Group 4

Onward

Report 1 Part 1

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Individual Contributions Breakdown

All team members contributed equally.

Customer Statement of Requirements

Modern navigation applications allow the user to enter a starting location A and a destination B and then calculate the best route between both locations, all the while giving an estimation of how long the trip may take. These applications do not, however, allow for users to see the future conditions of traffic and get an idea of how long their trip may take beforehand. As a result, users' ability to effectively plan ahead and adjust for traffic related issues is limited. Being able to more accurately measure trip time is an incredibly valuable asset for both business and commercial users. As a result, an application that allows for a user to view traffic conditions in an area or along a route days before their travel would be meaningful and effective for a large group of users. Although there are several applications that individually display current traffic and weather conditions, they do not take into account historic traffic and weather, and will not calculate the cost of a particular trip. Most importantly, these measures cannot be taken days in advance, which is a necessity for most users. An application that takes into account all of these factors simultaneously will create the most appropriate solution for every-day users.

Currently, most mapping applications are mobile oriented and often restrict the user from entering their lengthy travel plans in favor of ease-of-use for immediate, simple travel plans. A web-based application that focuses on helping accommodate users' longer plans would be more helpful in specifying the entirety of the user's trip. This way each location, date, time constraint, and weather condition could be thoroughly described, and a route could be planned that would take each of these factors into account. This application would be more fitting for a traveler that is in constant need of adjusting to different traffic patterns and is inconvenienced by limiting mobile-only software that only allows for basic itinerary information. With this in mind, however, as traveling users often do also spend time away from a computer, it is important that the web-application be responsive for mobile users.

In order to select the fastest **route** between two locations ahead of time, it is necessary to predict the traffic along all possible routes between those locations. But how can such a prediction be made? Historic traffic and weather records can be an effective indicator of future traffic in any given area. By using this historic information, this application would allow the user to see predicted traffic along the three fastest routes connecting two locations once they enter the time, day, and expected weather. Allowing the user to see predicted traffic along these routes will allow them to select the route that will likely minimize time wasted in traffic. A system that uses data from over a large period of time to identify patterns of traffic would likely be accurate enough to consistently help users do this. This would be useful if the user were moving to a new area and wanted to see what their commute would look like in the morning. They could enter their home address and work location, and would be able to see what their average daily commute may look like based on past traffic data. They could then adjust their route accordingly, depending on which routes have the least traffic during rush hour. In addition to

having a starting location and destination and intended time of travel, the user may have a weather they expect to travel in. Furthermore, if they have a specific day within 10 days in mind, then the application could use a weather forecast instead of user input for the weather parameter. In either case, using the historic traffic and weather records, an accurate representation of traffic conditions along a route can be shown. Roads along the route can be highlighted based on traffic severity. And if a route contains excessive traffic, a detour route can be suggested along with traffic conditions on that route as well. A user would also be in need of this type of application if they wanted to plan a road trip. The user could figure out the optimal departure times on each day of their trip that would minimize time spent in traffic. This application would give meaningful information to users looking to plan a trip ahead of time, or investigate general traffic conditions along a certain route.

Along with predicting the future traffic along a specific route, it would also be useful for the user to see the general traffic trends in a larger area. The user should have the ability to enter a zip code (or city), a radius around that zip code, a date and/or time, and weather conditions in order to see the predicted traffic for the designated area. A traffic **heat map** could effectively accomplish this, allowing the user to see how much traffic is expected in a particular area at a particular time. By color-coding the traffic severity, users can easily get a visual overview of how congested certain roads are at a certain time. Particularly congested area would be identified as traffic **hot spots**. These would allow the user to identify and avoid routes that are expected to have heavy traffic, if possible. If the user doesn't want to manually enter the weather conditions, the application should also be able to use the weather forecast if the date of travel is less than 10 days away. The traffic will only be shown on major roads, in order to avoid visual clutter. A major road is defined as any interstate, highway, or county road. If the user-specified area does not contain any such roads, the heat map will simply select the roads with the highest percentile of average traffic. The user would also benefit from the ability to show or hide the traffic on this map by the severity of the predicted traffic. That way, the user can more effectively exclude lighter traffic from the visualisation, and focus on the areas with heavier traffic. Combining all of these tools, the user would then be able to use this **heat map** to make educated decisions about where and when they would like to plan their travels.

