Group #4: Traffic Monitoring
Project Title: Onward

Proposal

January 29, 2017

URL: https://github.com/solejar/traffic_ru_ece

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Project Team

Before we propose our business idea, we believe that it is best to introduce all the members of our team. Our team is comprised of six members:

Ridwan Khan:

Three years of experience in programming and development. Worked primarily with C++ and has experience with Python, Java, and is well-versed in object oriented programming. Spent a summer as an intern working with a large development team using agile development methodologies, using software configuration management and worked significantly with system testing. From working in academic and non-academic environments, Ridwan is very experienced with working with teams, and has exceptional management and organizational skills.

Mhammed Alhayek:

Three years of programming experience using primarily object oriented programming languages as well as MATLAB. Mhammed spent 10 weeks as an intern where he got experience in front end web-development using HTML, CSS, JavaScript, and Bootstrap. He has experience in programming on a large team - using GIT for version control - as well as in project development using Agile. Overall, he is very adept in team-environments and has excellent time-management skills.

Shubhra Paradkar:

Five years of programming experience particularly in Java and other scripting programming languages. Shubhra completed a research project in Mobile Security where she strengthened her team working, coordination, and time-management skills. The research project allowed for an extended knowledge of GIT and Android and iOS applications. She has designed automotive programs for the serverless architecture, as well as web-based platforms for cloud infrastructure. She has worked in several teams and uses her experiences as a research assistant and intern to effectively help her team draw up the most effective and efficient solution.

Lauren Williams:

Five years of experience coding in object oriented programming languages, particularly C++ and Java. Experience working with a software development team for academic research through the Aresty Research Center, using Unity and C#. Experience in both academic and professional environments solving project-based problems and working together with others to create a final product.

Brian Monticello:

With a considerable amount of programming experience between school, individual work, research, and internships, Brian has experience developing databases, communicating with APIs, and designing functional GUIs that incorporate the aforementioned technologies. He therefore also has experience in the necessary programming languages required to complete such objectives - from PHP, Java, and SQL on the backend, to JavaScript, JQuery, HTML, and the like on the front end. Brian also has experience competing in hackathons and in some of the startups he's worked on over the past few years that should prove useful in the organization, project lifecycle, and overall planning of this project.

Sean Olejar:

Three years of experience in object-oriented programming languages, including extensive project-based experience in C++, Java, Python, and MATLAB. Sean has experience working on large team-based software projects and academic research. He also has experience in big data, machine learning, data analytics attained through research opportunities. Additionally, Sean has worked in the Linux environment, has hands-on knowledge of relational databases such as MySQL, and has developed front-end applications using HTML, CSS, and JavaScript.

Project Description

The rise of GPS and digital navigation has represented one of the most convenient inventions of the digital age. What tools do these digital navigation apps provide that make them so useful to so many people? At their core, applications such as Google Maps and MapQuest major functionality is their ability to take two locations, and calculate the most efficient route between them. Current approaches use a combination of speed limits and current traffic conditions to estimate the best route for a user to take. The latter metric, traffic conditions, is where we notice room for improvement.

There are currently a plethora of applications that allow an individual to view current traffic conditions pertaining to his or her trip. While this use case is meaningful, it is not exhaustive. Many people need to plan their trips and daily commutes proactively, ahead of time. Instead of relying on current, circumstantial traffic and weather heuristics to predict the conditions of future travel, being able to make an informed travel decision based on historical traffic and weather trends would allow users to save both time in transit and money spent on gas. In order to motivate the need for a traffic monitoring application that can predict future conditions, we will now present a couple of example user stories.

Suppose a user is looking to spend a considerable amount of time travelling in an area of New Jersey a couple days from now. For this user, it would be much more beneficial and practical to know the area's general traffic trends before-hand as opposed to waiting until the day-of, when it might be too late. The user may also want to see what time of day will have the least traffic in the area he'll be traveling in. Also, if the user has a specific time and destination to which he wants to travel, he might want to view the likely traffic severity along his route ahead of time. It might additionally be useful for this user to be able to see detour options with less traffic. And finally, this user may also want to get a recommendation of a better time of day to take his trip based on historical traffic information.

