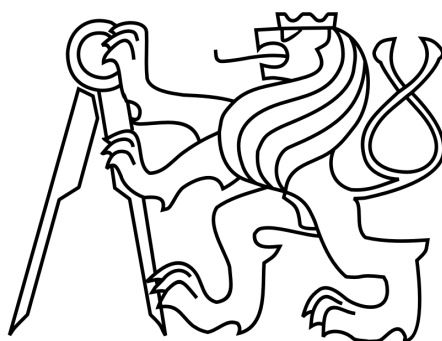


Czech Technical University in Prague
Faculty of Electrical Engineering
Department of Cybernetics



Bachelor thesis

Time to Go: A mobile app for navigation and time management

Jan Musil

Supervisor: Ing. Zdenek Míkovec, Ph.D.

Study programme: Otevřená informatika (Open informatics)

Specialization: Informatika a počítačové vědy (Informatics and Computer Science)

May 20, 2014

BACHELOR PROJECT ASSIGNMENT

Student: Jan Musil

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 - The Essentials of Interaction Design. Wiley, 2007.

[4] Kuniavsky, M.: Observing the User Experience: A Practitioner's Guide to User Research. Morgan Kaufmann, 2003.

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

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Prague, January 10, 2014

ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Student: Jan Musil

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 - The Essentials 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.

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V Praze dne 10. 1. 2014

Acknowledgement

First of all, I would like to thank my thesis supervisor, Ing. Zdeněk Míkovec, Ph.D., for letting me work on my project with him, his patience, and for his practical insights into user experience and human-machine interaction which made my app more user-friendly and less complicated.

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

Last, but not least, I can highly recommend course PDA – Principles of mobile app development, led by Ing. Zdeněk Míkovec, Ph.D and Ing. Jan Balata, which I took in the previous semester (in Czech language) as a complete beginner to Android (not a beginner to Java, though). The course motivated me to learn how to write apps for Android, taught me how to divide the development process in stages, showed me useful ways how to get user feedback based on various types of testing, and helped me transform rough ideas and concepts into real working apps.

Declaration

I declare that I carried out this bachelor thesis independently and only with the cited sources, literature and other professional sources.

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 _____ dne _____ Jan Musil

Abstract

TimeToGo is an Android application that helps with time management during travel. Its primary goal is to avoid delay, which may be caused by bad time management before travel or inaccurate estimation of distance and path. It is designed for people who walk, especially for those who take the same path regularly (e.g. to work, to school etc.) and often arrive late. The user sets the starting point and the destination point, the app then calculates the shortest path. Afterwards, the user sets a daily plan, for example, saying they need to arrive on Monday at 7:55. The app then enables him or her to choose their own speed (such as relaxed walk or quick walk). Based on the chosen speed, it returns the required departure time, for example, 7:35. On the given day, the app reminds the user that in some time, for example, in 10 minutes, it's time to go. On the go, the app tracks the user's GPS position and speed and compares it to the planned speed and position. In case it calculates that the user is going to be late, it sends out a notification.

Keywords: time, management, navigation, plan, walking, running, Android, app, tracking, GPS, map, notification

Abstrakt

TimeToGo je aplikace pro Android, která pomáhá s organizací času na cestách. Primárním cílem je zabránit zpoždění, které může vzniknout špatnou organizací času před cestou či špatným odhadem vzdálenosti a trasy. Navržena je pro chodce, především pro ty, kteří pravidelně chodí stejné trasy a mají zpoždění. Uživatel si nastaví počáteční a cílový bod cesty, aplikace mu vypočítá nejlepší možnou pěší trasu. Poté uživatel nastavuje denní plán, například v pondělí příchod 7:55. Aplikace mu dá na výběr, jakou rychlostí bude chtít jít (například pohodovou chůzí nebo rychlejší chůzí). Podle vybrané rychlosti pak aplikace vrátí požadovaný čas odchodu, například 7:35. V příslušný den aplikace upozorní uživatele ještě před cestou, že má naplánovaný odchod, například za 10 minut. Na cestě pak aplikace pomocí GPS sleduje uživatelovu polohu a rychlost, a porovnává ji s naplánovanou rychlostí a polohou. Pokud zjistí, že uživateli hrozí zpoždění, včas ho upozorní.

Keywords: čas, navigace, plán, aplikace, Android, mobilní, chůze, běhání, GPS, lokace, mapa, upozornění

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1.Introduction

I want to develop the app for people who are very often in a hurry, struggle a bit with the duties of life and need to improve their time management. I suppose that the target group will consist mainly of college students, employees and also some self-employed people who often use public transport.

Some people are really busy with numerous tasks at a time, but not everybody knows how to effeciently switch between them. From my own experience, sometimes we keep assuring ourselves that we still have some time left, and when we realize it is not true, it is already too late. What is missing is an app that would force us to get moving, just in time, and possibly teach us to be more organized ourselves. By this I mean that this app should not be a guide for life. After some time using Time To Go, the user shall be good at time management enough to arrive always on time **without using it** .

1.1 The idea and background

I am happy to say that the idea of an app that tells the user to hurry up came first from my own head. It's probably because I myself struggle with time management and cannot say I always arrive on time. There are a bunch of applications that do more or less the same job, like NeverLate, however, they are not focused primarily for late comers and I had not known about them before.

This app has been on my mind since last year, but I neither found time besides school to work on it nor knew how to approach it as a complete beginner to Android. With the help of PDA, the mobile app development course I took last semester, I finally learnt what I needed to know and got some experience with testing and development. Choosing Time to Go as assignment for my bachelor thesis then was a clear decision.

1.2 The intended features

The app shall be capable of the following:

- Help people reach their destinations on time
- Help people estimate better time required to reach destinations
- Help people learn to plan ahead
- Help people with time management in general

2.Design and Analysis

2.1 Target audience analysis

With any mobile applications, it is not sufficient to only define its features. All apps have one goal - helping the user. And in order to be successful in that, developers must first analyze the target audience. Without users, an application is worthless. On the other hand, if developed for and presented to the right group of people, it may be priceless.

It is up to the developer to define the right target audience for his own app. The best scenario is when the developer himself belongs to the target group of his app. Fortunately, this is the case with TimeToGo.

2.1.1 Demographics

I estimate that the biggest share of the audience will probably consist of users **aged 18 to 34**. It is a broad category of Android users that, in my opinion, makes the most out of the smart Android functions and useful apps. Younger users will probably prefer games and fun applications. Older users are, as we see below, a pretty big group, but I think these people use less functions of Android in general. Anyway, the times are always changing and Android smartphones with all those fancy and cool features and apps are gaining popularity with users above 40.

¹In the group of 18 to 25 years, we can find mostly high school and college students, which I expect to have a lot of various duties and even more activities that might interfere with them. For this and many other reasons, we can assume that these users will want to better organize their time and stop coming late for school.

	Android Smartphones
comScore MobiLens, 3 month average ending August 2012.	% of Audience
Total Audience: 13+ yrs old [Age]	100.0
Male [Gender]	51.5
Female [Gender]	48.5
13-17 [Age]	5.4
18-24 [Age]	17.2
25-34 [Age]	25.1
35-44 [Age]	21.0
45-54 [Age]	17.1
55-64 [Age]	9.3
65+ [Age]	5.0
<\$25k [Household Income (Pre-Tax)]	17.2
\$25k to <\$50k [Household Income (Pre-Tax)]	22.4
\$50k to <\$75k [Household Income (Pre-Tax)]	20.0
\$75k to <\$100k [Household Income (Pre-Tax)]	14.5
\$100k+ [Household Income (Pre-Tax)]	25.8

Image 1.1 - mobilens.comScore

¹ <http://www.comscore.com/>

2.1.2 Psychographics

What are people with bad time management like? They have difficulty being on time at school, at work, they turn up late for a date or for a business meeting. Any reason there might be for it, if they are trying to do something with it, they will surely make use of my app.

I will try to outline several reasons that might lead to people being late. As I believe that important things in life can be planned, I think that any such problem roots in the human psyche. At least in cases where the problem is long-term and not caused by unexpected short-term circumstances.

1. Wearing too many hats – A lot of people have tons of work to do, together with even more duties – school, taking care of family, pets, the house... Some people live in a real hurry and have to switch back and forth between activities, which cannot be all completed at the same time. So we are postponing, leaving out things... This can easily lead to laziness and, subsequently, to being late.
2. Lack of responsibility – This can be applied to some students – they don't have so much life experience, they still live with their parents, they get pocket money, all these reasons suppress responsibility, which can, again, lead to being late.
3. Negative motivation – It's a commonly known fact that positive motivation is generally better than a negative one. But negative motivation is the case here - coming on time is considered normal, neutral, while coming late is heavily penalized.

2.2 Early design concepts

At first, I'll show you some of my first sketches that I've made last year when thinking about the app for the first time.

Here you can see an example of a status bar notification. Android users are familiarized with this concept. Status bar notifications inform the users about various events, such as incoming messages and emails, missed calls or upcoming calendar events. I decided that TimeToGo shall also display notifications in this place.

