Sapienza University of Rome

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Applied Computer Science and Artificial Intelligence

A Crowd-Sourced Mobility Application

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Contents

Chapter 1

Introduction

1.1 Our Idea

The intent of our application is to give more precise information about possible delays or irregularities in the public transportation service. This could be achieved by the retrieval of information delivered directly by the community of users, who may have the chance to inform others about possible delays or overcrowding of the bus or the tram that they are taking. Furthermore, all the users will collect some credits for every contribution, which will be devolved into charity, in one of the NGOs chosen by the user, among those proposed by the application.

1.2 Existing Competitors

Google Maps: It is one of Italy's most frequently used mobility applications. It is a web service that provides detailed information about geographical regions and sites worldwide. In addition to conventional road maps, Google Maps offers aerial and satellite views of many locations. It works both for public transportation and private ones.

- **Pros**: It is very intuitive and offers many fundamental features. It delivers information about possible paths to reach the destination with their duration and arrival time. It specifies the possible expenses needed for every choice taken.
- **Cons**: The path duration is not defined by crowdsourced information or GPS tracking applications. It is based totally on statistical inferences which means that is almost never precise.

Moovit: It is one of the main mobility applications for public transportation only. It provides information about the statistically best path to reach a destination point. Describing when and where to take the transportation means in order to reach the destination as fast as possible.

- **Pros**: More reliable than Google Maps (based on users' interviews), the interface is very intuitive.
- **Cons**: Too many ads, the defined timing is almost never correct.

Probus: The application is designed for Android only and it only works with buses. It informs the user about the waiting time of a certain bus line and the fastest path to reach a destination.

- **Pros**: Useful because it is strictly focused on busses, and therefore is able to offer a more tailored experience to users.
- **Cons**: Although the time estimates are reliable within a single bus trip, the application does *not* give information about future ones, hence, users do not know how long they will have to wait for the next run.

Citymapper: Citymapper is a public transit app and mapping service which displays transport options, usually with live timing, between any two locations in a supported city. It integrates data for all urban modes of transport, including walking, cycling, and driving, in addition to public transport.

- **Pros**: An almost always accurate and comprehensive direction guide. Free for both Android and iOS. It provides a calories counter and specifies the expenses for every chosen path.
- **Cons**: Not available in many cities and it does not retrive crowdsourced information.

Transit: Transit is a mobile app packed with features that help you plan a trip on the bus. Real-time bus tracking and information, service alerts, and trip planners are some of the many useful features that make this app a favorite for transportation services.

- **Pros**: GPS tracking of public transportation in real-time, crowdsource support (tracking the user location when they use the app as a navigator), information about all the surrounding bus stops and possible paths to the destination.
- **Cons**: Many useful services are not free. It does not work very well in Italy.

1.3 Need Finding

1.3.1 The Interviews

In order to better understand what our users want, we first conducted a round of interviews. These allowed us to interact colloquially with our potential users and to gauge what they think are the major discomforts of public transportation. We also wanted to understand their approach to personal privacy and community-driven applications. We used data we obtained as a guide for our next steps in the design process.

Our Questions Our interviews were standardized around a set of ten questions that we designed, as a group, to be as open-ended as possible. We wanted to avoid leading the interviewees to answer in a particular way, have them act as designers, or figure out the specific purpose of the survey until later on, when the general questions were answered.

The Questions:

1. Did you commute via public transport in the last week? If so, what type?
2. What criteria do you consider when choosing your means of transportation?
3. What are some frustrating aspects about public transportation?
4. Do you use mobility apps (like Google Maps) while commuting? If so, which functionalities?
5. How much do you trust the information given by your app of choice?
6. Do you worry about giving authorizations to apps? Are there some you are more willing to share?
7. Are you concerned about organizations distributing your location based data to third parties?
8. Would you trust mobility info more if it were crowd-sourced? Would you participate in such a program?
9. Would a honor system, rewarding you based on the credibility of your contributions, incentivize you to participate more?
10. In a community-driven app, how interested are you in customizing and showing your profile?

The Outcomes To carry out the interviews, we split our groups into 3 teams of 2 people each. Each of those teams had a target of 10 interviews to reach, which was achieved in a few days (with some extra interviews to spare).

