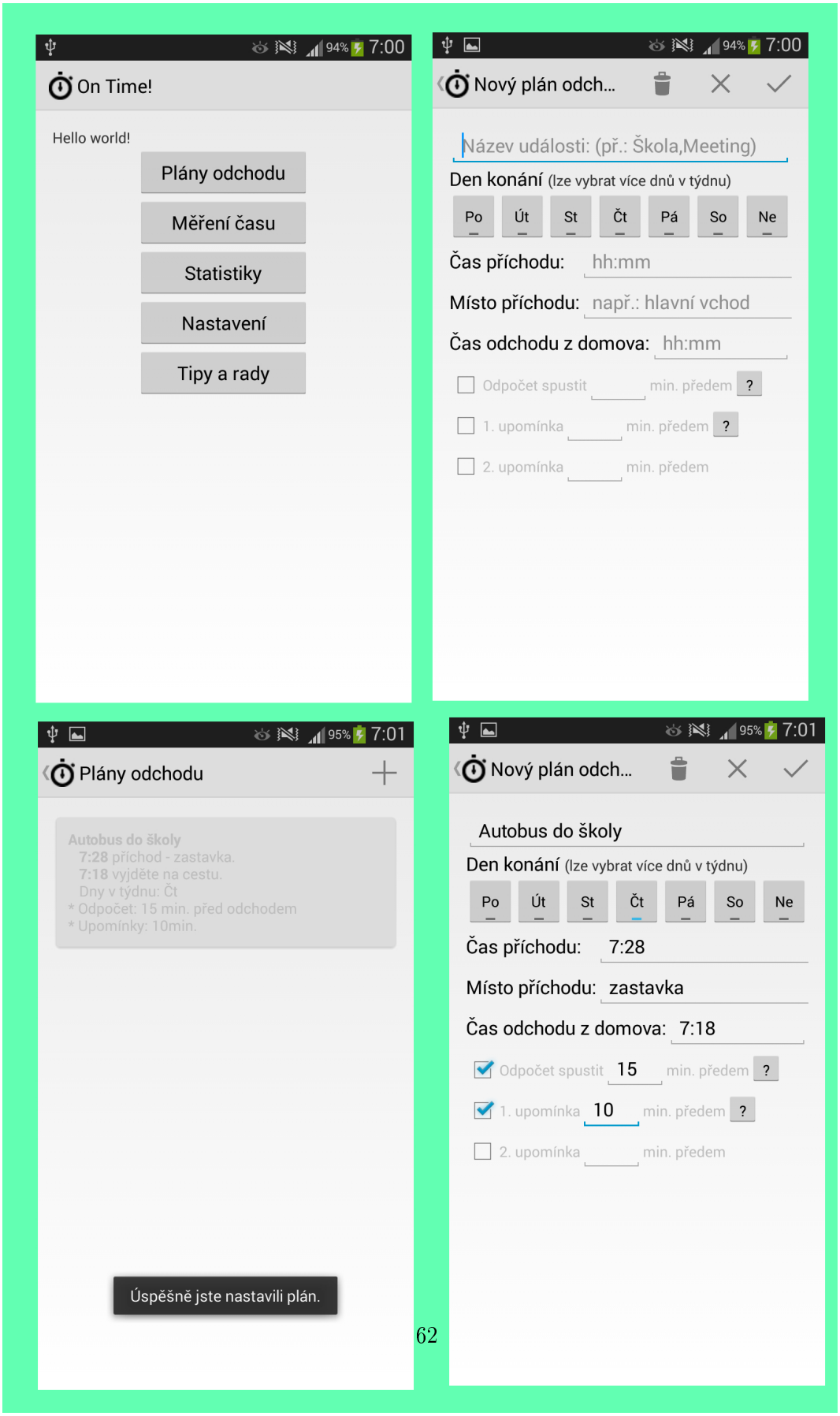
Omlouvám se, nedostatek času mi nedovolí udělat kompletnější návod, musím odevzdat bakalářskou práci. Pokusil jsem se naznačit návod k používání akutální verze aplikace alespoň na obrázcích umístěných na následujících dvou stranách.