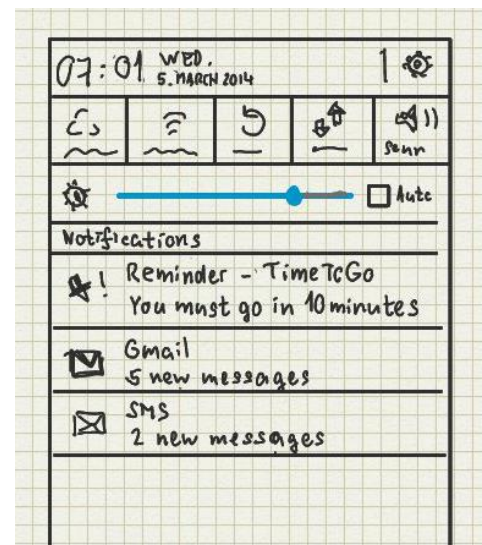




Image 1.2 Status bar notification

MOBILE APP FOR LATE COMERS

© Jan Musil

Be On Time!

5 minutes to go to school

YOUR SPEED	REQUIRED:
	
WALK	RUN



1. Help with time management

- HYGIENE: 10 min
- BREAKFAST: 15 min
- CLOTHING: 5 min
- RESERVE: 10 min

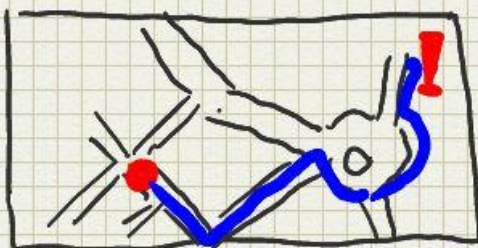
Set out in 3 mins. if you want to WALK.

Set out now if you want to WALK

You must run at 12.3 kph if you want to be on time.

2. Help on the go

Route to: School



Time left: 04:31
Distance: 1.22 km

YOUR SPEED	REQUIRED
5.1 kph 	12.6 kph 

HURRY UP!

Image 1.3 - My first sketch in 2013

2.3 Speed types

Originally, I wanted to introduce as much as 6 speed types, which would include:

- Stroll
- Walk
- Quick walk
- Light run
- Run
- Dash

After consultation with Mr. Míkovec, I realized that 6 might be a bit too much and 4 is better for user experience. What's more, the **stroll** speed is not a good idea as people might think it's OK to walk very slowly and get into the wrong mindset. We want to make them faster. The dash speed is also not sustainable and many people cannot even reach it it would make them uncomfortable. Therefore, the speed types used are the following:

- Walk
- Quick walk
- Light run
- Run

2.4 Walking speed research

I will now cite a couple of solid information sources about walking and running speeds. As far as I am concerned, this research is pretty interesting.

2.4.1 Decline in speed with age

Preferred walking speed declines modestly (by 0.11% to 0.20% per year) until age 60 to 65. (...Where the speed starts to decline much faster) ²

This might help me set the default ranges for older people. I could measure exact speeds for young people and then gradually lower those speeds at a small rate of 0.11 to 0.20 percent per year.

2.4.2 The breakeven point between walking and running

The speed at which human walking becomes energetically more expensive than running is about 2.2–2.3 m/s.³

Multiplying this by 3.6, the research indicates that at speeds 7.92 – 8.28 kph, walking becomes more difficult than running. That perfectly correlates with my measurements! Nobody was walking in Quick walk mode at a speed above 7.45 kph.

² Previewed at

http://books.google.cz/books?id=Cx22TcXodrwC&pg=PA665&lpg=PA665&dq=preferred+walking+speed&source=bl&ots=9J95evQtrC&sig=7rwd_1wHFFTor9dH2RJxF-DGIQM&hl=cs&sa=X&ei=zwN2U6OkF4-h7AaSgoHYDQ&ved=0CIYBEOgBMAg#v=onepage&q=preferred%20walking%20speed&f=false

³ <http://www.cs.utah.edu/research/groups/percept/papers/Mohler:2007:VFI.pdf>

And from my own experience, I can agree with the statement as well. My own measured quick walk speed was 7.13 kph. I remember that I could move as high as 7.50 kph, but further pushing myself to a higher speed while still walking made me feel very uncomfortable. The muscles were saying: “This not the right way to move, you should switch to running.” Having switched to running, I suddenly felt more relaxed.

2.5 Paper mockups

In the Appendix part of this thesis, you can find all paper mockups that were prepared for testers in the Lo-fi stage of the app.

3. Testing

The app was tested in two stages. At first, I organized formative tests of the Lo-Fi paper mockup. The main focus was on GUI and the possible ways of comfortable input. Later on, after the application was partially implemented and possible to test on a real device, I organized yet another sequence of tests. At that stage, we focused on real-time navigation - the best ways to notify users about speed and distance, the right frequency of "Hurry up!" messages and the interaction in general.

3.1 Research before first testing

Another step was to initiate formative usability testing on a paper mockup. For this purpose, I created a lot of paper screens to demonstrate the app's intended workflow and check how testers would respond. Nearly 40 screens were photographed and added to a free app called POP – Prototyping on paper. Later on, they were connected using buttons to provide interactivity.

Users held my phone with the POP app on, launched the paper app, clicked on buttons and used the app almost the same way as it was real. On the following couple of pages, we'll go a bit into detail on how the testing was organized, describe the testers' feedback and finally summarize the outcome of the whole process.

At first, I draw lots of paper screens based on previous ideas and sketches from my tablet. A few examples are listed here and all papers are placed at the end of this thesis and also on the enclosed CD.

3.1.1 Example routes and walking speed setup

In order to provide testers with real-life data, I did some research and created concrete examples of routes. I chose Prague as the majority of testers were students at the Czech Technical University.

Route #1: Example route to work

- From: Na lepším 1261/8, 140 00 Praha, Česká republika
- To: Tábořská 940/31, 140 00 Praha, Česká republika
- Distance: 1.20 km

Route #2: From home to school (CTU - faculty of electrical engineering)

- From: Ve struhách 1007/40, 160 00 Praha, Česká republika
- To: Technická 2, Praha, Česká republika
- Distance: 1.40 km

I also tried to derive the optimal walking and running speeds to use as default in the example app. As it was not that important at this stage, I got by with data on Wikipedia⁴. I chose the following:

1. **Walk:** 0 kph – 5.9 kph
2. **Quick walk:** 6.0 kph – 7.9 kph
3. **Light run:** 8.0 kph – 11.9 kph
4. **Run:** from 12.0 kph

⁴ Wikipedia - http://en.wikipedia.org/wiki/Preferred_walking_speed

Originally, I planned to introduce six different speed categories, but after consultation with my tutor, Mr. Zdenek Mikovec, I decided that limiting the number to just four would be better for user experience.

Of course, walking and running speed differ from person to person. I have to take this into account, therefore, these limits are not final. Later, in the app settings, the user shall have the opportunity to customize these limits to cover their very own preferred speeds.

3.1.2 Android POP – Prototyping on paper

In this app, I was able to create an interactive simulation of the app. One can choose a paper screen, mark a clickable area on it (a button), and choose another screen where the user is transferred on click.



Image 1.4 Prototyping app

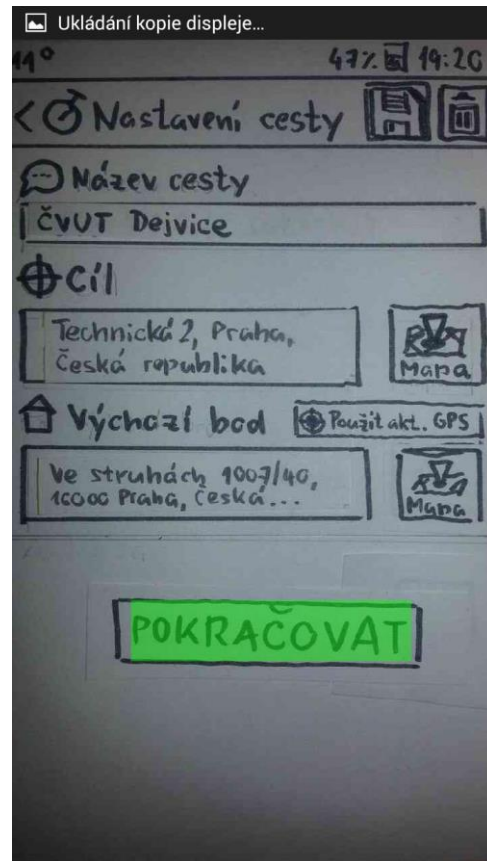


Image 1.5 Prototyping app with a button

I have added a short video with the interactive walkthrough of the whole paper mockup on the attached CD.

3.2 Paper mockup testing

Here I'll summarize the information gained from testing.

3.2.1 Instructions for testers

Here I'll show what the testers were told before the formative paper mockup test.

3.2.2 The tester's character

You are a Czech Technical University student. You live in Dejvice, and it's a 20-minute walk from home to school. You have lessons

- On Mondays from 8:00 (a small mistake, let's say there are such lessons)
- On Tuesdays from 14:30
- On Wednesdays from 9:15

You always walk to school. But you usually turn up late for your first lesson.

Now it's Sunday evening. You have just downloaded the TimeToGo app and you want to arrive to school on time tomorrow.

3.2.3 Tasks to do

A] Imagine it's Sunday evening:

1. Set up a journey from your home to school.
2. Set up a plan for Monday – arrive at 7.25 at the school gate.
3. Find out when it's necessary to set off.

3.2.4 Questions to answer

B] Imagine it's Monday morning:

4. Imagine the app is reminding you it's time to leave. Then, on the go, imagine you have been walking too slow and the app is telling you to speed up.
5. How do you want to be notified? And how often? Express your opinion on these:
 - Vibration
 - Sound
 - Frequency of notifications

3.2.5 Conditions of the tests

Despite the fact that we had just a paper prototype, I think that we got very close to the live application. The test was conducted on a phone (my own Samsung Galaxy SIII), the screens were interactive and clickable – I added even a bit of interactivity that was not absolutely necessary for the tasks, like dialogs, buttons for going back or the example journey.