Overall, if we look at the general trends, we can draw the following conclusions:

- A majority of our interviewees use public transportation on a daily basis, and most of them commute via bus or metro.
- All of the interviewees use mobility apps, with Google Maps being the most popular, usually paired with an app such as Moovit to provide more accurate information.
- Most of the interviewees find frustration in three things:
    1. Overcrowding of the vehicles
    2. Lack of punctuality
    3. Unreliability of bus rides (which are often late or do not show up at all)
- Users are generally willing to share data that is required for the functioning of the app, and are only really concerned about their privacy if the issue is brought up.

- Users enjoy the prospect of a community-driven application, and would be willing to participate in such a program, especially if it were to improve the quality of the service.
- Users are generally not interested in customizing their profile, *especially* in the context of a mobility app, this varies from person to person, and seems to correlate with the person's technical knowledge, but the general trend shows that the feature is not very popular.
- In a similar fashion, users seem not to be interested by a gamification system, rather seeming to prefer more direct rewards, either monetary, in the form of a better service, or through the possibility of devolving their rewards to charity.

1.3.2 Questionnaire

After the interviews, we had obtained an initial set of knowledge on the needs and wants of our userbase. We used this knowledge to produce a new set of focused questions that aimed to capture the opinions of a wider group. Firstly, we sent a test sample to 10 of our friends and relatives and we used their answers to retrieve information on how to refine our questionnaire. Then, we distributed the questions through Google Forms to various online groups, obtaining a sample size of ≈ 150 answers.

Questionnaire URL: https://forms.gle/ipkEswPH1cex8mFdA

Questionnaire Structure The answers are difficult to provide as a transcript, since we made use of Google Forms features to provide a slightly different questionnaire to users based on their ongoing answers. The single greates use of this feature was to not collect informations of users who did not utilize public transport recently, in order to avoid pollution of our dataset. In general, we can give an outline of the structure of our questionnaire:

1. Introductory questions — Age group, frequency of use of public transport, device brand
2. General questions on transit — Principal frustrations, interest in a crowd source system, etc...
3. Opinions on reward systems — Whether they prefer customization, charity, honor systems, etc... as forms of reward to their contributions

Testing Before sharing our form with multiple people we first gave it to a number of acquaintances, as to test whether everything was alright. This let us spot two problems:

1. When asked *In which **city** do you use public transit?*, some answered with lesser towns such as Fisciano or Monterotondo — This prompted us to change the question into *In which **province** do you use public transit?*.
2. Some were baffled by the presence of further questions on the sharing of data after they had already answered **No** to the question *Would you like to share (anonymously),*

your position to help the app inform others? — Therefore we made sure to shadow those questions in case of such an occurrence.

Unfortunately this testing phase didn't let us catch another small problem (albeit one nonetheless), when prompted to share their age bracket, people were shown the following:

- < 18
- 18-25
- 25-35
- ...

What we didn't realize is that there is no guidance on how the extremes of these ranges should be considered! Therefore, without further instructions, the ranges could be considered in different ways, some such that the ranges would be overlapping. Fortunately, this was not a real problem as this question wasn't really fundamental to our analysis.

Conclusions We performed some descriptive statistics on our dataset in order to draw more informed conclusions, this consisted mostly of the production of a series of graphs that aimed to quantitatively describe certain metrics (*e.g:* preference for a certain reward system) while categorizing our samples in different groups (*e.g:* by age, device, etc...).

First thing first, let's check the age distribution of those who answered our form:

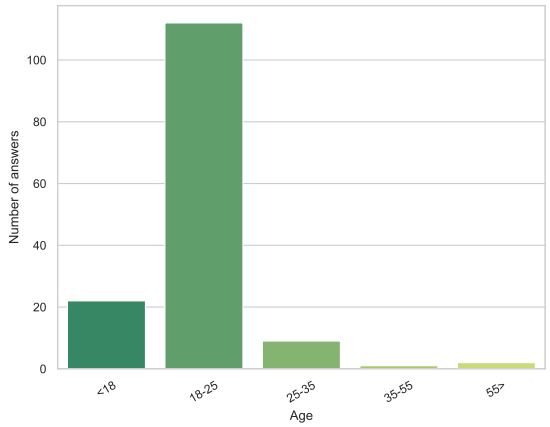

Figure 1.1: Age distribution of our respondents

The majority of our respondents are of ages 18-25, followed by a minority of users under 18 years. Those remaining are distributed across people aged 25-35 and > 55, with no respondent of age 35-55.