Now imagine a mother who is trying to plan out the best way to tackle her weekend errands a few days in advance. She knows that on Saturday she needs to take her child to the doctor's office, take her dog to the veterinarian, and finally stop by the mall to pick up a present for her brother's birthday. She wants to make these three stops in the most efficient way possible. At what time should she make this trip to assure she encounters the least amount of total traffic? If she uses a current traffic application to plan out this trip, she won't be able to predict what the traffic will be like in the future. Not only that, but she also wouldn't be able to tell the application that she needs to stop at three different locations in any given order. She could arbitrarily choose a time to leave her house, but this might cause her to unnecessarily increase her travel time by traveling during a high-traffic period. At this point, she would be grateful for a service that recommended a specific itinerary that would allow her to spend the least amount of time in traffic and complete her errands in the smallest amount of time. This same use case can extend to a variety of users. For example, a businessman going on a trip to a city that he has never been to before may need to stop by several offices to complete his job. If he could predict in advance, what the potential traffic will be like, he could plan for a more time and cost efficient trip. The ability to plan ahead is invaluable.

Another feature that current navigation applications lack is the ability to portray the cost of a trip. Imagine a traffic application shows you three routes you could take to get from point A to point B. For all users, shortest-time might not necessarily be the best available heuristic for selecting a route. A user may prefer to select a route that is more economical on gas, even if it presents slightly longer travel time. This would help a traveler who is planning a trip ahead of time to plan for approximately how much their trip may cost. This feature also has relevance to business users, for example a manager at a car service. The manager at the car service would be able to plan out all his drivers' routes ahead of time to both minimize and calculate total gas expenses. The program would take into account traffic and miles per gallon of both highway and city driving to provide an approximate cost of gas. With a program like this, the user would be able to better plan their budget for a trip ahead of time, whether it would be for business or personal use.

Solution

In order to solve these issues, we have decided to introduce a brand new web application called Onward.

Onward will provide users with various information pertaining to current and future traffic conditions along with a slew of other useful features. This web application will allow users to view traffic conditions ahead of time so they will be able to plan the most efficient route ahead of time. Onward will be deployed as a desktop web application so users can take full advantage of the detailed user interface, but it will also be responsive enough that mobile users will be able to easily use our services on the go. Our initial development of this product will be demonstrated on the New Jersey area branching into areas of Pennsylvania and New York.

As mentioned in the previous section, we want to be able to predict traffic conditions proactively and ahead of time, so that suggestions can be made about the best route to take. We plan on making predictions by first collecting two forms of data - traffic and weather. From our personal experiences, we know that weather plays a major role in traffic conditions. Weather conditions can affect the flow of traffic because they can cause congestion or cause several traffic accidents as well as natural traffic roadblocks (ie. rain or snow).Therefore collecting traffic and weather data over a considerable period of time will allow Onward to provide a more accurate prediction of future traffic conditions. Our traffic data will be collected from the Bing Maps Traffic API, and weather data from the OpenWeatherMap API.

One of the main available features of Onward will be visually identifying the various severities of traffic in a large scale area. This feature will allow users to enter a zip code (and a surrounding radius) or an area of interest along with the weather they anticipate and obtain a graphic of the traffic in the area they will be traveling. This feature would mark areas of traffic by their average intensity as provided by the historical traffic data collected from the Bing Maps Traffic API (https://msdn.microsoft.com/en-us/library/hh441726.aspx) . It will specify results to users based on a span of time that they are interested in seeing. Additionally, if the user wants to further identify areas of traffic along a specific route, Onward will further specify the results.

In order to solve the problem of minimizing traffic and travel time for users traveling with several stops (such as the mother in the previous example), Onward will be introducing a system that, upon entering various points of information about his or her travel itinerary, will recommend the best time to leave, the best route to take, and the best order in which to visit each destination on the itinerary to save the most amount of time. We will also allow the users, if they wish to do so, to choose time of travel, and even specify weather conditions (if they plan to travel on a specific date). If the date of travel is within sixteen days, then Onward will be able to predict the weather conditions using the OpenWeatherMap API (https://openweathermap.org/) , saving users from having to enter the weather themselves. If the date of travel is outside of that scope, the user will have the option to enter the weather based on the assumptions that they make themselves. This allows the user to identify traffic conditions on their route if they were to encounter severe weather conditions and whether those conditions would affect the estimated time of arrival for their trip. Some of the individual features would include the ability for the user to enter multiple destinations, and specify any time constraints (time spent at each location, certain time of arrival). The user then will be given the best route that factors in their restrictions such that the user spends the least amount of time in traffic.