V dalších, kompletnějších verzích aplikace On Time! budete moci z hlavního menu otevřít i následující sekce:

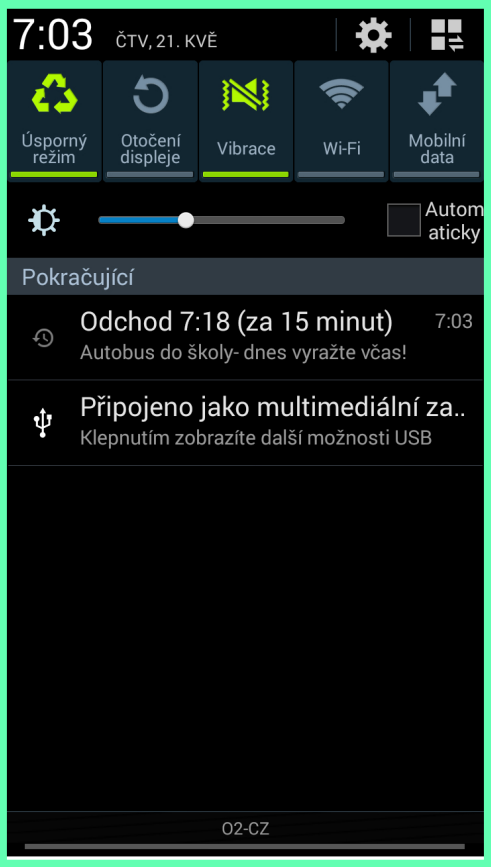
- Měření času - budete moci (opakovaně) měřit určité denní aktivity (snídaně, koupelna, učení, práce...) a získáte lepší přehled o tom, jak dlouho vám co trvá
- Statistiky - uvidíte, jak často chodíte včas nebo pozdě na které události, ve které dny, časy, atd.
- Nastavení - nastavíte si zvuk či hlasitost notifikace a další parametry aplikace

Algorithm 7.1 URLs for access to alpha testing and for upcoming public version

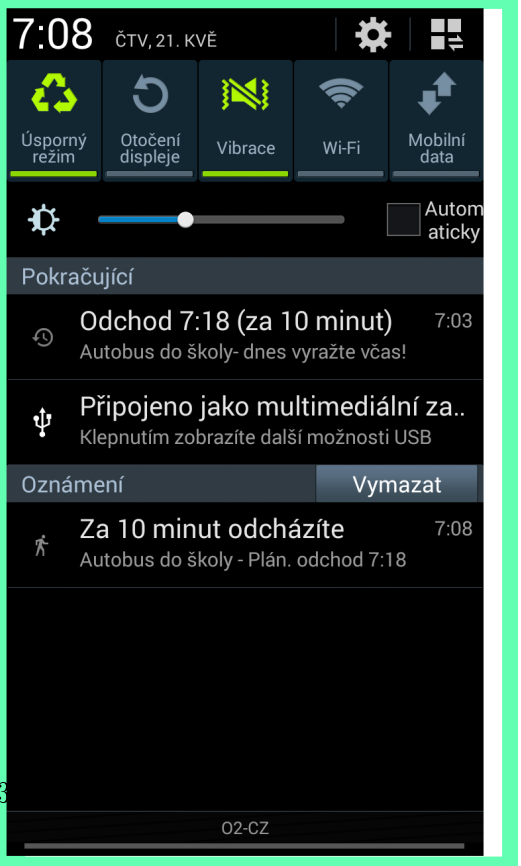
```
* Alpha testing - must be approved by me *
https://plus.google.com/communities/116089209309283261816 // join here
https://play.google.com/store/apps/details?id=cz.cvut.fel.ontime // then visit this link
* Public version when available *
https://play.google.com/store/apps/details?id=cz.cvut.fel.ontime
```