About the main province in which the respondents take public transport:

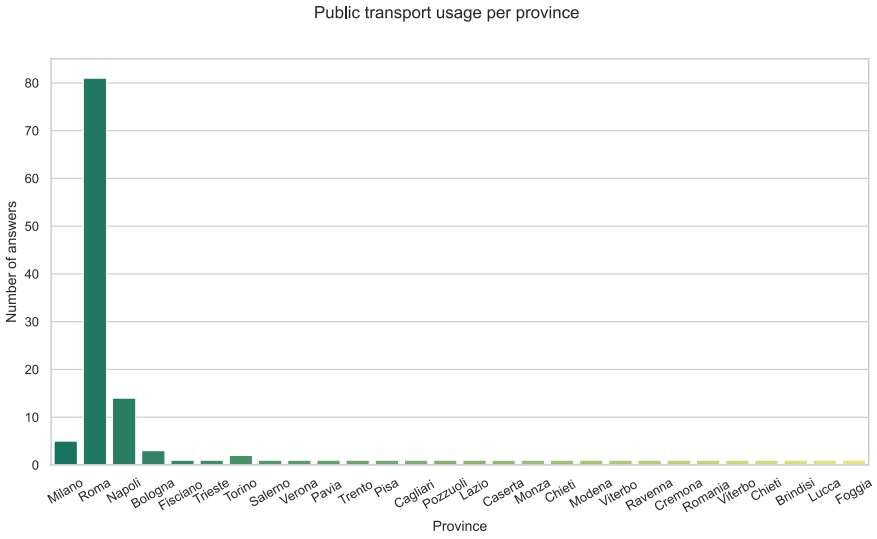

Figure 1.2: Public transport usage per province

As we can see, the majority uses public transport in Rome, with a minority in Milan and Naples. These results were obtained after having modified the questionnaire. As explained above, initially, we were asking for the city and not the province.

We are also interested in the most used operating system among the respondents:

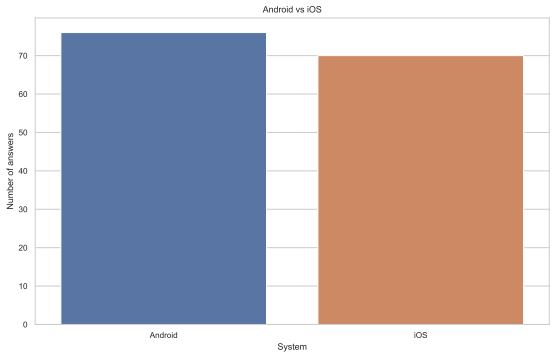

Figure 1.3: Android VS iOS

Hoping for a more noticeable difference, the statistic shows that the obtained results are similar: 52% Android users and 48% iOS users. We have decided to implement an Android application.

As follows, we show the number of public transport users by their device's operating system

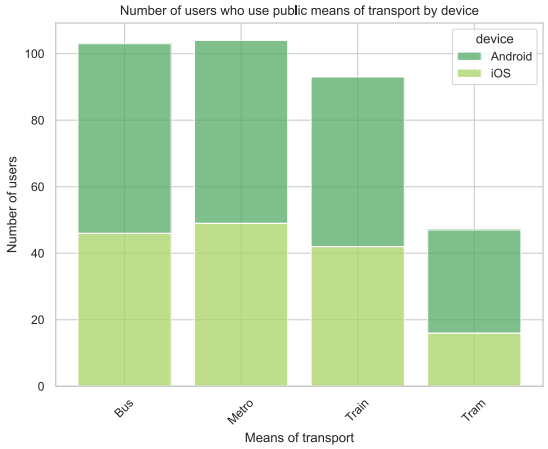

Figure 1.4: Users by means of transport by device

Let's look at the number of public transport users by province:

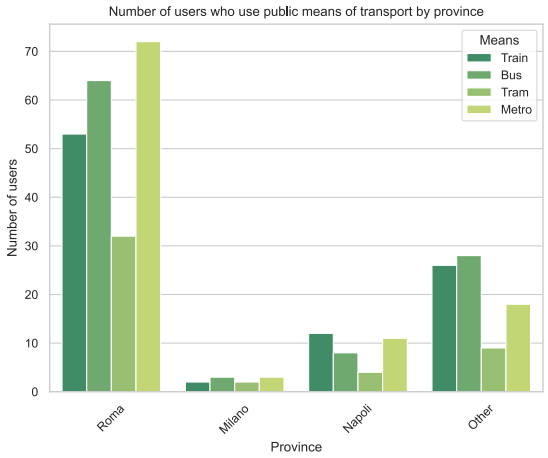

Figure 1.5: Users by means of transport by province

Since the majority of the respondents use public transport in Rome, Naples and Milan, we have collected the statistics of other provinces in the 'Other' column. It is evident that, in each province, users take the metro and the bus mostly.

