

Driven by Rewards: A Ridesharing System Addressing Flexible Commuting Requirements

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Abstract. Persuasive technology has the potential to influence people in choosing a sustainable mean of transportation instead of staying in the learned, convenient behavior of using the own car. Ridesharing systems offer a huge potential to improve commuter traffic by reducing the number of vehicles on our roads, and consequently the length of traffic jams. One problem of existing digital ridesharing solutions is, however, that they often require to pre-register an upcoming trip using web-services or tedious online forms. We postulate that these services are thus not really suitable for today's flexible commuting requirements. As a potential solution, we propose a novel ridesharing concept that specifically targets commuters with daily flexible schedules. The system stays "invisible" most of the time – meaning that there is little or almost no user interaction needed for offering or consuming services. A gamification-based approach is further used to stimulate more frequent use and, by rewarding usage of the system, creating additional personal benefit.

Keywords: Persuasion in transport, Behavior change, Social systems, Ubiquitous sensing, Ridesharing, Incentives, Gamification.

1 Persuasion in Ridesharing Systems

To reduce the steadily increasing number of vehicles on our roads (20 percent or more in the past 10 to 15 years [10],[12],[5]), ridesharing is, beside other obvious solutions such as public transportation, biking or walking, an approach with high potential. By increasing the average number of persons per vehicle in commuter traffic (which is currently just above 1.0 [6],[5]), ridesharing could make an important contribution to sustainability and consequently reduce traffic jams.

When talking about ridesharing, most existing systems rely on a classical driver-passenger relationship and drivers might often not see an advantage in using such a system, i. e., offering rides, what is crucial for a service that relies on their active contribution. With this work, we propose a concept trying to maximize drivers' participation in a commuting context by **(1) persuading them to build up carpools together, (2) minimizing the user input needed and**

(3) adding motivational features such as incentives for active participants.

An interesting question in this context is, why most people nowadays do not take advantage of public transportation services? Vug, Lange and Meertens [11] presented a psychological view on this issue and argued that transport decisions are influenced by many factors, some of quantitative (travel time, uncertainty) others of qualitative (security) nature combined with the individual beliefs of “pro-social” (people that tend to make decisions based on the impact to the whole group) or “pro-self” (individualists) persons. This directly leads to a social dilemma where self-interest conflicts with long-term collective interest [11]. Rethinking mobility behavior will - for most people - require a major change in deep grounded habits so we might assert them - based on their personal attitude - to one of Prochaska’s “stages of change” [7]. A ridesharing system could try to convince people to advance to higher stages as, according to Salah et al. [8], future pervasive systems will “change from a passive observer to a socially active participants that influences peoples’ attitudes and behaviors by providing support in goal selection and acquisition”. Since Gabrielli et al. [3] state that not all users are motivated by environmental concerns – and thus would not be willing to change their behavior “just for the sake of the environment” – people have to be motivated in a different way. One possibility to ease a change in someone’s personal behavior is the application of persuasive technology, for example by using rewards [9]. According to [3], this concept is most effective when rewards are “real” and not just nominal. In our case, we provide drivers with incentives such as vouchers that are collected from sponsors who got in turn the opportunity to present themselves within the system as a company that “invests in environment protection”. Agatz et al. [1] argue that incentives in such a context can be even more effective if they are supported by local governments (like tax reductions). As we decided to use incentives to support both the peoples’ attention and action in this process we also want to mention the work of Scekic et al. [9] who stated that a hybrid approach [9] including team-based and individual incentives could further improve the situation.

Some of the ideas we propose in this work directly emerge from a master thesis that already had the aim to build up a ridesharing system for commuters but in our opinion was still too much influenced by classical and prominent ridesharing services like *Fliinc* or *BlaBlaCar*. In this early work we present some results from a survey that helped us refining our concept as well as some qualitative findings that arose when implementing a first prototype.

