CarLoop: Leveraging Common Ground to Develop Long-term Carpools

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Abstract
We developed and tested a website and public display to connect and sustain carpoolers in the workplace. We arrived at this design through study of traffic congestion and its causes. After finding that many problems are deeply rooted in transportation infrastructure, we discovered several that could be addressed through design of an interface to carpooling. We found that people are often hesitant to carpool with unknown drivers. Our system offers numerous features to create and nurture sustainable carpools, bringing together design principles with organizational principles and workplace knowledge. Preliminary testing of our system encourages us that its combination of features could increase the success rate of workplace carpools.

Keywords
Design, community, social awareness, social reinforcement

ACM Classification Keywords
H5.2. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction:
Traffic congestion wastes three billion gallons of gas a year. This is made worse by continuing growth of

private automobiles. From 1980 to 2000, 1.2 more automotive vehicles were added to the vehicle population of the United States for every 1.0 persons beings added to the human population [7]. Seven times as many journeys are made by private automobiles as are made with public transit, which leads to significant congestion and pollution. CO2 emissions from U.S. cars & trucks totaled 314 million metric tons in 2002. That's as much as would be released from burning all the coal in a train 50,000 miles long. If every commuter car in the U.S. carried just one more person, we'd save eight billion gallons of gas a year (7). An intervention that even slightly decreases commuter traffic can have an enormous positive impact on traffic congestion.

Figure 1: Interpretation Sessions

Information Gathering:

We began by identifying low-hanging fruit and quickly discovered, through literature review, that commuter traffic offered (1) by far the largest number of travel miles and (2) a focal point, the workplace, to support an intervention. Our initial review of transportation literature led us to two major problem areas: public transportation systems and single passenger vehicles. To further analyze these problem areas, our team conducted a series of contextual interviews with users of the Ann Arbor metro system. We rode the bus and took notes on rider behavior, then conducted brief, semi-structured interviews with riders on the move. Our groups then conducted personal interviews with ten users about their current and past experiences with single-passenger vehicles and carpools.

Figure 2: Affinity notes

Interpretation Sessions:

During our interpretation sessions (Figure 1) our team worked to synthesize our findings. We discussed our interviews, made affinity notes (Figure 2), and set up an affinity diagram to identify the major areas of the major areas of concern, experience, interest of the users and directions for our project.

We found that most problems with public transportation were rooted in infrastructure. Issues such as costs and deeply-rooted personal preferences could not be solved through a computer interface. Our study of single passenger vehicles led to a very different conclusion. There, we found that the most pressing problem was a lack of information about other passengers. Once we picked a problem area, we continued to analyze our data. We discussed our findings with experts at the University of Michigan working on transportation and ride sharing, focusing on the best solution based on our data and the resources available to us. Our findings are presented below.

The problem of Single-Passenger Vehicles

In 2000, 83.8 commuters drove to work alone, while 9.1% car/van pooled and another 1.1 percent took public transportation (including taxi) [4]. If we can motivate even a moderate portion of these workers to commute to work together, we can have a significant impact on congestion. Carpools target peak periods of traffic congestion and hence reduce congestion when it matters most. For a population of 42 millions household heads, an increase in auto occupancy from 1.2 to 2 persons reduces number of vehicles in use during peak periods by 14 million (from 35.1 million). Carpooling may also be the most effective technique for transportation energy conservation. If automobile occupancy is increased from 1.2 to 1.3 persons per vehicle an estimated 100,000 barrels of oil can be saved daily and $4.8 billion per year saved in commuter costs (in 1980) [3]. Carpooling reduces

Figure 3: Our Judith Persona

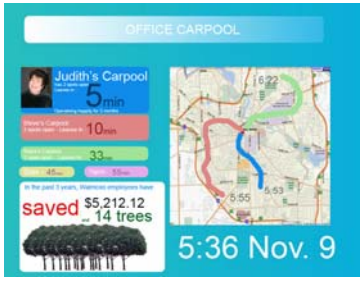

Figure 4: An LCD display to advertise CarLoop within an organization.

commuter travel time for individuals where high occupancy vehicle lanes are present. As we found in our interviews with carpoolers, carpools also provide people with a way to socially connect and interact, building lasting relationships over time.