At the basis of our reasoning, the most frequent disservices caused by public transport are:

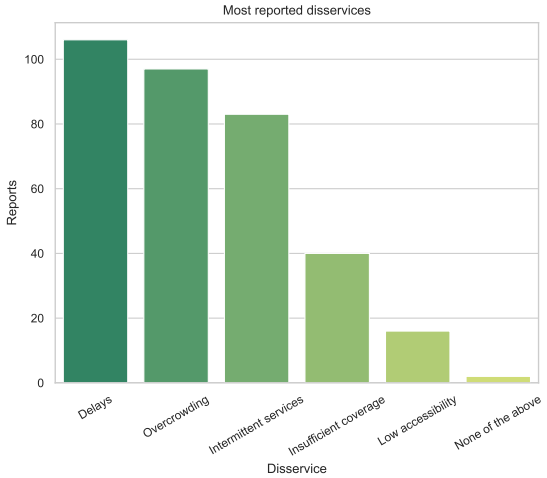

Figure 1.6: Disservices reports

This analysis is fundamental to our project. It highlights the most frustrating aspects of public transport. Those are the ones on which we should focus, in order to improve people's experience while using public transport. As shown, the majority of the respondents report about delays and overcrowding. The obtained results give us a further confirmation of our objective.

In the form, we ask some questions in order to understand users preferences and how they would be interested in our idea. Crowdsourcing is at the basis of our application. Retrieving information, about possible delays or transport overcrowding, directly from the community of users will make transportation more efficient. But, are users willing to partecipate? If so, would they be more incentivized having some kind of reward (e.g., charity, features and customization unlocking)? Let's look at some statistics...

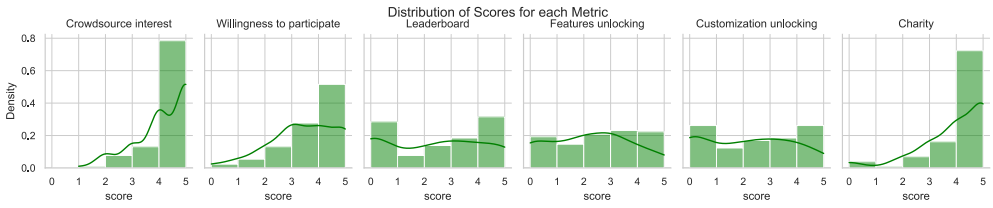

Figure 1.7: Overall distribution of respondents' interest

Without considering the age of the respondents we can see that the overall interest in a crowdsourced app and the willingness to participate in it is fairly high. For the functionalities, on the other hand, the opinions are mixed if not negative to everything except the idea of charity.

Let's look at these same statistics broken down by age ranges (there were not enough respondents in the 35-55 gap, thus a plot was unfeasible).