When I (Tester no. 1) tested the app myself, I did it at home. All other three tests took place at a table in an atmosphere of relative calm. Testers 2 and 3 both took the test with me, one after another, then I met tester 4 a few days later.

3.2.6 Tester number 1

At first, I decided to test the prototype myself to ensure everything was working smoothly and also to ensure that my opinions are not influenced by others' ideas. I'm a 22-year-old male, student of IT at Czech Technical University.

First glance

I have this procedure for new apps I download: I open one tab, then click even a few more buttons, check out all the features very quickly, without too much thinking, just out of curiosity. I prefer to do everything using “trial and error“ method .

So I went intuitively to tab „Moje cesty“ (“My journeys“) and checked out the example journey, if it was possible, I would have clicked all the map buttons and checked out the locations, then looked at the speeds and tried to make some deduction (such as “this is pretty slow“, “this is pretty fast“ etc.)

Walkthrough

To me, the task was quite easy to do, yet still not perfectly easy. I quickly identified a few things that deserved improving:

- The „[Použít akt. GPS](#)“ (“Use curr. GPS) button suddenly seemed unnecessary. I would simply click on the „Mapa“ button and expected the current position to be shown.
- When adding a plan in [screen S9](#), it shall be more clear that the journey name and route (for example, by showing it in weak grey font rather than black) are fixed, given and the user shall input something else. I found myself trying to click on the journey name, which is not what we want to do. It is already given, we shall input just day and time.

Ideas for the travel phase

I have a few [ideas for the travel phase](#). There shall be a status bar icon showing clearly what the current situation is – whether it is still enough time (before journey), time to go (the scheduled departure time) or whether the user is on the go (and whether the speed is OK to get to destination in time, or it is necessary to hurry up).

Upon pushing the status bar down, the push notification should display the current state. Especially on the go. Something like: The speed is OK. Or: You’re too slow, speed up to light run (9 kph), current speed 6 kph. But it should be obvious and intuitive, so it’s best to avoid too much text and rather use self-explanatory icons.

3.2.7 Tester number 2

A 22-year-old male, student of Energetics at Czech Technical University

First glance

At first glance, he liked the four figures (walk, quick walk, light run, run) and said they are very descriptive.

After being presented with the app functionality but before being shown the prototype, he said: „I would appreciate an app that would tell me when it’s time to pay and leave the pub in order to arrive at Holešovice in time. Possibly, with a 5-minute safety margin.“

Walkthrough

At the beginning, there were no issues and behavior was pretty much as expected. Fortunately, I discovered a few bottlenecks when it was time for Tester 1 to make some input.

With my assistance, he finally completed the intended task.

- In [image S5](#), there was some friction between the text field for entering address manually and the button for finding address on map. It was not clear which one to choose. He seemed a bit confused for a moment, finally he clicked the button for finding point on map manually
- In [image S6](#), he did not notice at all the button Akt.GPS ("Current GPS"). He clicked again the button for finding on map and expected that the current GPS coordinates should be selected by default in the newly opened map dialog.
- The map dialogs such as [D3](#) shall be unified so that from one dialog, the user can select both starting point and destination point.
- In [S8](#), he wanted the route to be shown immediately in a dialog just after calculating it.
- In [image S10](#), he had two remarks:
 - The slider shall be moved a bit down so that it's more separated from the times
 - It is confusing that the figures (walking, quickly walking...) are not clickable. (He tried to click rather on them than on the slider.)

Ideas for the travel phase

He said he would not need to be notified, it would be enough for him to look when it's time to leave and that he would take care of the rest just by looking at his watch and using common sense.

3.2.8 Tester number 3

A 22-year-old male, student of Microelectronics at Czech Technical University

First glance

At first glance, he said the idea is good and that many people would use it.

Walkthrough

He appeared more familiar with the app than tester 2, and also finished the task successfully without too much assistance.

- While inputting the journey's starting point in [image S6](#), he realized that the button "Použít Akt.GPS" (meaning "Use current GPS") is redundant. He would just click at the map and expect the current GPS location to be centered and selected by default.
- He mentioned while on [screen S8](#), there might be some questionmark button on which a dialog with speeds, figures and descriptions could be placed. Something like: Quick walk 0 to X kph, Quick walk X to Y kph etc.

Ideas for the travel phase

He at first mentioned that it would be cool to have a widget on the home screen with time left and speed required.

He also mentioned that it might be good to notify the user of elevations, as going uphill at a stable speed might not be as easy.

Furthermore, he pointed out that when choosing a sound for the notification, it should sound the same as a received SMS message. That's because users will be curious and more likely to actually take the phone out and look at the notification, which should bring higher success rate.

3.2.8 Tester number 4

A 23-year-old male, not exactly the technical kind of person. He works as a financial advisor.

First glance

At first he said "That's cool". But then he said: "I don't need such apps, though. My time management is very good already."

Walkthrough

For this tester, the task was not that challenging. He was able to finish the task very fast, compared to other testers.

- He was a bit unsure [in image S8](#) where to find the route. He thought it would be displayed after the loading dialog.
- Still [in image S8](#), when the journey has already been saved, it was necessary to set a daily plan (for Monday) to arrive at 7:55. He hesitated there for a while.
- He said the slider looks just fine, but for better clarity it would be better to write something explanatory like: „If you want to walk slowly and relaxed, you should set-off early, or you can increase your speed and save your time.“

Ideas for the travel phase

He said he would not need such a notifications app. However, he suggested that the notifications are not overly frequent, as that would make users start ignoring them. He said that vibrations are not enough, especially in the city when there's a lot of noise.

3.2.9 Feedback

Starting point input

It turned out that there is no actual reason to include the button (crossed out with red lines on the right) "Použít Akt.GPS" (meaning "Use current GPS") along with the "Mapa" ("Map") button. Nobody bothered using it, probably they haven't even noticed. The majority of users simply click on the Map button and expect the current GPS to be selected by default. For the starting point, it's clear. The user usually wants to start from where they are standing physically. For the end point it's not that clear, but

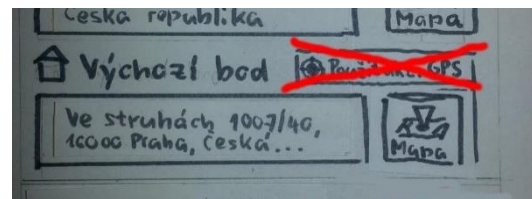


Image 1.6 Suggested change

The Slider

To some people, it wasn't clear what the slider is supposed to do, many didn't even know they should move it to the left or to the right.

I think that the problem is with the sentence „Kdy je potřeba vyjít?“ ("When is it time to go?"). It is a question. After a question, people may expect an answer. They intuitively think the answer is already displayed as the few object under the question. Therefore, they might feel like there's no need to do anything.

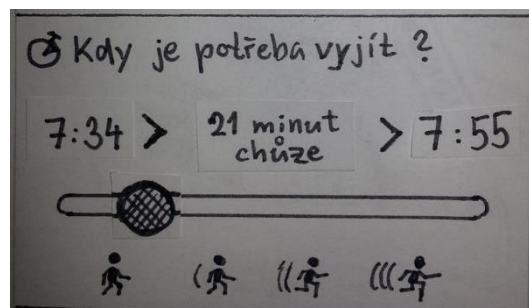


Image 1.7 Slider with icons

Solution: Instead of a question, use an instruction. Rather than asking „Kdy je potřeba vyjít?“ (“When is it time to go?”) I should state clearly what the user shall do here: „Nastavte si rychlost pohybu“ (“Set up your travel speed”) with a subtle note: „Podle rychlosti pohybu zjistíte čas, kdy je potřeba vyjít.“ (“From travel speed you’ll get the right time to set off.”)

Start/end point input

- „Název cesty“ = “Journey name“
- „Cíl“ = “Destination“

While inputting route points (right), two testers seemed confused whether to go for option 1 (entering an address using letters) or option B (selecting address on map). The friction was strong enough for me to notice.

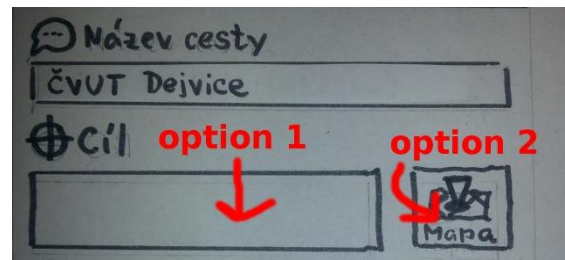


Image 1.8 Friction between options

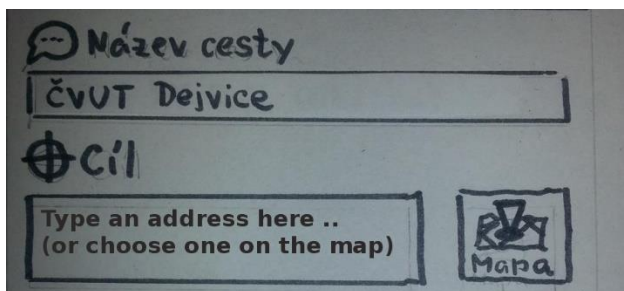


Image 1.9 Solution - suggestion text

Solution (left): Adding subtle text to the text field with instructions, as shown on another image. It seems to me that it solves the problem, actually, I think it is a convention of most web and mobile applications today.