Carpools for Organizations

Several important themes emerged as we analyzed our user data in our interpretation sessions. The most important issue for our users in terms of sharing rides was trust. Users were much more likely to ride in a carpool if they trusted the driver and other riders to be timely and polite. We found that many existing carpooling websites focus only on connecting riders, and do little to deal with the issue of trust. Users also valued stability and structure in their rides, which ruled out ad hoc carpooling systems.

Based on the desire for trust and structure, we decided to embed our carpool system within an organization, such as a corporate office or school. This introduces a basic level of trust, and makes it easier to attain the critical mass of users so essential for such a service to operate. We also expect an increased motivation for people to share rides with co-workers in the presence of in-group biases [2]. The system can also be more easily implemented by leveraging an organization's existing technical infrastructure. An organization can better tailor to local needs and resources. Additionally, it can provide offline contextual cues necessary for understanding ambiguous information in the system and provide shared spaces to display information which have proven successful for ad-hoc ride sharing systems such as RideNow [1]. We also expect network externalities to result in a much faster growth of the system when rooted in an organization.

Our Project: CarLoop

Based on the themes that emerged from our interpretation sessions, we developed a website and corresponding public display to help people working at large organizations develop carpools. We developed four personas and lead them through a variety of scenarios before building a functional prototype with HTML, JavaScript, and CSS. Below, we will explain our system through the persona of Judith (Figure 3).

Before our Website and Public Display: Consider the following scenario: Judith, a secretary at a large corporation, sees swarms of people coming in and out of her office building around the same time as she does. She knows that some of them must live close to her and she would be interested in carpooling to save money on gas and to reduce her driving time. Currently, there is no easy way to find out who lives close or even who would be interested.

With our CarLoop Website and Public Display: Judith arrives at work, again with the swarm of people. Near the entrance, she notices a large LCD display (Figure 4) of a map on which the paths of current carpools available are displayed. Judith is intrigued to see that her fellow employees have already saved over $3,000 that year. The website address is prominent on the screen, and she thinks about visiting the site later on that day.

After Judith logs into her computer, she sees a link to the CarLoop system on the company's internal homepage. Intrigued, she clicks the link and finds herself at a web page to help people specifically at her company develop carpools. Though this page, she can

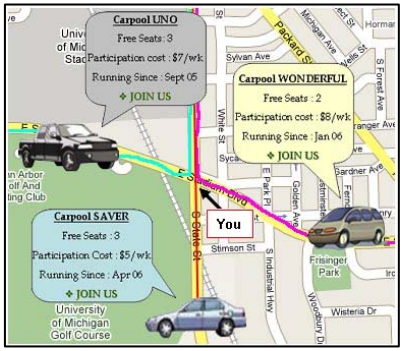

Figure 5: A display of available carpools and their routes in CarLoop

Figure 6: Creating a new carpool in CarLoop

look for current carpools to her company or try to start her own.

Typing in her address to the system, it shows her there indeed is a carpool already available to her neighborhood (Figure 5). Unfortunately, the web-site tells her that the car is a SUV (which Judith hates) and is run by her nemesis, Lilly, in accounting.

Judith decides to start her own carpool instead of joining the one she found. After taking Judith's address information, the web-site shows a map that includes Judith's neighborhood and her worksite. The website tells her to circle the area in which she is willing to pick people up (Figure 6). She does this and then continues on to the next page: the carpool pledge.

This page is a series of statements to which each member of the carpool needs to agree. They include the rules about notification and cancellation protocol aw well as a promise to keep a clean car. Judith is glad that these have been set out ahead of time and does not need to make them herself. There is also a calculation of how much the ride costs in gas and a recommendation of how much each person might be asked to pay per month. Judith can choose between being paid for a ride, sharing driving duties, having riders donate to a charity, or just providing a carpool for no compensation.

Next, there is a page on which Judith can describe the kind of culture she wants her carpool to have; what kind of music she listens to, if she wants a quiet of talkative carpool, or even if topics like religion or politics are off-limits for the ride.

Finally, there is a page which shows other employees of Judith's company who live within the coordinates she circled and who have indicated that they are interested in a carpool. She can select which ones she wants to invite. Within a few hours, some of these people have written back, interested in participating in Judith's carpool.