2 Evaluating User Requirements

To identify requirements of potential users of a ridesharing system we conducted an opinion survey (online questionnaire distributed by Email). Most of the questions had to be answered on a 5-level Likert Scale (1...totally agree, 5...totally

disagree) and targeted commuting behavior, general views on commuting, carpooling and public transport, as well as an evaluation of potential features and, last but not least, demographic information of responders.

N=166 persons (\bar{x} =34.4 years, σ =8.9 years; 109 male, 57 female) filled out the questionnaire and the initial findings on commuting behavior fit well in previous studies [2][4] - their households mainly own 1 (41%) or 2 (40%) vehicles and most car commuters (57.2%) use their car alone (73%). Only a few (5.4%) have used digital carpooling solutions before, but 58% of all participants “might” do so if it fits into their needs. On the other hand, **many participants state that public transport is not flexible (61%) enough and nearly 70% indicated their will to change to public transport if travel frequency would be increased.** Beside such general information we want to highlight the following findings to be important for our system concept:

- **Automated Tracking:** Important for us was to find out whether ridesharing system users would allow the system to record their movements automatically or prefer to publish upcoming commuting trips on their own. As expected, some (about 35%) respondents refused automatic recording/ publishing of routes due to safety/security concerns but much more (57.5%) are ok with this feature. Interestingly, more than 50% stated to have enough time to manually publish upcoming commuting trips regularly (i. e., day-by-day before leaving home). We believe this to be a socially desired answer in the context of ridesharing and that relying on this feature will sooner or later result in inactivity. Contrary, many users rated features such as ad-hoc requests, that rely on permanent user tracking, high.
- **Sacrifice of Door-to-Door Requests:** To raise acceptance at the driver’s side we thought that some of them might deny requests that would require a detour from their common commuting route. So our initial idea was to allow requests only between predefined “nodes” that can be connected to the available net of public transport stations. As a consequence, a driver would never have to leave his original route as the system makes sure that pick-up and hop-off locations will always lie directly on his trip (in our approach, we used public transport stations as infrastructure to get on/out without interfering other traffic). Answers in this section indicate that **allowing door-to-door requests can be a show-stopper for drivers** - more than 90% of the participants stated that they would likely pick someone up at a bus station directly on the way while door-to-door requests polarized.
- **Verification:** A huge majority wants their potential driving partners to be verified (64.1%), what should be concerned in every new system. To minimize misuse of the solution for criminal activities, verification in this context means that the system can connect every active user account to a legal entity - this can be achieved by requesting official documents like passports or

more easily by SMS code allowing domestic operators only.

- **Incentives, Leaderboards and Ratings:** Incentives as motivation were seen very positively (71.9% state that a reward like a highway toll could additionally motivate them), while classical gamification approaches have not been favored – in case of leaderboards even most people disagreed and stated comparison with others not to be very important (59.5%). Rating of users on the other hand seems to be and this is currently also a feature of most systems.
- **Guarantee Return Trip:** Another important finding for a dynamic, flexible ridesharing system is, that uncertainty on the return trip is not tolerated by most users - 91.5% want to know how to get back beforehand. This should be reflected in every new system, for instance by providing pairwise suggestions including return trips or proper designed search masks.
- **Stable Prices are Preferred:** A further aspect is the calculation of prices (in case that drivers have to be paid). People seem to prefer stable prices they can rely on and calculate with. This seems very contrary to solutions (like *Uber*) that use supply-and-demand principles for calculating transport prices.

Question	++	+	o	-	-
I allow a ridesharing app to record my commuting behavior	26.1	31.4	7.2	20.9	14.4
I have enough time to publish upcoming routes beforehand	14.4	35.9	22.2	21.6	5.9
I would pick someone up at his home	5.9	39.2	12.4	35.9	6.5
I would pick someone up at a bus station	47.7	43.1	3.9	3.9	1.3
I will only drive with verified participants	30.1	34	12.4	17	6.5
A reward like a highway toll would further motivate me	32	39.2	20.9	5.2	2.6
A leaderboard is important for comparison with others	2	9.8	28.8	32.7	26.8
Rating passengers and drivers is very important	17	36.6	20.3	17	9.1
I want to know how to get back beforehand	61.4	30.1	2	6.5	0
The same route must always cost the same price	41.2	29.4	23.5	4.6	1.3

Table 1. Results (Percentage) of the most important findings from the questionnaire (++ totally agree, + agree, o neutral, - disagree, - totally disagree).