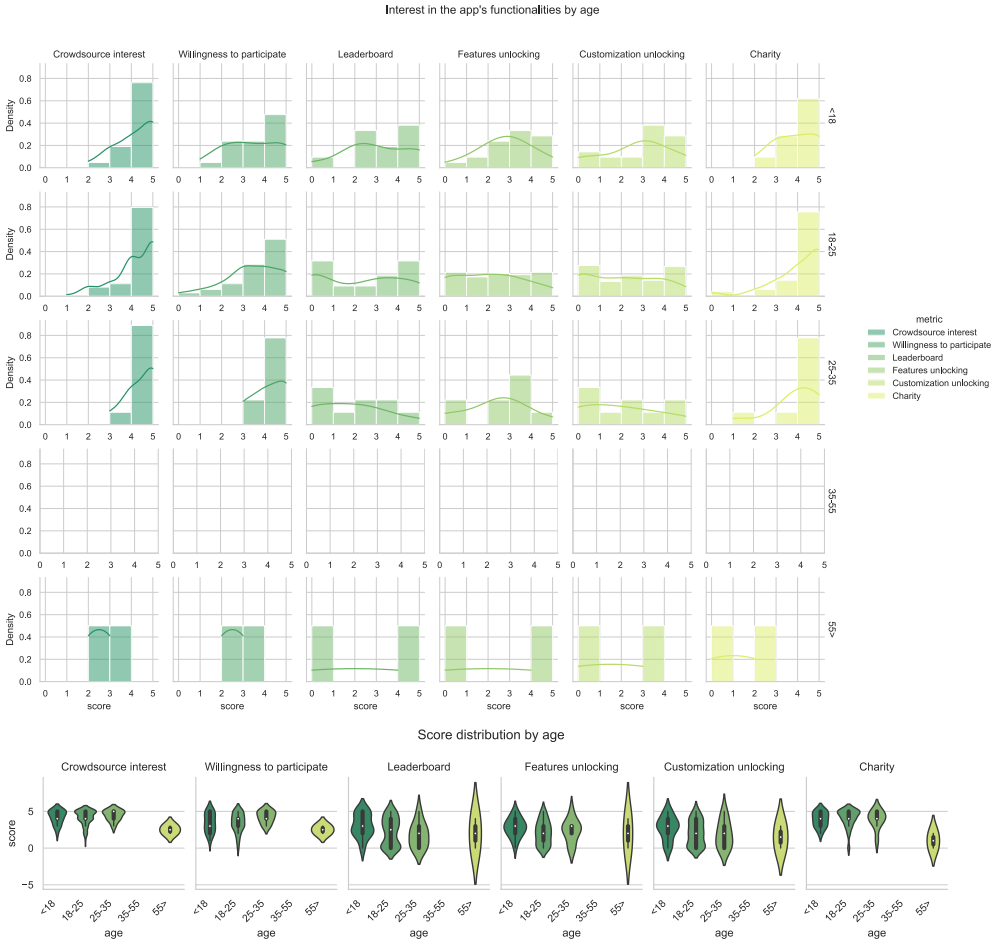

Figure 1.8: Respondents' interest by age

From this breakdown we can see that both the willingness to participate and the interest in the offered functionalities is slightly higher in the younger population, strengthening our interest in that target. Indeed, here's a focus on the 18-25 gap:

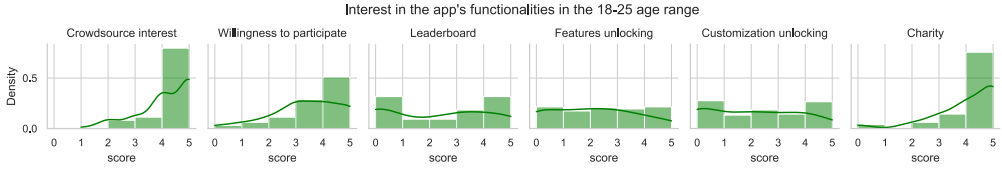

Figure 1.9: Interest in app functionalities 18-25

Now, to draw some conclusions, we arbitrarily set a threshold for *interested/not interested* respondents to each metric at a score of 3.

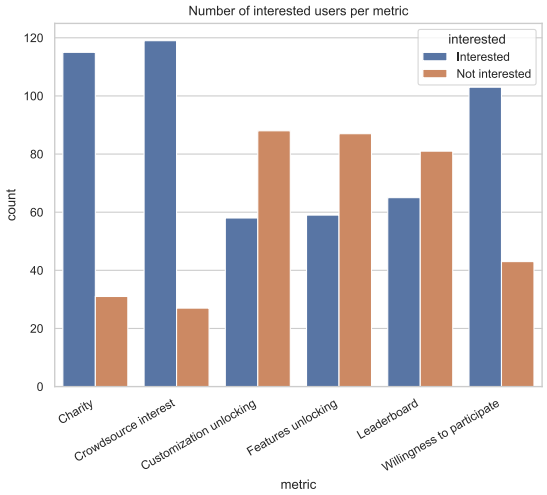

Figure 1.10: Interested users per metric

As we can see, the majority is not interested in a leaderboard of the users who have reported the greatest number of information (e.g., delays, overcrowding). In the same fashion, reward systems such as features and costumization unlocking have not captured the attention of the respondents. However, their crowdsource interest and willingness to partecipate in such a community give us a positive feedback. Charity donations incentivize them more.

Lastly, but not in terms of importance, let's check how the users would like to report the vehicles they are currently on.