Financial Costs of Implementing CarLoop

CarLoop is intended to be a low-cost system that is designed to live on an organization's existing network hardware to minimize additional costs. The software for CarLoop would be licensed under the free open-source MIT-license. No additional software beyond basic web hosting and SQL databases would be necessary. We estimate CarLoop costing approximately $200 to implement assuming a system administrator works at $25 per hour for 8 hours. Additional maintenance costs are estimated to be $200 per month assuming an employee working $25 per hour for 2 hours a week.

User Testing and Results

Our group conducted a preliminary usability testing on four participants and found their feedback invaluable. We will describe what we chose to test, the methods we used to conduct the test, the tasks the participants were given, and the feedback we received about the first prototype from the participants.

Because we were most concerned with how the user would engage with the interface, we decided to only test the website and not the public display. The public display merely displays information, whereas the website facilitates the transfer of information between the user and the application.

Methods

We used several methods to gather qualitative information. The participants' mouse movements were captured using screen capturing software. Additionally, the usability investigator followed a series of questions we designed based on Nielson's design heuristics [6]. In particular, we focused on the following heuristics:

- Match between system and the real world; the system should speak the language of the user not of the system or the designer;
- Consistency and standards; different formatting should not share the same meaning
- Aesthetic and minimalist design; dialogues should not contain information that is irrelevant or rarely needed.

Our test participants were evaluated one at a time by two different. Both the investigator and the participant sat in front of a computer with our CarLoop prototype loaded. The investigator took handwritten notes as the participant interacted with the website. The participant was encouraged to speak aloud their thoughts and feelings of the various controls of the website as they tried to accomplish the tasks the investigator asked them to do. Before the usability test began, the screen capturing software was activated and was deactivated when the usability test concluded.

Participants were given two tasks. The first task was to register for a carpool. The second task was to create a new carpool when there was no carpool to join.

Results

Our users generally expressed satisfaction with our system, to the point that one user who worked within a large organization wanted to implement it as soon as we were finished. Our tests did help us identify aspects of our prototype that could be improved.

While our users generally expressed satisfaction with the carpool culture and pledge, they identified areas for improvement. The carpool pledge includes rules that the passengers agree to when joining the carpool, such as how long to wait for the passenger to arrive before leaving. The carpool culture describes the general atmosphere of the carpool, such as the types of music that are played. Users welcomed the oversight that came from having these policies embedded in the system. The carpool pledge page seemed to be especially popular, so popular that our users complained of not being able to add additional items to the page.

Users also appreciated the use of maps to convey the geographical route of the carpool relative to the user (Figure 6), but still identified areas that could be improved. In particular, users felt that the fonts used to display the carpool information were too small and the information was not well visualized. Additionally, one of the users felt that displaying all the carpool information at once was too overwhelming and would have preferred to mouse-over icons on the map that would then display the information.

The least successful design of the website was the section that encouraged the user to invite their friends (Figure 7). All of our users had difficulty understanding which buttons to click invite their friends. Users did identify and appreciate the button that would allow them to skip through the invitation page.

Figure 7: The "Invite Friend" interface was the least successful design we tested

In response to our initial user testing, we revised our prototype to include suggestions based on our data. We plan to conduct additional user testing in the future.

Conclusion

Traffic congestion is a major problem in the United States, and we feel that such congestion can be reduced by increasing the number of carpools on the road. Many commuters desire to carpool to save money and reduce driving time; however, this desire is mitigated by the difficulty involved in connecting commuters with others they trust. To this end, we have developed a carpooling system which connects commuters in the same organization with each other, leveraging the common ground of their shared employer. We began by conducting research and interviews into single-passenger vehicles. We analyzed the data, and built personas and scenarios to help flesh out our system. We then built a prototype, CarLoop, which we further refined after conducting user testing.

CarLoop has several advantages over similar systems. Because it is installed on an organizational level, it can use an existing technical infrastructure. Organizations can simply make a CarLoop available, and they can advertise through LCD screens, organizational web pages, and other means as they see fit. As a result, they will need little to no additional hardware.

Through our design and testing, we have worked to make CarLoop intuitive. Users can create a carpool and find a carpool quickly and easily. Rules and reimbursement are enforced through the carpool pledge and carpool culture. Through the invitation system, the user base can be expanded rapidly, leading to carpools that can last for years.

Our evidence shows that effective carpools need to enforce trust and provide structure. CarLoop does this by bringing members of an organization together and treating carpools as continuous entities rather than a collection of individual rides. The trust and structure provided by CarLoop is essential for creating effective carpools and reducing traffic congestion.

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