Displaying the best route

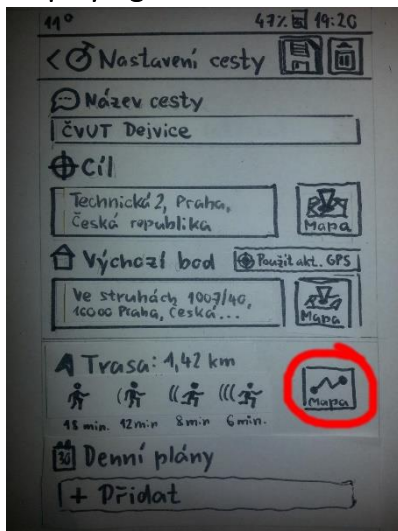


Image 1.10 Show route button

Two testers were of the same opinion that while going from screen [S7](#) (through loading dialog [D5](#)) to screen [S8](#), they expected the calculated route to simply open in the foreground straight away. They found it strange that the route (on the map) is not shown by default and users have to open it manually by clicking on the particular button (marked as red on the left).

Solution: I will display the route immediately after it has been calculated in a pop-up dialog.

3.3 Measuring exact walking and running speeds

As I had already decided, there would be four speed types: Walk, Quick walk, Light run, Run. But the question of exact ranges in kilometres per hour was yet to answer.

In order for the app to be useful to real people in real-life situations, I decided to get as much information as possible about people's walking and running speeds. I wanted these ranges to appear natural to users.

So I measured walking and running speeds on myself and other people and also did a lot of research on the internet to get further numbers. Finally, I decided how to set the ranges for my four speed types.

I used MyTracks, a free app by Google. It's a great app for tracking movement, measuring distance and speed, it even takes elevation into account. Here are two sample screenshots from our testing.

3.3.1 Who participated in the test:

I was able to contact individually 5 different testers from the target group (18 to 34 years), some were male, some were female. Some were older, some were younger. At least some diversity was ensured.

3.3.2 How I measured the speed:

With each of the testers, the procedure was the same.

I explained that there would be four speed levels: Walk, Quick walk, Light run and Run. My instructions before testing were:

1. **Walk:** Show me your normal walking speed. You are not in a hurry, but don't be too slow either.
2. **Quick walk:** Then speed up as if you were in a hurry. But don't run yet, feet should stay on the ground.
3. **Light run:** Now you should run, but not too fast. Run at a speed you think you would be able to keep for around 5-10 minutes.
4. **Run:** This time run fast, as if it was your last chance to catch the last bus to an airport to catch your plane. Let's say you would be able to keep this speed for 1-2 minutes.

Then we set off. I was walking / running alongside the participants with my phone and MyTracks on. Each speed was kept for at least 15 seconds in order for MyTracks to calibrate properly. Speed was shown on the screen and I took screenshots using the "karate chop" touch gesture. For each speed, I measured the speed at least three times. After the tests, I checked screenshots from all measurements and averaged the speed for each speed type using Excel.



Image 1.11 MyTracks app

The tests took place on straight routes with no curves on the way and there was no significant elevation as I wanted to avoid going uphill or downhill.

3.3.3 Measured values

Values in the table are averages of two or three measurements at each speed level.

	Speed in kph					
	Myself	Tester 1	Tester 2	Tester 3	Tester 4	Tester 5
Walk	5,96	5,05	5,12	6,15	5,46	5,78
Quick walk	7,13	6,63	6,40	7,45	6,97	7,02
Light run	10,85	9,10	9,50	10,51	8,93	10,21
Run	15,02	*	13,92	14,36	12,37	13,80

Age	22	18	33	24	22	23
Gender	male	female	male	male	male	male

* tester did not want to run

Image 1.12 Measured values of speed

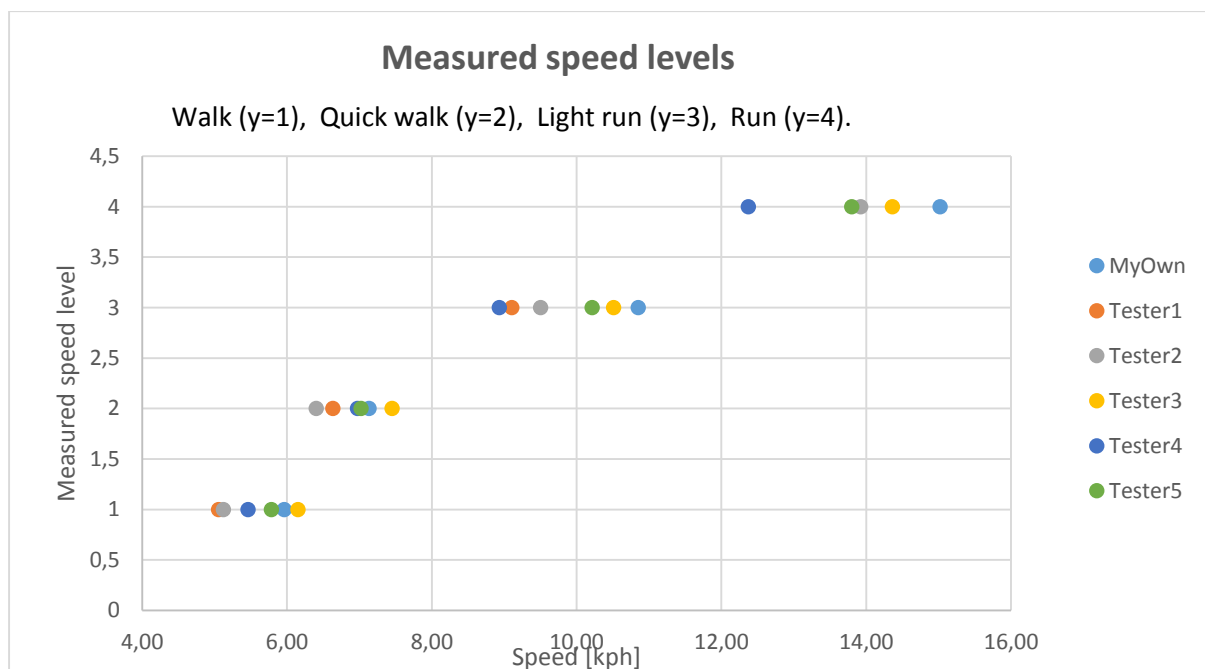


Image 1.13 Measured values of speed

3.3.4 Commentary on the measured values

The span of “quick walk“ level is not as big as the span of “light run“ and “run“ level measurements. There are also significant gaps, dead zones, between “quick walk“ and “light run“ and between “light run“ and

“run”. Nobody measured either between 7.50 kph and 8.50 kph or between 10.90 kph and 12.30 kph, even though both genders and all age levels 18-34 participated.

3.3.5 Decision based on speed research and measurement

Having researched the Internet and taken exact measurements, I had to implement the formula for deriving the speed ranges based on user’s age and gender.

I think that users shall feel the difference between **Walk** and **Quick walk** so that Walk denotes normal and relaxed speed and in order to switch to Quick walk, the user has to kick it up a bit. Therefore I estimate that the really “quick” walk shall start a certain amount of kph above the average relaxed walking speed, so that the difference is apparent. The same goes for **Quick walk** and **Light run**. There I can apply the newly learnt fact about breakeven speed where it becomes more efficient to be running rather than walking.

I used both the measurements, the research and my own intuition to set the default ranges.

Data for a 22-year-old male:

1. Walk level shall be under **6.00 kph** (the average “walk” speed in a group of four young men aged 22 to 24 who do sports from time to time was 5.84 kph, so quick walk shall start a little higher).
2. Breakeven point between Quick walk and Light run shall be **8.28 kph** exactly.
3. Run shall start at **12.50 kph**. While most male testers averaged higher, the slowest one scored 12.37 kph. I do not want my users to run too quickly, even though we want them to hurry up.

Data for a 22-year-old female:

1. Walk level shall be under **5.30 kph**.
2. Breakeven point between Quick walk and Light run shall be **7.70 kph** exactly. I know the study said 7.92 kph, but I think that is an average for both men and women and women have this breakeven point lower.
3. Run shall start at **10.50 kph**.

These values will decline gradually at a small rate (maybe rather 0.50 % than 0.20 %) per year for older or younger people.

From an objective point of view, I think this is still not accurate enough. The diversity in preferred speed of real people is pretty big. Users may also need to choose a fitness level, let’s say there are three fitness levels: Sporty people, average people, lazy people.

There will definitely be further upgrades to these rules.

I will mention in the code comments how the final values of default speed ranges were set after the app’s implementation and live testing in real conditions.

3.4 Live version testing

The next stage was to test the application in real environment. At first, I tested the app at home many times during development before presenting it to the testers. This time we focused on the travel, GPS and notification part. Here are our findings.

3.4.1 Conditions

We used my Samsung Galaxy SIII with the borrowed security case (if we dropped it). The journey and plan were set by me in advance before taking the test. The only thing to test was the notification system.

3.4.2 Route

- Starting point: Lotyšská 1, Praha 6, Česká republika
- End point: Technická 1902/2, 160 00 Praha, Česká republika
- Distance: 0.6 km
- Planned speed: 5.0 kph
- Planned arrival: 10:00 (concrete times were adjusted for testers)
- Necessary time to leave: 09:52 (better than 09:53, no rounding up 😊)

3.4.3 Tester 1

Managed to reach the final destination in time with a nearly 1 minute advantage.