94% 7:00
On Time!
Hello world!
Plány odchodu
Měření času
Statistiky
Nastavení
Tipy a rady
94% 7:00
Nový plán odch...
Název události: (př.: Škola,Meeting)
Den konání (lze vybrat více dnů v týdnu)
Po Út St Čt Pá So Ne
Čas příchodu: hh:mm
Místo příchodu: např.: hlavní vchod
Čas odchodu z domova: hh:mm
Odpočet spustit min. předem ?
1. upomínka min. předem ?
2. upomínka min. předem
95% 7:01
Plány odchodu
Autobus do školy
7:28 příchod - zastavka.
7:18 vyjděte na cestu.
Dny v týdnu: Čt
* Odpočet: 15 min. před odchodem
* Upomínky: 10min.
Úspěšně jste nastavili plán.
95% 7:01
Nový plán odch...
Autobus do školy
Den konání (lze vybrat více dnů v týdnu)
Po Út St Čt Pá So Ne
Čas příchodu: 7:28
Místo příchodu: zastavka
Čas odchodu z domova: 7:18
Odpočet spustit 15 min. předem ?
1. upomínka 10 min. předem ?
2. upomínka min. předem

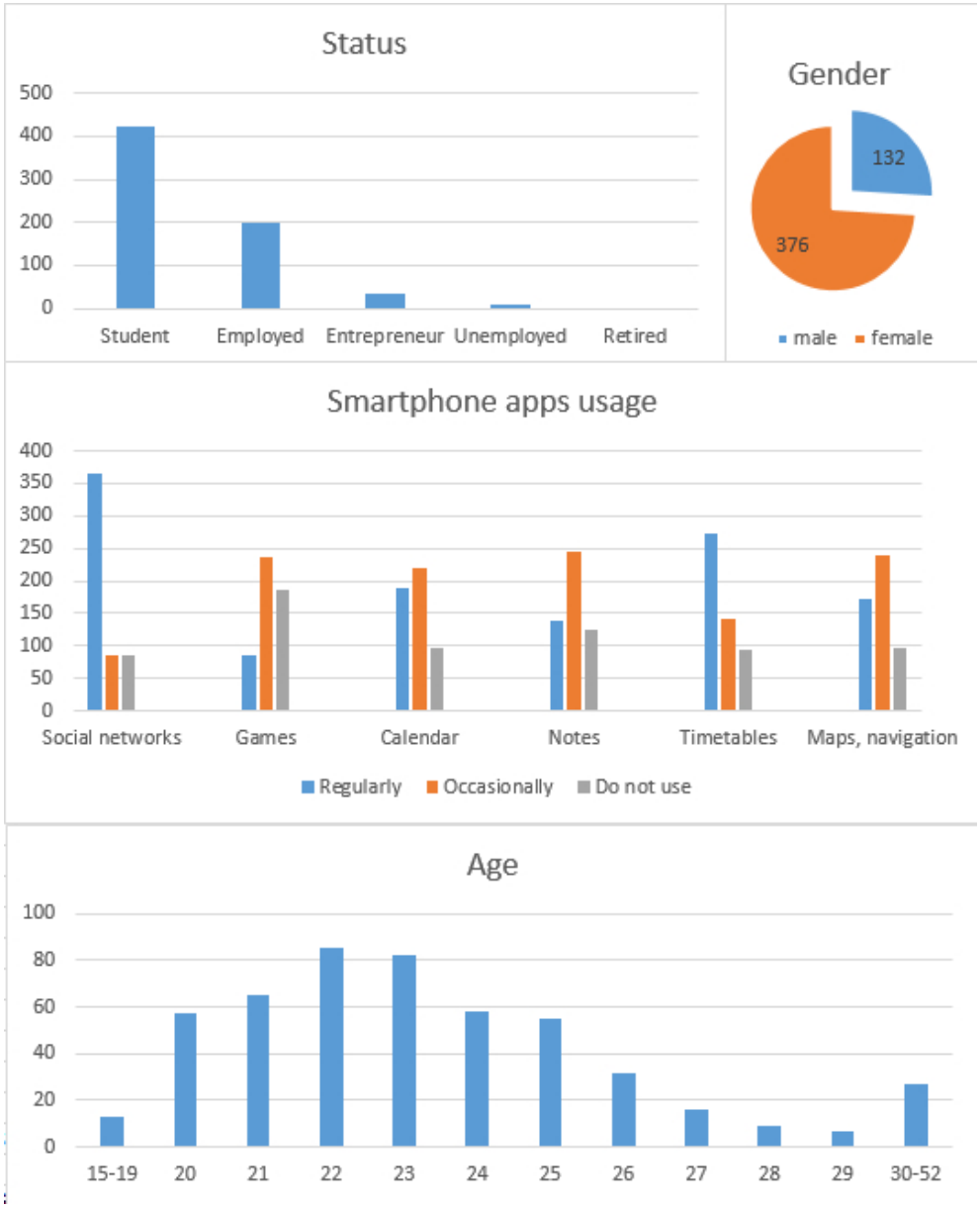

95% 7:03


7:03
ČTV, 21. KVĚ
Úsporný režim
Otočení displeje
Vibrace
Wi-Fi
Mobilní data
Autom aticky
Pokračující
Odchod 7:18 (za 15 minut)
7:03
Autobus do školy- dnes vyražte včas!
Připojeno jako multimediální za..
Klepnutím zobrazíte další možnosti USB
O2-CZ


Za 10 minut odcházíte


7:08
ČTV, 21. KVĚ
Úsporný režim
Otočení displeje
Vibrace
Wi-Fi
Mobilní data
Autom aticky
Pokračující
Odchod 7:18 (za 10 minut)
7:03
Autobus do školy- dnes vyražte včas!
Připojeno jako multimediální za..
Klepnutím zobrazíte další možnosti USB
Oznámení
Vymazat
Za 10 minut odcházíte
7:08
Autobus do školy - Plán. odchod 7:18
O2-CZ