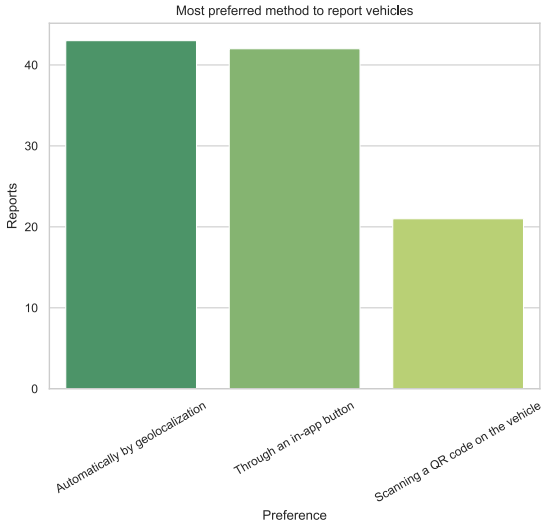

Figure 1.11: Most preferred method to report vehicles

From this, we deduce (since the GPS method is probably the most intrusive one), that the best course of action would be to create a system without geolocalization but that would also be as simple and annoyance-free as possible.

1.4 Storyboarding

Tasks After our questionnaires, we wanted to clearly identify a set of *core* tasks that should be supported by the application.

The Tasks:

- Reporting public transport delays to other users
- Reporting overcrowding in a public transport to other users
- Spending points for a donation to a non-profit organization
- Looking for a route to a destination

For each of those we then proceeded to produce a storyboard detailing the sequence of interactions that a user must perform in order to complete the task.

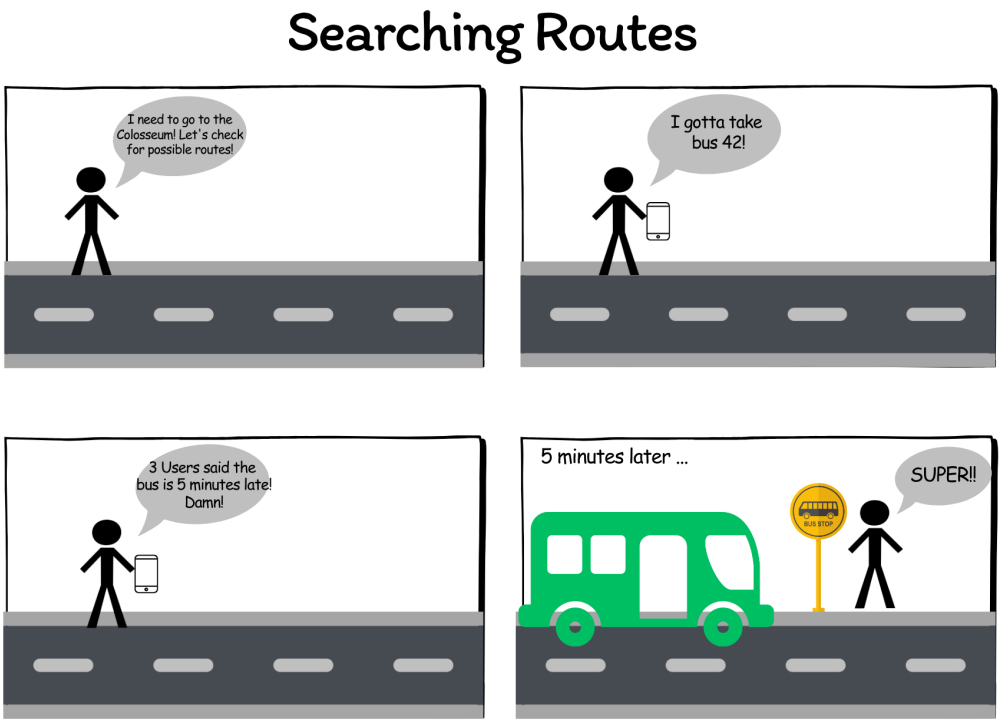

Figure 1.12: The user can find all the possible paths leading to the defined destination point, moreover, he/she can be informed about the statistically calculated waiting time as well as any reported delays regarding the proposed bus lines.