- Behaviour: At first, he was walking pretty slower than expected, after a couple of notifications he went on to move faster and he ended up arriving earlier than expected.
- Remarks: Said it is important to tell the users that they must always pay attention to cars and trams. He found the app to be sending too many notifications, for example when he just stopped at a pedestrian crossing to let a tram pass for a couple of seconds, he was already reminded to hurry up.

3.4.4 Tester 2

Also managed to reach destination in time around half a minute earlier than scheduled.

- Behaviour: He was walking at more or less constant speed, of course, with the exception of the pedestrian crossings, where we got a lot of “hurry up” notifications.
- Remarks: Said the app is cool but a little bit too annoying.

3.4.5 Tester 3 (myself)

I managed to reach the destination with a 1 minute 9 seconds advantage. But I admit that I was walking very fast just to beat Tester 1.

I did not find the frequency of notifications too annoying, however, the users’ opinion is more important to me.

3.4.6 Decisions made after live test

After discussions with testers, I decided to **lower the notification frequency** so that the “Hurry up” notification is not repeated too often, especially when the user is walking and has to stop for just a few seconds at a pedestrian crossing or tram tracks.

I also **improved the notification messages** so that they are more clear and require less time to understand. In real situations, clarity is a very big time saver and also ensures that the user's attention is not drawn too much from the real world. In a real city, it proves that safety of users is very important.

3.5 An important fact I think is good to mention

The efficiency must derive from the the user-frendliness and good usability of the app, not from forcing users to very high speeds. I think I should keep this in mind throughout the whole development stage.

4. Implementation

After thorough analysis and formative testing, finally it was time to start writing up code. Here I will describe the implementation in a bit of detail.

4.1 Software and hardware

4.1.1 IDE

I used Eclipse with ADT plugin, a popular development tool available for free at developer.android.com

4.1.2 Language

I stucked to the most common language among Android programmers, which is Java with Android SDK tools. I used [Google Maps API v2 for navigation](#) by building upon a [free library by developer tyczi on Github.com](#).

4.1.3 Testing device

During implementation and testing, the app ran on my own Android smartphone Samsung Galaxy S3. Debugging was done using a USB cable.

For tests in real situations, I borrowed a protective case for my phone as there was too much risk of a tester or myself dropping the phone. Eventually, it did not happen, however, broken displays are **very** costly to repair.

4.1.4 Android version

My Samsung Galaxy runs Android 4.3, on which the app was tested, but it should be working all the way back to Android 3.0. The target was Android 4.4 (which I expect to come out for my device soon).

4.2 Algorithm

4.2.1 Navigation

Using GPS, the position of the user is periodically refreshed and compared.

What is the user's location compared to? Imagine there is a route 2 km long and the planned speed is 6 kph. That is 100 metres per minute. Next, imagine there is a ghost moving on the same route as the user

from start to end at a constant speed of exactly 6 kph to arrive exactly on time. The user might be currently walking “in front” of the ghost, which is OK, or “behind” the ghost, which is bad because the user is likely to come late. So when the user is located a certain number of meters “behind the ghost”, we send him or her a notification.

4.2.2 Notifications

There are two types of push notifications that an app can display on Android:

1. **Notifications** – individual alerts, can be dismissed, users can swipe left or right on them to dismiss or click on them to do something with the app
2. **Ongoing notifications** – cannot be dismissed, more information bars than notifications, they usually show some continuous information such as weather or mobile data usage.

So we stick to this practice and use the [ongoing notification bar](#) for continuous information about speed, remaining distance and remaining time. The individual notifications serve as alerts to hurry up in case the user is going to arrive late.

4.3 How to test the current version of TimeToGo

During development, I encountered a lot of issues with [wake locks](#) which left me with little time to implement a full GUI. However, I know how to approach it and I am looking forward to developing GUI in the following few weeks. See Conclusion section to know about my further plans with Time To Go.

Anyway, due to currently missing GUI, to prove the main functionality (tracking a journey plan and notifying about delays) was achieved, I created an activity called **TestActivity**, which is accessible from the main menu of the current version of app. I tried to make the test activity screen as self-explanatory as possible, However, further necessary information about testing is given in the readme file on the enclosed CD and a video from live testing is attached.

Conclusions and final remarks

There is still a lot of room for improvement. However, the app in its current form can already be quite useful to some people. It does what it is expected to do successfully – tracks the user's movement, measures his or her speed and compares it to the scheduled position and speed.

Therefore, it is already capable of helping people arrive on time. GUI is yet to be implemented, but it is a matter of a few more weeks and thorough testing, which I am looking to do in my free time.

We got close to the right amount of notifications that ensures high efficiency and provides the optimal way of communication with the users.

I am optimistic about Time To Go. The testers confirmed me that the app has a lot of potential to be successful. It is up to me how I carry on and how much effort I put into enhancing and promoting TimeToGo. I realize that publishing a successful app can be a big plus for my future career. At the same time, I realize that it is not going to be easy. My opinion is that the app itself is based on an original idea and there are few apps focused strongly on late comers.

My take on this project

I think that working on this project gave me a better idea about how complex mobile apps are made and gave me valuable experience.

Besides code, I think that I learned interesting things about user experience and human-machine interaction, which I can make use of in further Android development and also in website design and development.

My probably biggest take on this project is that Android programming is not as easy as it may seem. It takes a lot of time to implement things that seem very easy, such as map input or touch gestures. However, I have a good idea how to approach that and the necessary resources to continue building GUI in the next few weeks.

Future work

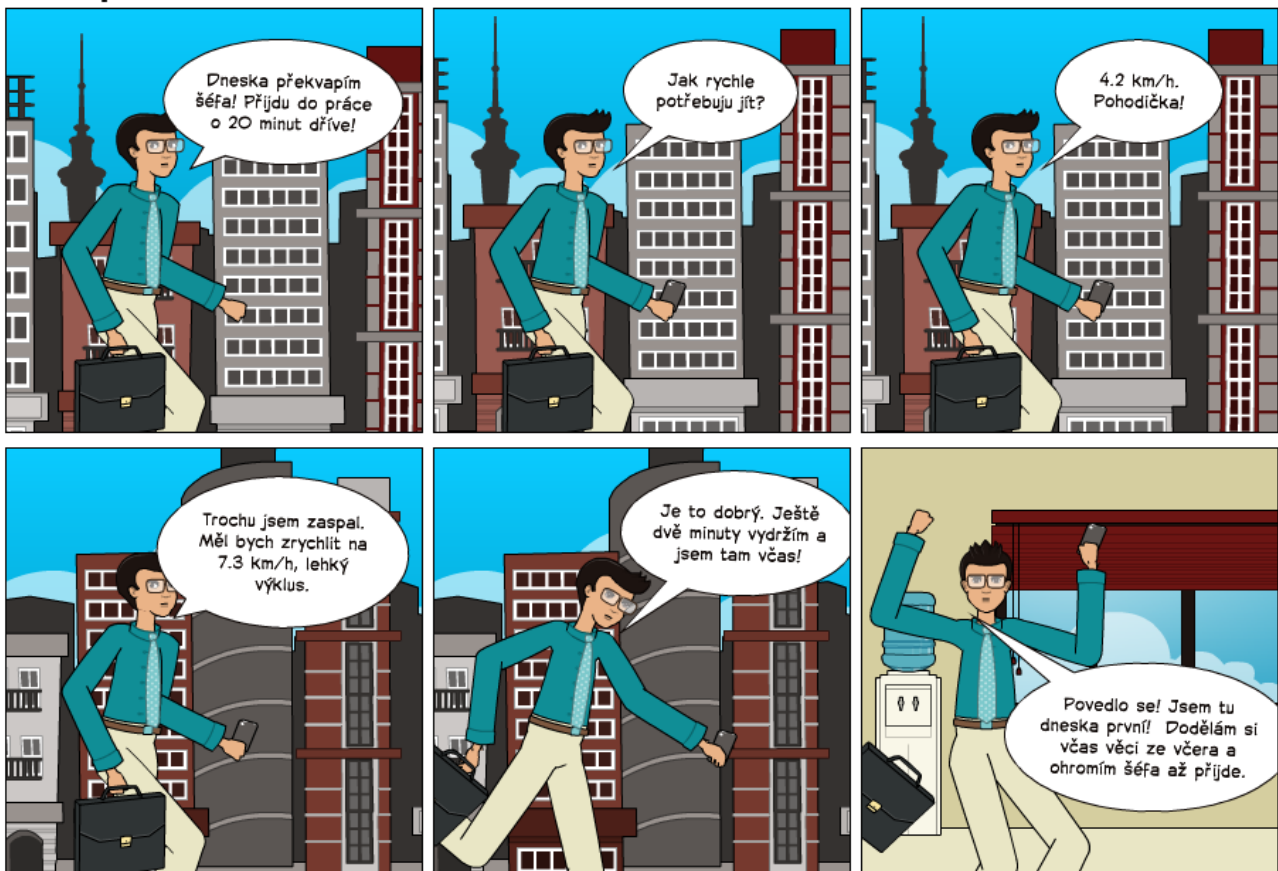
I enjoyed all the stages of the project and am looking forward to extending Time To Go further and publishing it on Google Play when it is ready.

The most important thing is to ensure the users do not get distracted and do not get hit by a car or tram when travelling in a city. After live testing, I take this as the highest priority.