Another useful extension upon the basic route feature would be the ability to accommodate multiple stops in a user's travel plans. In other words, many users will not only need the ability to plan their route out from point A to point B, but also to plan out their **agenda** if they have multiple stops throughout their day or week. A user may have to run to the grocery store, go to the gym, and go to the mall all in one day. The user would like the ability to enter in all of these locations and find the route with the least amount of traffic between them. The user would benefit from being able to include time constraints to describe this trip. Examples of these constraints are the time frame in which they would like to accomplish all of their tasks, and the time at which they want to arrive at one of their locations. Considering these constraints, the user would like an application that can generate an agenda that minimizes total time in traffic. They would like their destinations displayed in order along with the optimal routes and suggest time of departure. This agenda feature would also allow the user to detail weather conditions

for a particular journey so that they can receive as accurate a trip agenda as possible. This feature would be effective for users who generally travel with multiple destinations in mind and do not have the ability to plan ahead without knowing how much traffic they will face. These users are also generally unaware of the best time to depart for each destination that would allow them to avoid traffic. Currently applications exist where the user is only asked to specify one destination and there is no intuitive way to add multiple destinations. An application that can create an agenda with multiple waypoints would be a huge convenience to a user over having to plan each route one at a time. Looking at the overall trip, rather than the individual routes, allows the application to more effectively minimize total time in traffic.

Currently available applications provide a good estimation of trip mileage, but they do not go any further in turning this information into something usable for the user. The user wants to know not only the mileage of their trip, but also details regarding gas consumption for their trip and therefore the costs associated with this gas consumption. The user can also use the cost of gas as a heuristic for Onward's best route/agenda recommendation. This feature is especially useful in the context of the recent increase in taxi and delivery services such as Uber and Lyft. This feature would allow companies to both accurately predict overall gas expenses and to also suggest routes for their driver that would minimize gas expenses. By calculating the cost along with the other individual features mentioned, the user would have a very direct plan of how to travel, when to travel, and the cost of travel. This application would provide that, allowing the users to see a route for their trip, the predicted cost of gas based on the route, and the predicted traffic based on the historic traffic records. Furthermore, if detour routes are suggested due to excessive traffic on primary route, the user can compare the cost of travel between suggested routes.

The above paragraphs demonstrate the need for an application that can fill in the gaps where traditional navigation applications are lacking. While identification of routes and traffic at the current point in time is meaningful, users also have a need to understand and predict traffic ahead of time. Being able to understand future traffic trends on both specific routes and general areas would allow users to be more effective travellers. In addition, an application that gives users the ability to create, plan, and analyze their multi-stop trips and the traffic they will encounter ahead of time would be exceptionally beneficial to have. Many modern users strive to use technology to make conscientious, well-informed decisions about their day-to-day activities. Onward facilitates this part of the user's life, allowing them to make an accurate and efficient decision about their travel plans ahead of time.

Glossary of Terms

Incident - Any event which contributes to an increase in traffic severity. Examples include, but are not limited to, congestion, inclement weather, and accidents.

Location - A user inputted point on the map. It is allowed to be defined on any level of granularity from as specific as an address, to as general as a city or zipcode.

Heat Map - A heat map refers to a city or zipcode scale map which contains color indicators along the major roads of the designated area. The color indicators vary along a spectrum, and serve to indicate the average traffic conditions on the roads.

Major Roads - Where applicable, defined as all interstates, highways, and county-roads. Where not applicable (i.e. few relevant roads of the above categories), Onward may also consider roads with the highest amount of traffic in the area as major roads.

Hot Spot - Either a subsection of a road or an intersection which is known to regularly exhibit very congested traffic.

Route - A path that connects any two locations together.

Primary Route - A route that is recommended to the user based on the user-determined heuristics (i.e. total time in traffic, gas cost).

Detour - An alternative to the primary route.

Agenda - An element which consists of several, individual, contiguous routes which are combined together. While an agenda will typically end at the same location it starts at, this is not required by definition.

Heuristic - A tool that allows Onward to make decisions regarding how to predict future traffic.

Highlight - A continuous-color marking, along a road segment. Indicates traffic severity

System Requirements

Functional Requirements:

Identifier	Priority	Requirement
REQ1	5	The system shall take user input for a zip code or city in the tri-state area, and a value for the radius of desired traffic information.
REQ2	3	The system shall provide an option to take user input for day of week to travel and user expected weather.
REQ3	3	The system shall provide the option to automatically select weather conditions based on a 10 day forecast.
REQ4	2	The system shall allow a user to choose to show/hide information corresponding to one of 4 different levels of traffic severity.
REQ5	5	The system shall display a map that shows traffic trends for the area specified by the user. It should highlight all major roads, and use different colors for different levels of traffic severity.
REQ6	2	The system shall display statistical data about traffic patterns in a large scale area of interest in the form of a graph.
REQ7	5	The system shall take input for a starting point and destination address as well as desired time of travel.
REQ8	2	The system allow a user to choose to show/hide information corresponding to the 4 different levels of traffic severity along their route.
REQ9	5	The system shall suggest a route which connects starting point to destination and shall display this route on a map.
REQ10	3	The system should offer 2 alternative routes for the user to choose from, in addition to the primary route
REQ11	2	The system shall display statistical data about traffic patterns along a route in the form of a graph
REQ12	2	The system should provide an estimated time to get from starting point to destination(s).
REQ13	3	The system shall take as input multiple locations, and any time

		constraints for the travel.
REQ14	3	The system should allow users to input specified times they must get to certain destinations and constraints on the order to reach each destination.
REQ15	3	The system shall display the optimal route to reach the specified destination(s) while stopping at all the requested stops based on inputted constraints.
REQ16	2	The system shall suggest the optimal time to depart in order to encounter the least traffic based on inputted constraints.
REQ17	4	The system shall offer users the option to input vehicle gas economy information in order to receive information about the estimated cost of all suggested routes.
REQ18	2	The system shall provide current traffic conditions from starting point to destination.