3 Discussion and Proposed Workflow

Additionally to the survey we implemented a prototype of the system (Fig. 1) to evaluate tracking capabilities and visual representations. As some provided functions of the prototype have not been used regularly (ad-hoc requests, internal messaging system between users) we decided to collapse the concept back

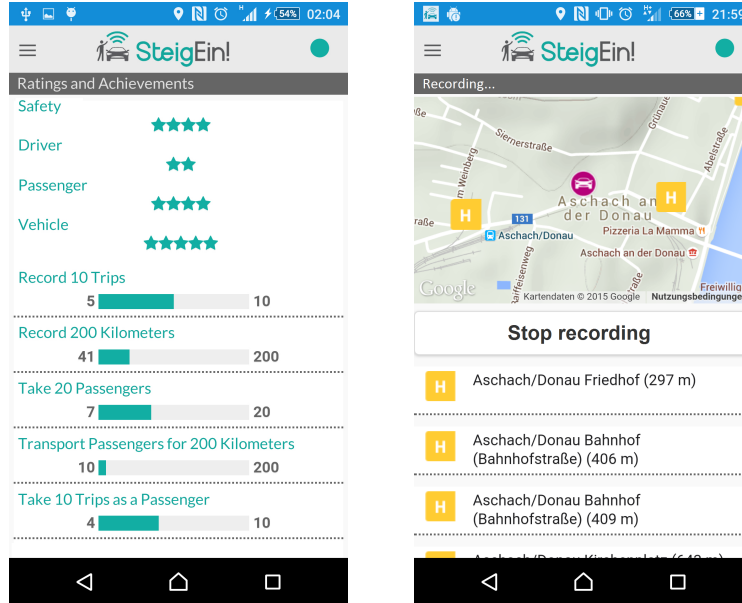


Fig. 1. View of ratings and ongoing achievements as well as the driver's trip-recording dashboard with near pick-up locations (public transport stations).

to its core functions what, combined with the findings from the online survey, results in the following workflow:

A novel ridesharing solution targeting commuters with flexible commuting schedules should **actively track users and find best-matching compositions** that are then **presented to the proper passengers**. Since uncertainty of a return trip is hardly tolerated, such a notification might also already include a possible partner for getting back home. Potential meeting points for participants should be arranged in a way that the driver is not forced to detour and a possibly good choice for such pick-up locations might be public transport stations as they usually allow stopping the car without interfering with other vehicles (another advantage is the possibility to transfer from a bus to a carpool or vice versa). The system should further use the tracking data to **automatically determine if the suggestions are followed** what would eliminate the participants' need to confirm their shared ride on a daily basis. To incentivize users for their contribution to sustainable mobility, the system will **credit active participation with points**. A metric how points should be finally distributed amongst participants to make the service been perceived fair will be part of further investigations – one possible method could be starting with a fixed amount of points for a shared ride that is always multiplied and again reset when a driver commutes alone. We also want to highlight the need for a suitable business model to account for running costs and costs for incentives. **Points that have been gathered**

by a participant should finally be used to be exchanged in “real” rewards. Those rewards may exist in form of vouchers obtained at an in-app marketplace and **provided by businesses that advertise for their products or services**. This would create a win-win situation. Beside the advantage for users businesses can use the marketplace **to create brand awareness** – such brand-awareness raising voucher systems already exist and some of them have been highly rated by investment companies. A system with a direct connection to sustainable transportation or environment protection might gain even more sympathy for the advertising businesses as they can present themselves as helping to “generate a better future”.

Next steps are to consider the findings from the qualitative/quantitative pre-studies in an improved prototype and to examine 1) if the proposed (new) concept leads to higher usage, 2) which suggestions for potential carpools (time, distance) are preferred by participants, and 3) how a proper metric for the distribution of incentives could look like.

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