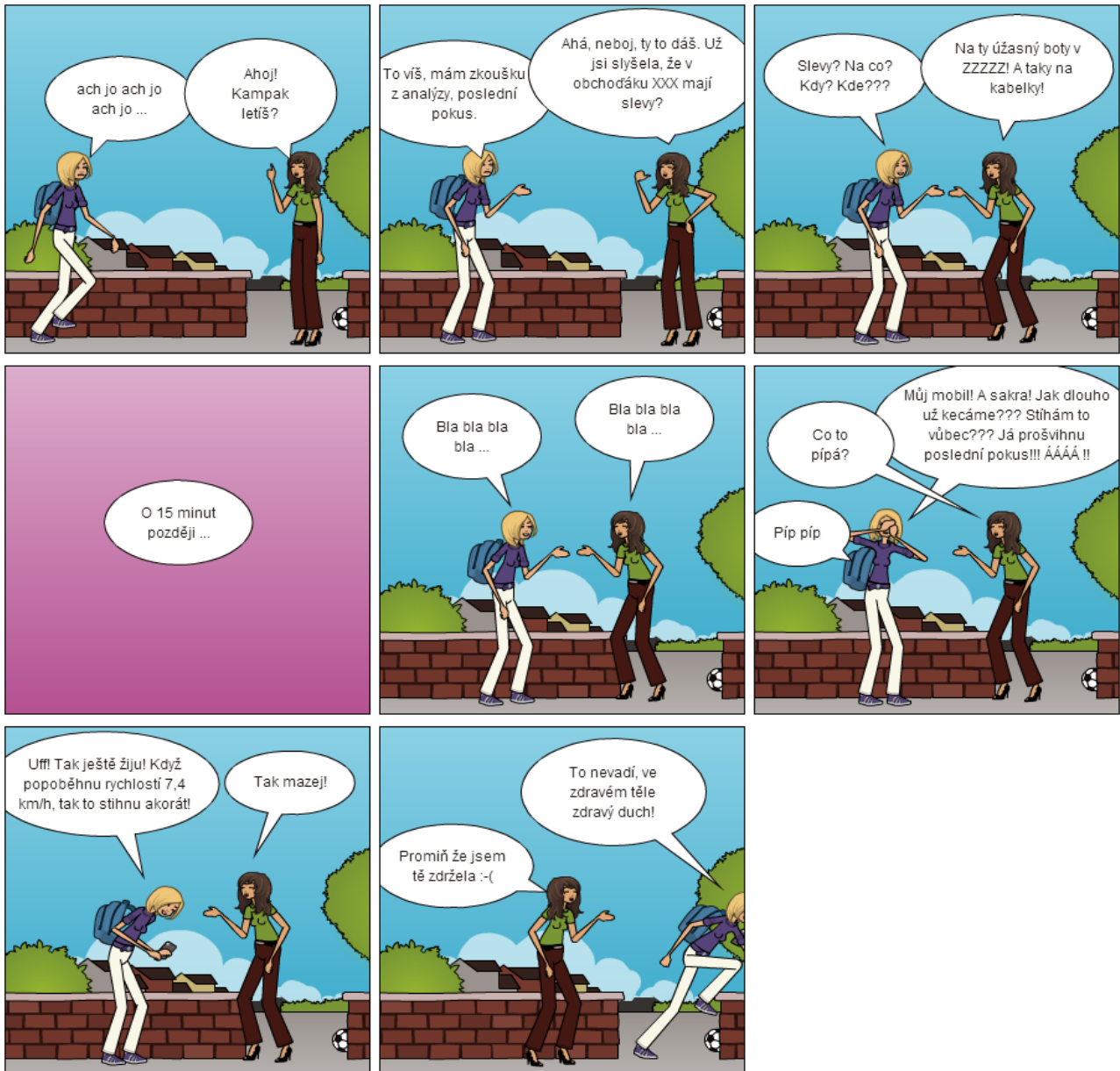
Appendix 1 – Comic stories

Joe do práce

by JMBusiness



1.1 Joe wants to go to work early this time. He wants to surprise his boss by arriving 20 minutes earlier.



IMAGES © 2014 PIXTON.COM

1.2 Two friends in the street. One is in a hurry for an exam (it is her last try) but somehow forgets about it. When she remembers, thanks to TimeToGo she checks that she can still arrive on time if she runs at 7.4 kph, which is no problem for her.



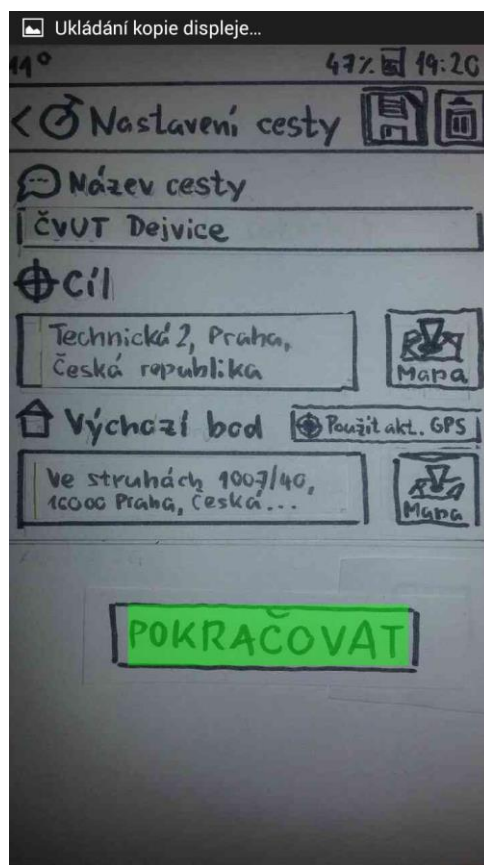
IMAGES © 2014 PIXTON.COM

1.3 Joe is late for school very often. With TimeToGo, he knows exactly when to set out for school and how fast he shall go. Even though he sets out a few minutes later than he scheduled, the app still helps him arrive on time.

