Harker Innovation Team

Technical Plan

Your technical plan will require that you answer five questions within the allotted word count. Keep in mind, you are explaining to the judges the "why" and the "how" for your design, so try to use as much detail and evidence as possible. Don't forget to check out the Judging page to view the scoring guide.

What is the concept for your dashboard of the future?

Our concept for the future vehicle is to have a dashboard which can properly advise the driver on how to drive in the most fuel efficient manner possible through the use of abstract pictorial means. Although numbers can be very telling, most people have no concept as to whether 20 MPG is a good or bad number. The "goodness" also depends on the car model; a Hummer would probably have a max MPG of 25, whereas driving a Prius at 25 MPG means the driver has some bad driving habits.

Our team researched ways in which people could change their driving habits in order to drive more efficiently. We learned that "jackrabbit driving" (hard starts and stops), low tire pressure, idling vehicles, having the wrong octane rating of fuel, using the AC at low speeds, and an unserviced engine all lead to low fuel efficiency, among others. We then made eHeart in order to advise drivers on how to improve their habits in those areas.

We decided that our dashboard should not be intruding, and therefore not too flashy or creating any sound besides important ones--when the door is open and when the seatbelt is not on. We also decided to minimize the number of words on the driver display, since they take time to process. This resulted in a visual, qualitative dashboard that alerted the user of critical information though symbols and dials rather than words and numbers. After all, is 35 MPG good or bad? It all depends on the vehicle; therefore the driver might get confused. If instead, the dashboard displays a meter for efficiency as compared to the maximum, it is very easy to see how one's driving habits rank compared to the average EPA rating and the maximum efficiency possible. Although we included several words and numbers on the dashboard to help the user understand newly introduced information, critical values, such as efficiency, fuel, speed, battery charge, regenerative braking, and tire pressure were qualitatively expressed. Of course, speed was displayed prominently in the center of the screen since this is universal to all cars and is thus intuitively understandable for drivers.

We still did not wish to undermine the numbers, though, so we included them under a Stats tab in the navigation system. There we showed graphs of MPG over time, Power Consumption, and how the MPG ranks up quantitatively against the EPA rating. We also included a trip average, and a lifetime average for the MPG, since instantaneous MPG doesn't give a full picture as to how the average MPG stacks up cumulatively.

We also included a tips section on the bottom of the dashboard where the driver, could, at a red light, look at auto-generated messages based on the driver's car condition for MPG, speed, weight, etc. In order to not be annoying while driving, these messages only show up when the car is stopped.

Overall, the design for our dashboard is comprehensive and accumulates a variety of different feedback mechanisms in order to inspire change in driving habits.

How will your dashboard design and related feedback mechanisms support behavior change to help drivers maximize fuel efficiency and reduce environmental impact?

Our dashboard design will support behavior change by prominently displaying key information regarding fuel efficiency on both the driver’s dashboard and the onboard navigation screen between the driver and passenger.

On the dashboard itself, qualitative and quantitative displays will show speed, efficiency (based on MPG), RPM, regenerative braking energy saved, battery charge, fuel, and tire pressure. Each of these show subtle indications to let the user know when something is slowing down efficiency. For instance, improper tire pressure is displayed in red, along with a textual tip, to subtly alert the user the next time he/she stops at a gas or other service station with a tire inflator. Routine service (maintenance) messages are also displayed in the bottom left area, and efficiency tips on the bottom right. These tips remain until they are applied or the screen is filled with other tips to help the user remember them and adjust driving habits accordingly.

On the navigation system, a separate tab for stats will show detailed fuel efficiency information graphically and numerically. At the top, the instantaneous and average MPG will be displayed, along with a horizontal bar comparing the values of instantaneous MPG, actual average MPG and EPA estimated average MPG for the specific vehicle (city and highway). This will provide the user a point of comparison. Below this on the left, the cost per mile of fuel will be displayed based on the actual average MPG and using a user-input price per gallon, which the user will be prompted to update whenever the tank is refilled to reflect changing fuel prices. Below this, the gallons of fuel used and total cost for the last year, month, and cumulative (since the car was purchased) will be displayed and graphed on the right. There will be tabs above the graph to switch between plots involving fuel usage and cost over several years, months, or days so the user can compare fuel usage across wide and small spans of time and adjust long and short-term driving behaviors accordingly.