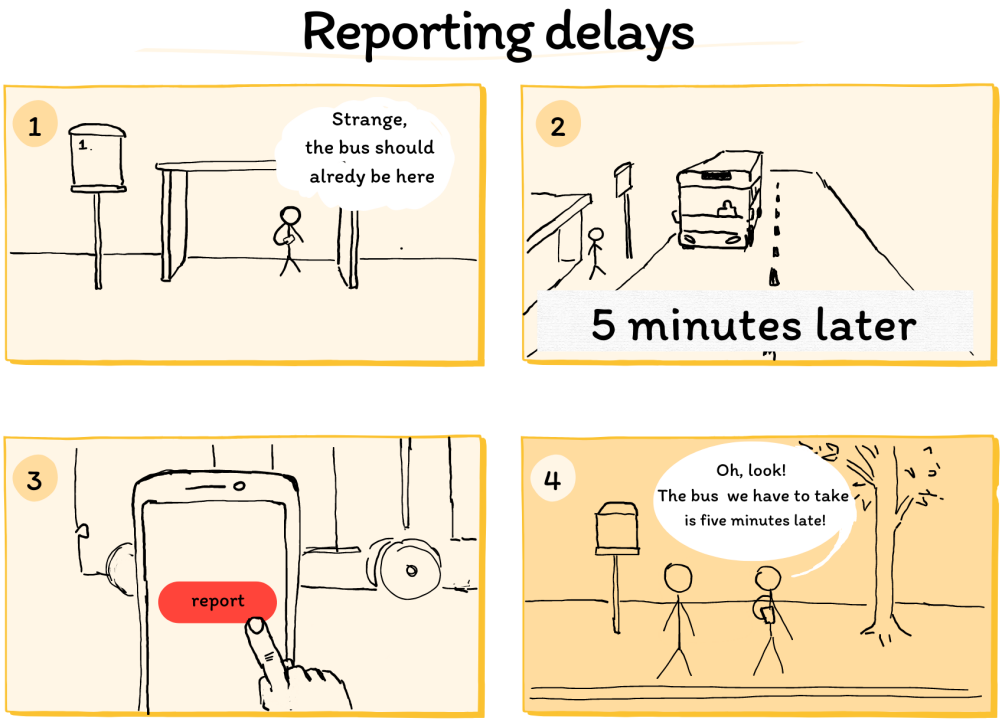

Figure 1.13: The user can visualize the real time statistics on the expected waiting times for a certain bus line. If the statistics are not correct he/she has the chance to inform others about the actual arrival time of the bus, leading to a recalculation of the waiting times.