Appendix 2 – Paper mockup

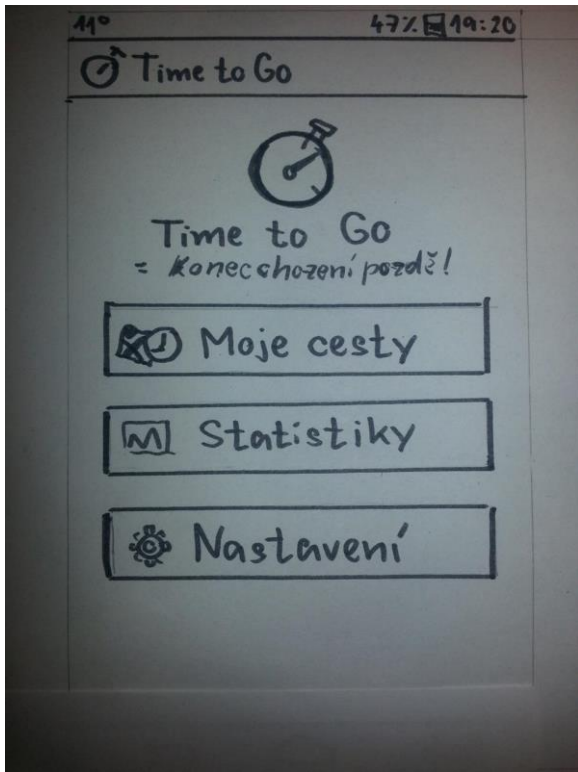


2.1 POP

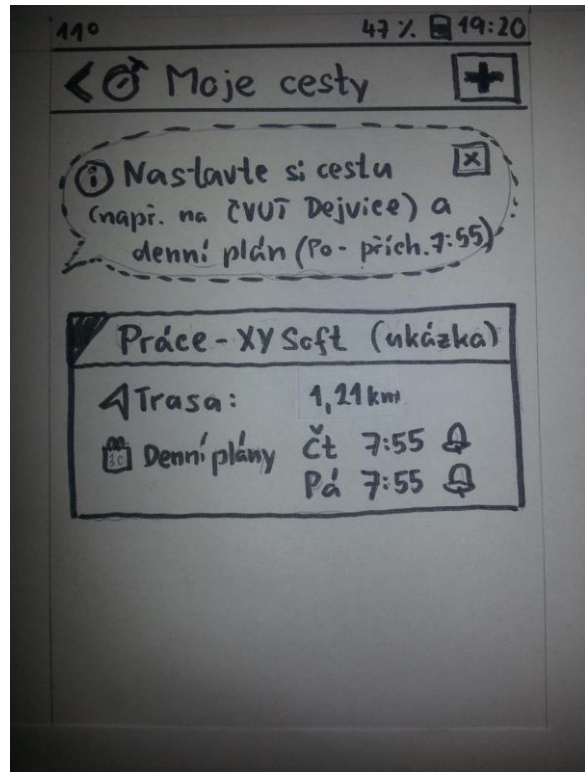


2.2 POP

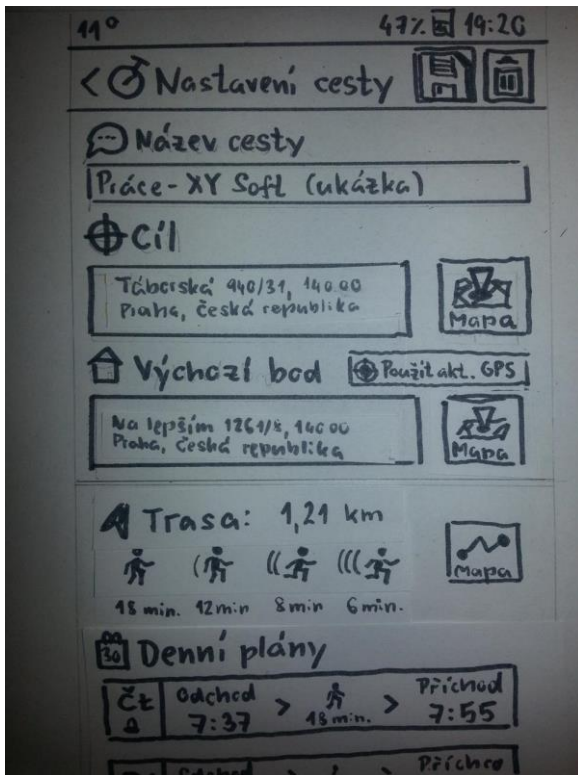
2.3 POP



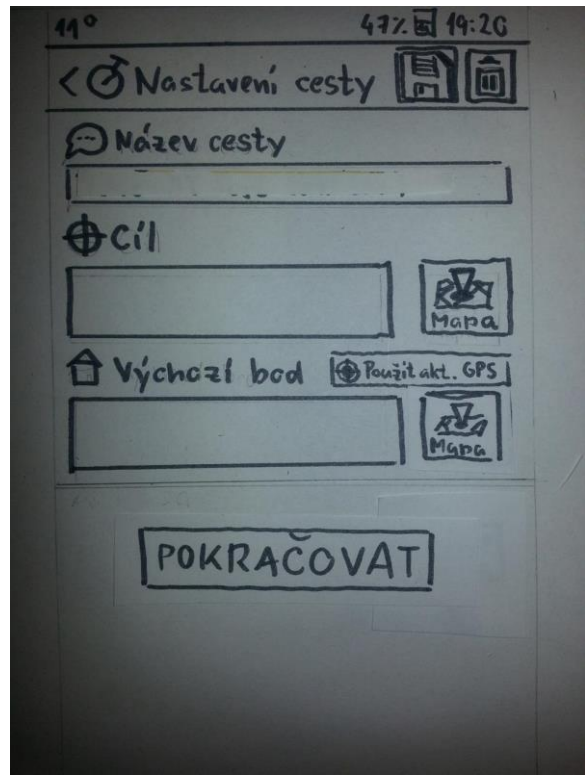
2.4 POP



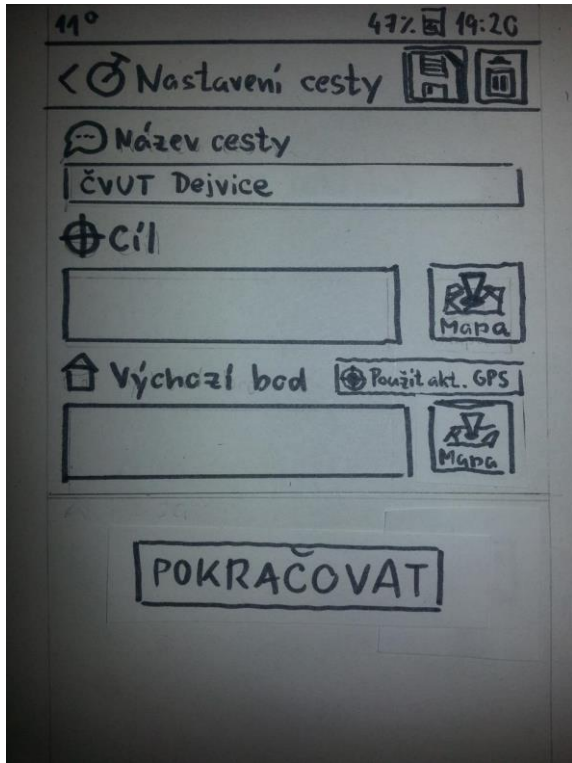
2.5 POP



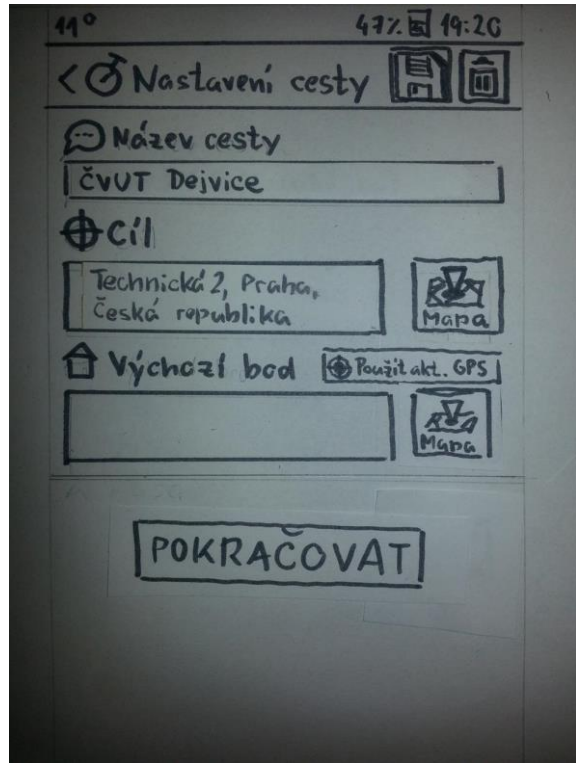
2.6 POP



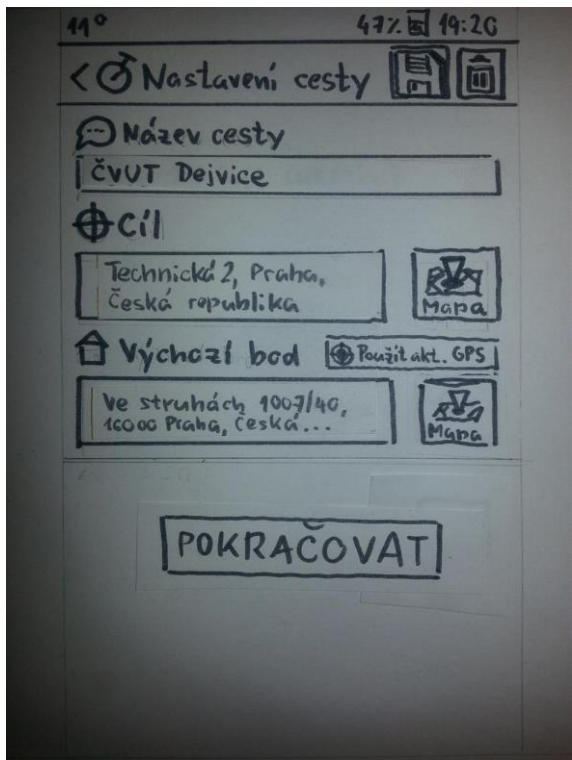
2.7 POP



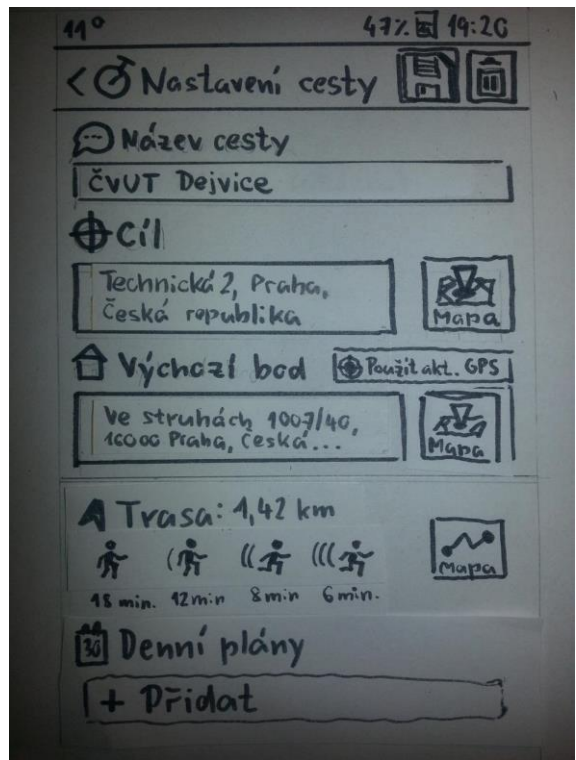
2.8 POP



2.9 POP



2.10 POP



2.11 POP

11° 47% 19:20

< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

🚩 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 08:00

POKRAČOVAT

2.12 POP

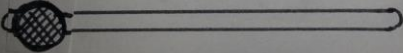
11° 47% 19:20

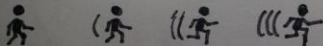
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

🚩 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:28 > 27 minut chůze > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.13 POP

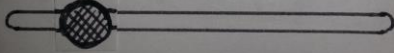
11° 47% 19:20

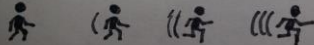
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

🚩 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:34 > 21 minut chůze > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.14 POP

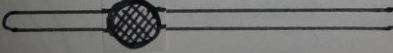
11° 47% 19:20

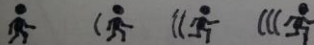
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

🚩 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:38 > 17 minut rychlá chůze > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.15 POP

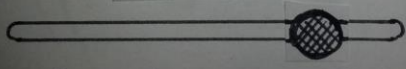
11° 47% 19:20

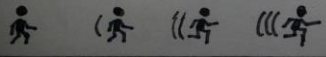
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