Appendix C - Complementary Images



1. A full graphical overview of the distribution of respondents

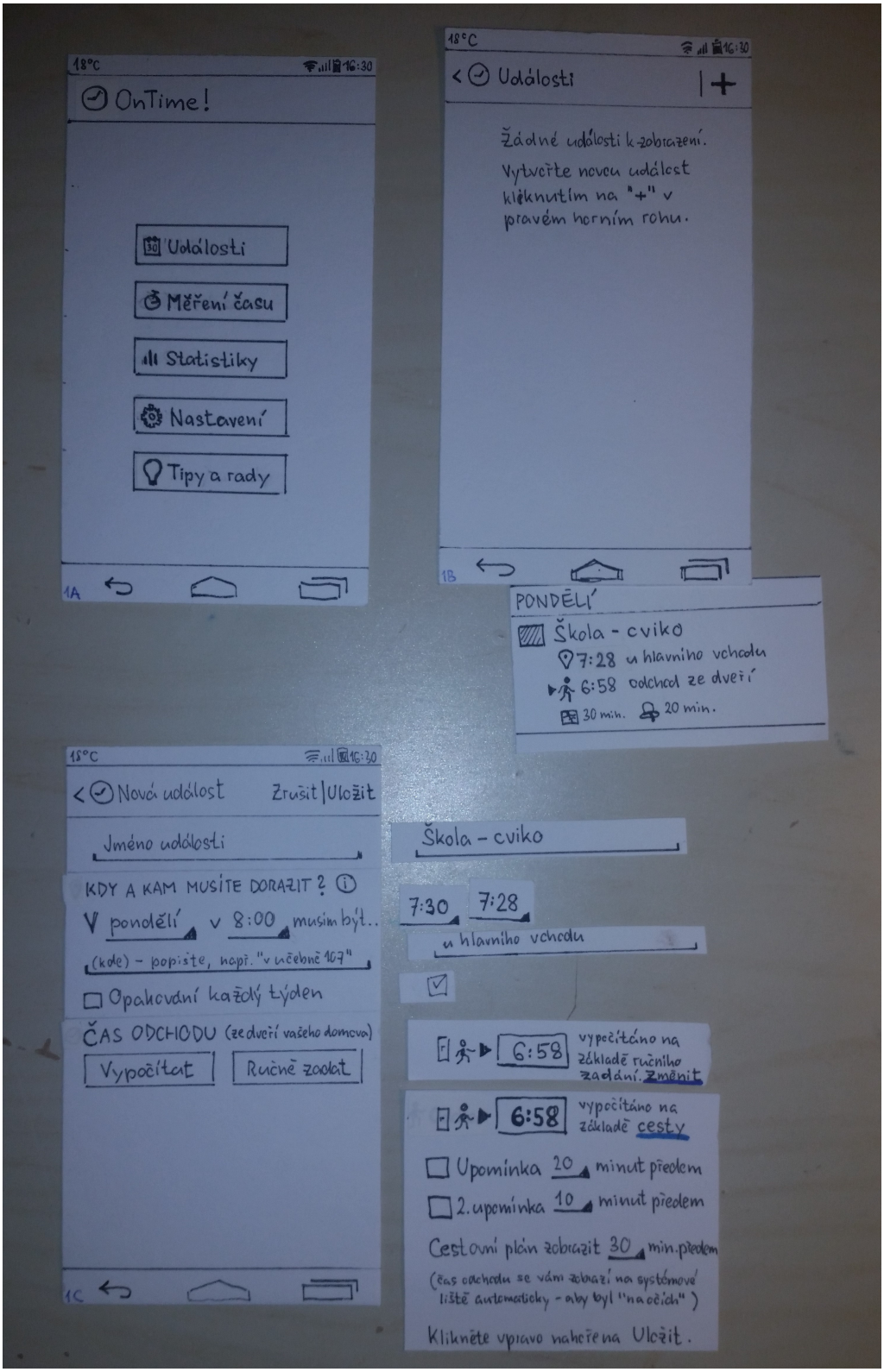


Figure 7.1: *
2. Lo-Fi prototype, test A, part 1

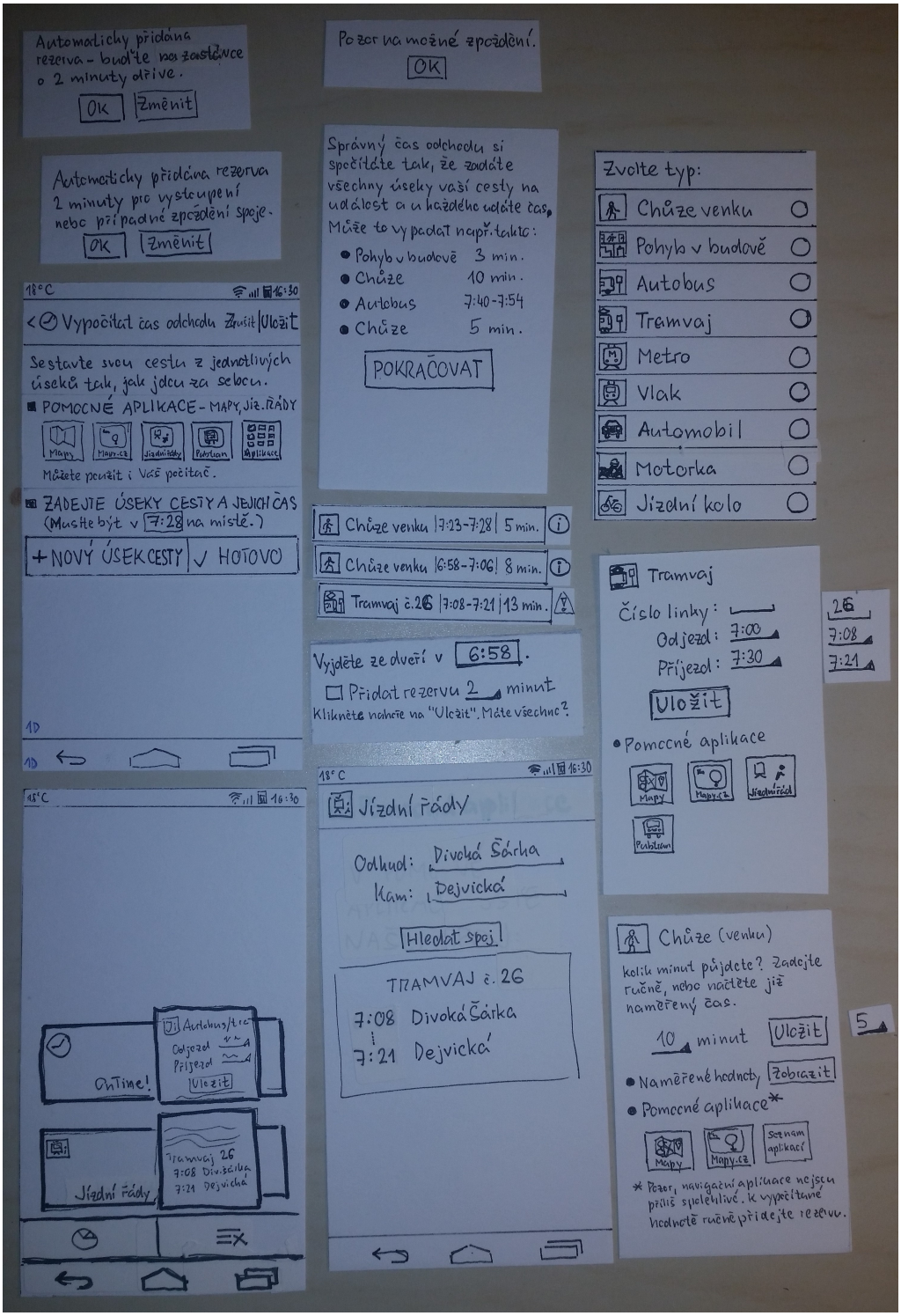


Figure 7.2: *
3. Lo-Fi prototype, test A, part 2