To give users a better idea of what a trip costs them, Onward will add a trip expense feature that will calculate roughly how much a user can plan to spend on gas for a calculated route. We will find how many miles are spent on highways and how many miles are spent on local roads for each route. Then we will ask the user to specify the gas economy information for the vehicle they will be driving. Finally, using the gas economy information of the vehicle, we can calculate how many gallons of gas the user will need. We will retrieve information regarding the average gas prices each day and then use that to calculate how much money the user will spend on gas. Gas prices will be found using this api: http://www.mygasfeed.com/keys/api. If applicable, the feature may also suggest a cheaper route for the user to take.

Our application gives users the most essential business value there is: time. Current practices do not allow for users to see traffic conditions ahead of time. Previous attempts at solving the traffic monitoring issue did not include an agenda feature for people to plan out their day, getting a recommended time to travel, using a weather forecast as an alternative to user inputting weather, or a feature that accounts for the cost of a trip. By using our application, users can plan their trips and tasks in order to spend the least amount of time in traffic and money on gas. Spending less time in traffic allows for greater productivity in people’s lives, and allows people to possibly spend more quality time with family and friends.

We will, contingent upon the user's approval, collect relevant data from the user’s trips in order to further enhance both the robustness of our existing traffic data, and to also allow us to start making time-based predictions about various routes. We can also use this user data in order to test the validity of our predictions, by allowing us to compare travel times of user who followed our suggested route, compared to users who did not.

We would evaluate how successful this program is to our users by asking them to rate the product after use. They can also report how accurate the predictions were. This product would be contingent upon its ability to track traffic intensity affected by weather and not affected by weather, plan an optimized agenda for travel, and to provide an accurate estimate of the gas mileage required by a specific trip.

Functional Features:

- “Traffic Heat Map” - a map of a large area of the user’s choosing which will show all the severity of traffic in the given area, using a color code. The user will have control over the parameters of their search.
- Traffic en route - the user will add their origin and destination, and Onward will show the severity of traffic along their route, and will give an alternate route if needed. The user will have control over the parameters of their search
- Agenda feature - the user will enter multiple stops they want to visit throughout the day, how long they plan to stay at each stop, and any time constraints they may have. The program will predict the best time and order to go to each destination based on the historical traffic data at certain times of day.
- Cost feature - the user will be able to enter in their origin and destination, and the application will show the approximate cost of the trip based on their specific car’s gas mileage. The feature will also suggest a cheaper route, if applicable.

Plan of Work

Our team will focus on developing Onward using an iterative, Agile-based, development process. While an iterative process is implicitly mutable and subject to potential change, we have decided on a rudimentary course of action which will guide our initial efforts.

The first major iteration of Onward involves the development of a shared infrastructure upon which our team members can effectively add their future contributions. Part of this infrastructure is the database which we will construct using current and future traffic and weather records. The other part of the infrastructure is the basic framework of the website where we will host our application. Because all team members will be interacting with these two components, all team members will participate in their construction, so as to have a handle on their usage. We anticipate that this stage will take around one week to complete.

Going forward from this first stage, we will separate our group into two teams of three. Based on an analysis of the core features required by our application, we determined that this split into two teams would be the most effective way to share the work. In our subteams, we will each develop one of the two major functionalities of our web application. One subteam will be responsible for generating an area based “heat-map” showing severity of traffic as a function of time, day of the week, and the weather. The other subteam will be responsible for using traffic records, a starting location, and a destination to suggest a route that minimizes traffic for the user. We estimate this stage will take around 3-4 weeks.

After we finish this second stage, we will be able to begin adding the auxiliary features to our application - the agenda and cost features. Additionally, in order to get a better idea of the actual desires of our consumers, we have put out a survey that asks them what features they would most like to see in a “navigation” based application. Based off of this feedback, we will decide what additional auxiliary features would best allow our product to develop value over our competitors.

Below are the breakdowns of the subteams:

Subteam 1:

Lauren Williams
Shubhra Paradkar
Sean Olejar

This subteam will be initially responsible for constructing the route suggestion feature of Onward. We believe this team has the ability to develop this feature based on the team members' experience implementing shortest-path algorithms. The team also has the experience required to both implement a visual interface for the feature and to effectively interact with the database. Following this initial development, this team is tentatively schedule to develop the agenda feature.

Subteam 2:

Mhammed Alhayek
Ridwan Khan
Brian Monticello

This subteam will be initially responsible for the traffic severity heat-map feature. We believe this team has the ability to effectively develop this feature based on the team members' experience in visualising data. The team members also have the experience required to implement a visual interface for their feature and interact with the database, much like Subteam 1. This team is then tentatively schedule to develop the least cost of travel feature.