📌 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:46 > 9 minut běh > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.16 POP

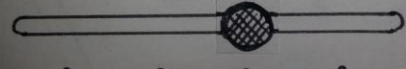
11° 47% 19:20

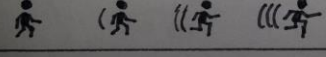
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

📌 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:43 > 12 minut lenký běh > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.17 POP


11° 47% 19:20

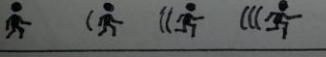
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

📌 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

⌚ Kdy je potřeba vyjít ?
7:41 > 14 minut rychlá chůze > 7:55





🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

2.18 POP

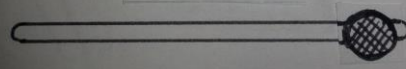
11° 47% 19:20

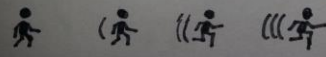
< ⌚ Denní plán cesty 📄 🗑️

Cesta: ČVUT Dejvice
Trasa: 1,40 km

📌 Kdy potřebujete dorazit ?
Den: ▼ Pondělí
Čas: 07:55

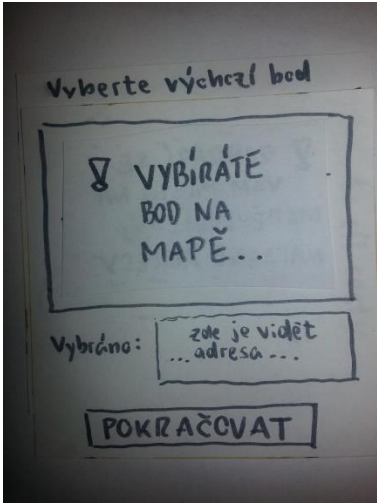
⌚ Kdy je potřeba vyjít ?
7:47 > 8 minut běh > 7:55



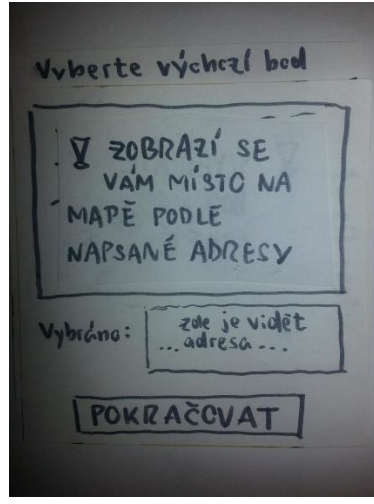


🔔 Upozorňovat
 Před cestou, že je čas vyjít
 Na cestě, pokud se zpozdím

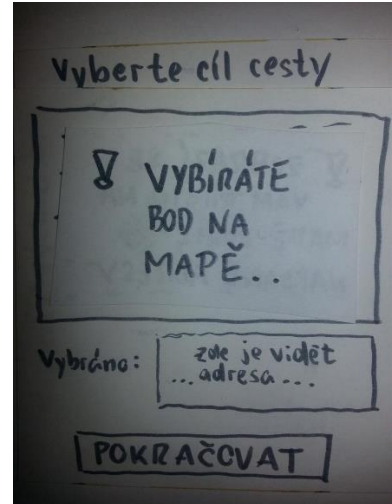
2.19 POP



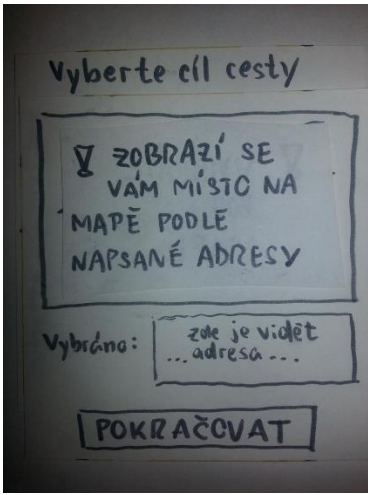
2.20 POP



2.21 POP



2.12 POP



2.13 POP



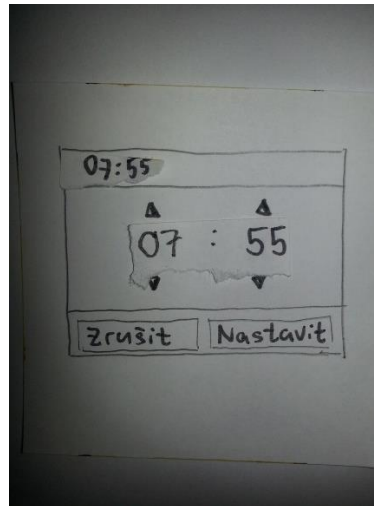
2.14 POP



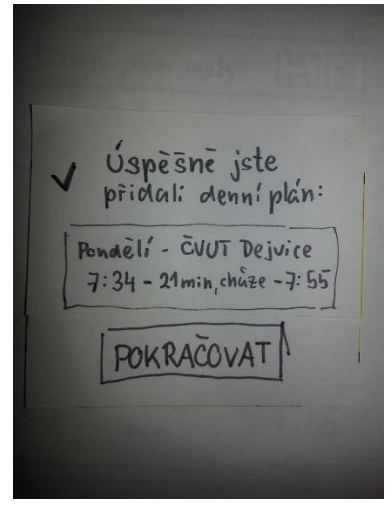
2.15 POP



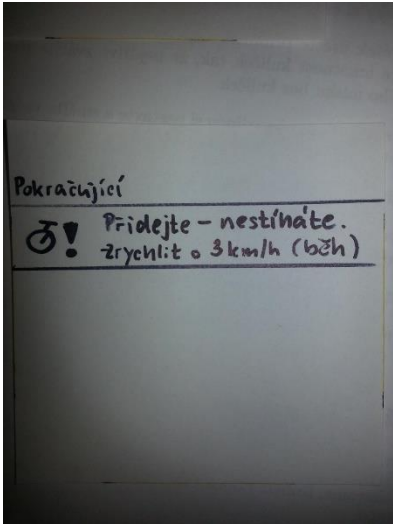
2.16 POP



2.17 POP

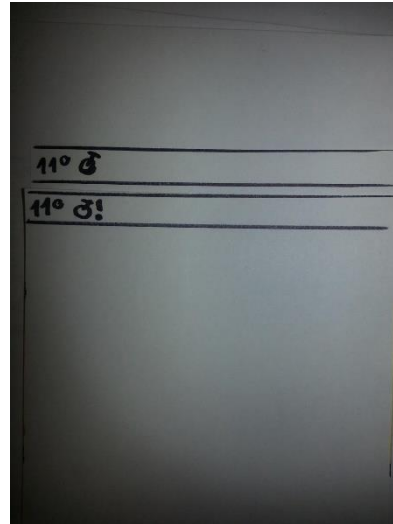


2.18 POP



An idea how to display a push notification telling the user to hurry up by 3 kph to running.

2.19 POP



Icons on the status bar (just next to a weather app's icon) showing whether the current speed is OK or not.

Acronyms used

- UCD - User centered design
- Lo-Fi - Low fidelity
- GUI - Graphical user interface
- IDE – Interactive development environment

Contents of enclosed CD

- thesis.pdf – this thesis in PDF format.
- Thesis.docx – this thesis in Microsoft Word format
- testingMockup.mp4 – a video from paper mockup testing where I show the workflow of the app
- testingLive.mp4 – a video from live testing
- /PaperScreens/ - a folder containing the paper mockup screens
- /Comic/ - a folder containing three comic stories prepared at Pixton.com
- Readme.txt – information on how to use the current version of TimeToGo and test it on your device

References

1. <https://developers.google.com/maps/documentation/android/?hl=cs> Google Maps V2 API
2. <http://sankarganesh-info-exchange.blogspot.cz/2012/09/notification-in-android-using.html> Examples of notifications on Android
3. <http://stackoverflow.com/questions/3510649/how-to-pass-a-value-from-one-activity-to-another-in-android> Passing values between activities
4. <http://pulse7.net/android/date-picker-dialog-time-picker-dialog-android/> Dialogs in Android
5. <http://mobiforge.com/design-development/using-google-maps-android> Working with google maps
6. <http://eagle.phys.utk.edu/guidry/android/mapOverlayDemo.html> Working with google maps
7. <https://developer.android.com/design/index.html> Design principles for Android
8. <http://www.comscore.com/> - data about Android users, genders, ages etc.
9. <http://www.cs.utah.edu/research/groups/percept/papers/Mohler:2007:VFI.pdf> Walking research
10. http://books.google.cz/books?id=Cx22TcXodrwC&pg=PA665&lpg=PA665&dq=preferred+walking+speed&source=bl&ots=9J95evQtrC&sig=7rwd_1wHFFTor9dH2RJxF-DGIQM&hl=cs&sa=X&ei=zWN2U6OkF4-h7AaSgoHYDQ&ved=0CIYBEOgBMAg#v=onepage&q=preferred%20walking%20speed&f=false Walking research
11. <http://stackoverflow.com/questions/5693997/android-how-to-create-an-ongoing-notification> About ongoing notifications
12. <http://android.stackexchange.com/questions/34969/how-to-deal-with-orphaned-wakelocks> Issues with WakeLock explained
13. <http://developer.android.com/> The main source of information for this project
14. <https://github.com/tyczi/MapNavigator> The big library I used for Google maps implementation