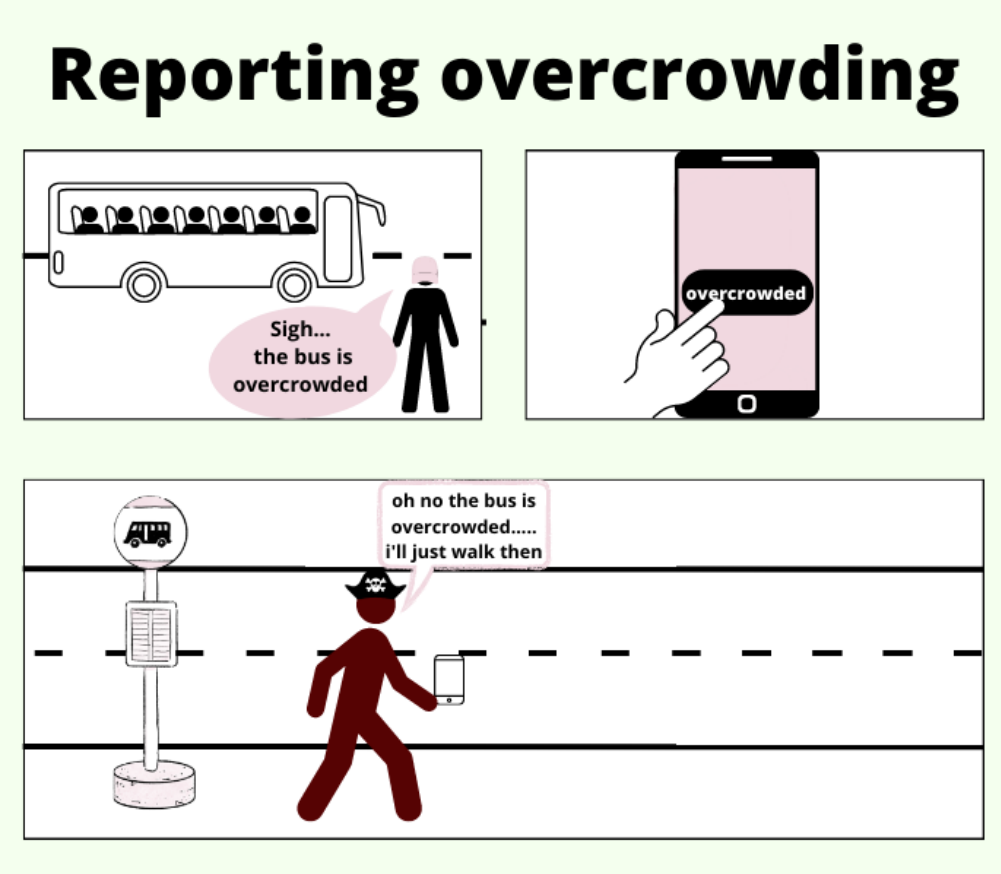

Figure 1.14: The user can also report if the bus that is passing is overcrowded, thus, even if the bus arrives in time, he can give useful information to other users, who may benefit from this information and choose a different route to their destination.

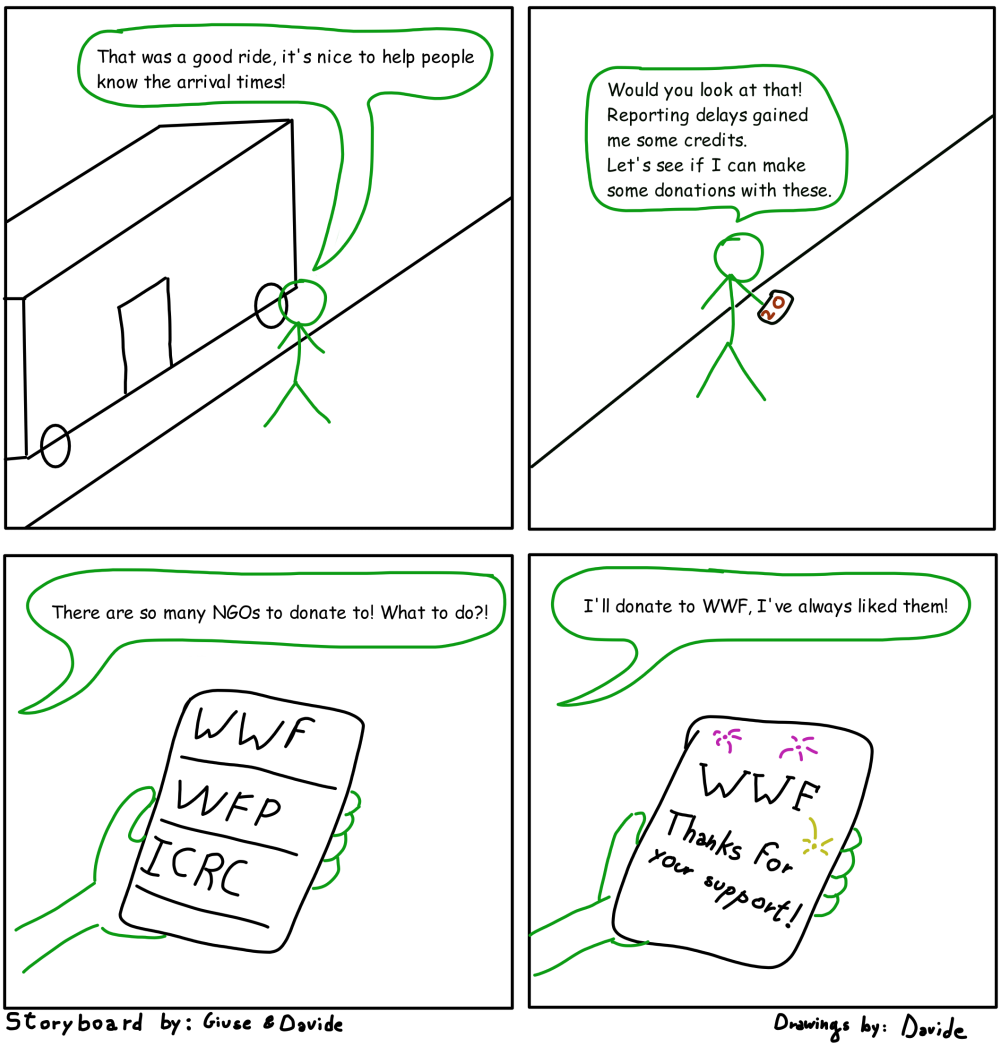

Figure 1.15: In the end, the user gets to store a certain amount of credits for reported departures. After n reports, he/she can devolve their credits as charity to one of the NGOs proposed by the application. Thus, every free contribution to the service may help other people in need.