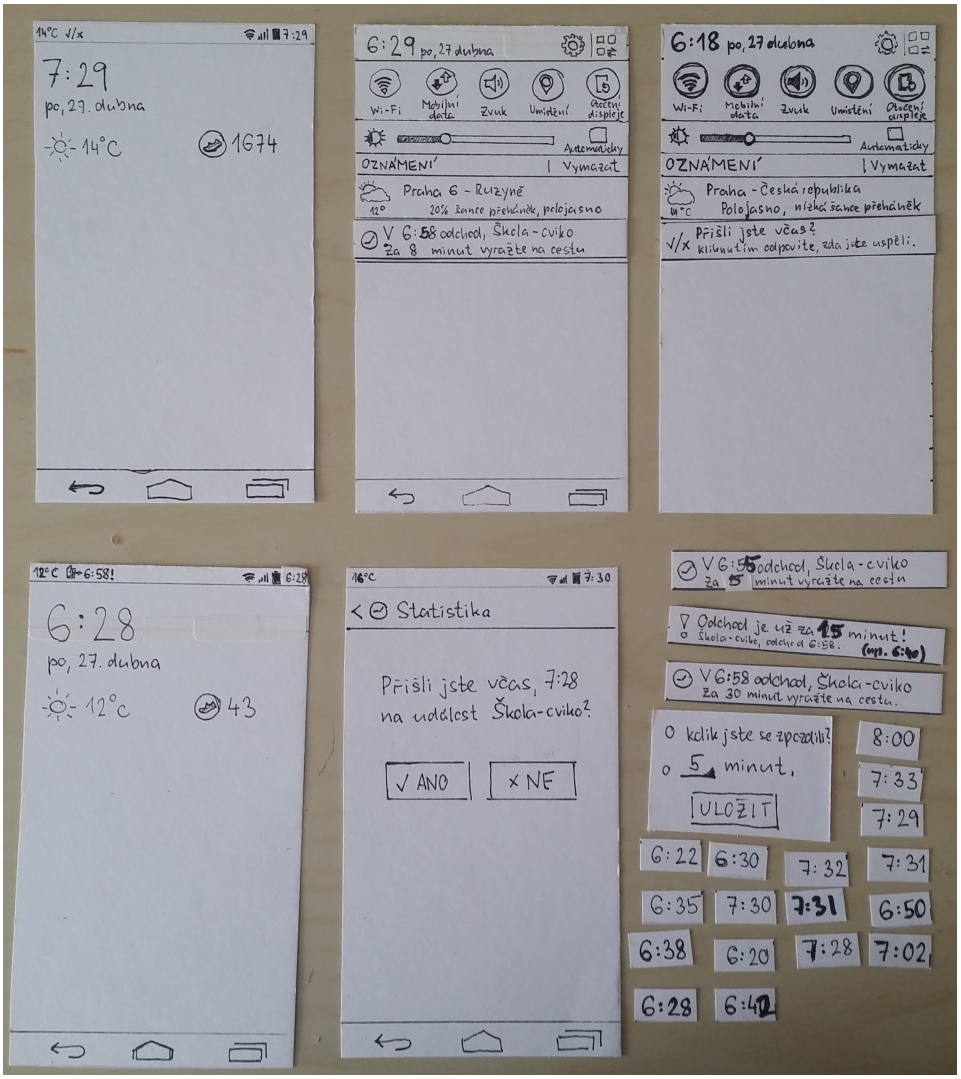


Figure 7.3: *
4. Lo-Fi prototype, test B and C

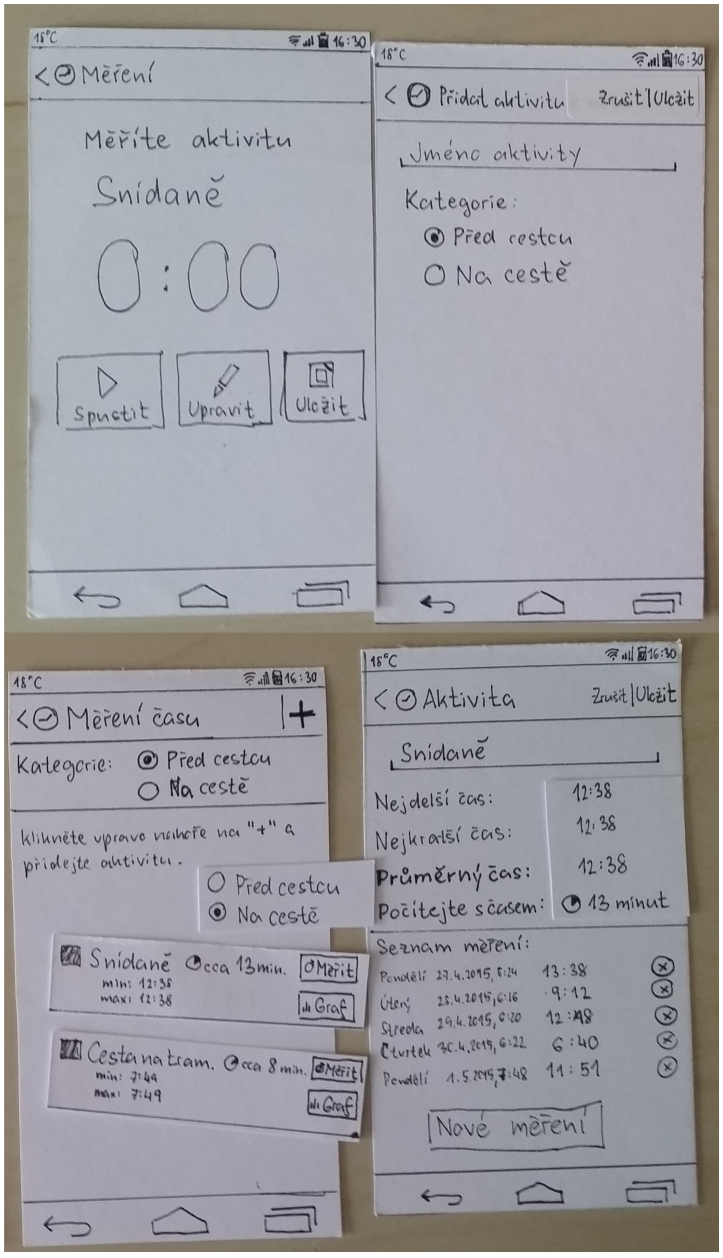


Figure 7.4: *
5. Lo-Fi prototype, test D

Appendix D - Contents of enclosed CD

- **Questionnaire.pdf** ... Questionnaire exported from Google Forms in PDF format
- **QuestionnaireAnalysis.xls** ... MS Excel file with both raw and analysed anwers of respondents (e-mail addresses were deleted)
- **OnTime-stable-prototype.zip** ... Source code of the last stable version (hi-fi prototype tested by users) as an Android Studio project
- **OnTime.zip** ... Source code of the latest version (with latest fixes, cleaner code, may be unstable)
- **app-release.apk** ... Installable file of hi-fi prototype that was provided to testers
- **HifiQuestionnaire.pdf** ... Questionnaire sent to hi-fi version testers
- **HifiQuestionnaireAnswers.xls** ... Answers to the questionnaire