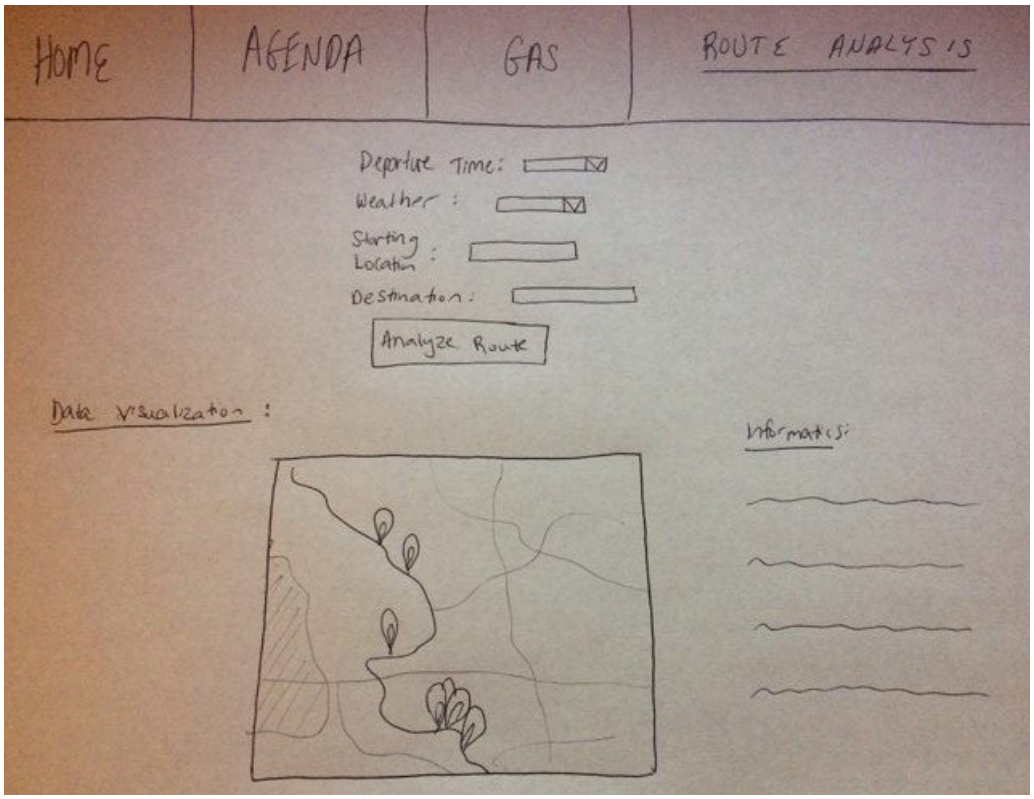
Nonfunctional Requirements

Identifier	Priority	Requirement
REQ19	5	The system shall provide a sleek, user friendly, easy to understand web page.
REQ20	3	The system shall provide a mobile interface which will be responsive enough to be used on-the-go.
REQ21	5	The system shall collect traffic and weather data every hour and add any new incident information to the database.
REQ22	4	The system should be able to produce suggest routes within 10 seconds of user inputted parameters.

On-Screen Appearance Requirements

Identifier	Priority	Requirement
REQ24	5	The system shall provide a graphical representation of the user's route in map form.
REQ25	5	The system shall provide a form for the user to input his/her information about the route
REQ26	4	The system shall provide useful information about the user's trip based on the specified route details alongside the map interface.

Figure 1: Web Application Main Page



The above image represents the user interface for basic route analysis. On this page, users will be able to enter in the relevant information about any trip. Upon doing so, and hitting "Analyze Route", Onward will visualize historical traffic trends that best fit the user's trip. The departure time drop down box will include the date, as well as the time in which the user's trip will commence in order to properly display predicted traffic trends in a map of the area. Additionally, as seen in the bottom right corner of the figure, there will also be an information

section that will showcase any auxiliary information about the user's route. This information includes, but is not limited to, graphs of traffic severity vs. time, graphs of traffic severity vs. weather, and information about gas costs.

Project Management

All team members are evenly responsible for project management. Version control is being established through the use of Git. Though we are using a managed workflow, all team members are responsible for unanimously reviewing and accepting pull requests. All team members are working equally in scheduling and participating in meetings, distributing and coordinating work and developing the system.

References

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