Under the navigation tab, alternate route options, estimated fuel consumption, and displayed information will encourage the user to use alternate methods of transportation or minimize fuel consumption if driving. Whenever a route is calculated, the distance, estimated fuel consumption in gallons (based on actual average MPG), and estimated cost of fuel will be displayed to give the user greater awareness about the cost and environmental impact of each trip. Alternate routes will also be suggested along with the estimated distance and time for each. Recommended routes will be highlighted in green in the list—walking (distances up to 1 mile), biking (0-10 miles), and public transit (5-20 miles). Standard driving routes will also be calculated—shortest time, shortest distance, avoids freeways, maximizes freeways, avoids toll roads—along with distance, fuel usage, and cost estimates. These myriad route options will help the user choose the most efficient route that fits his/her schedule and budget, benefiting the environment and saving money by lowering fuel usage.

How does your dashboard design and related feedback mechanisms comply and defy <u>Federal Motor Vehicle Safety Standards?</u>

The regulations we found concerning dashboards for cars were that they need to have illumination when the headlight is lit, and must include labels for all controls; essential ones must be lit up. Our dashboard consists of one on-board computer running multiple monitor screens that can each be lit up with the headlights, and labeled controls and dials. Although the dashboard is always slightly backlit due to the computer screen nature, there can be more lighting or less lighting depending on the time of the day. Our navigation system is also lit up all the time.

Other regulations concerned the use of standard symbols for identifying certain features, such as the low fuel light, the tire pressure light, and the seatbelt light. We have included a few of these on the 2-d design image file as an example of where these symbols would appear, but given that the dashboard is a screen, the images can be changed according to the situation. In other words, the screen's symbols display can be changed, so that in reality any combinations of these symbols can be displayed on the dashboard screen.

How does your design measure and visually display data reflecting fuel economy, environmental impact, and vehicle position?

eHEART's design elucidates the automobile's condition in relation to its environmental impact. The dashboard conveys velocity, fuel statistics, service reports, regenerative braking data, and more to the user on colorful and intuitive displays tracking his or her progress on becoming a more fuel-conscious driver.

The tree-shaped speedometer tracks the driver's environmental progress. According to a 1999 study, fuel economy declines sharply when driving at high speeds. Though the optimal speed differs for each car, "gas mileage usually decreases rapidly at speeds above 60 mph" (Fuel Economy). In order to warn drivers of high-speed driving, the LCD glows increasingly redder as the speed increases above 60 mph. From 0 to 30 mph, the tree glows green; from 31 to 40, yellow; 41 to 50, orange; and 61 and above red. Furthermore, because driving "over 60 mph is like paying an additional $0.24 per gallon for gas," eHEART calculates the added expenses from driving quickly and records it into the fuel statistics application of the navigation screen (Fuel Economy).

A message box at the bottom of eHEART offers driving and service tips based on data such as fuel consumption, power usage, and weight. Using a color-coding system, green text highlights what the user is doing well whereas red text offers constructive criticism. The dashboard instills greener driving habits in the driver. eHEART's wireless internet connection allows the message board to be synced to the latest information in the Department of Motor

Vehicles. New findings on fuel-efficient driving are automatically downloaded into the dashboard. Furthermore, on the navigation system, drivers can find additional data on how to service their vehicle.

The regenerative braking monitor records how much energy is conserved when the driver brakes. During deceleration, the system funnels the automobile's kinetic energy into electricity rather than releasing it as heat. The accumulated energy refuels the battery in a hybrid vehicle or simply powers lights and other electronic applications if the car is not electric. eHEART tracks the energy saved each day from regenerative braking, which is most successful within a specific speed range (How Regenerative Breaking Works). The navigator's fuel statistics app displays a graph of the driver's daily progress on generating electricity.

eHEART also allows the driver to self-inflate tires with the push of a button. According to AA1Car, "tire life decreases 10 percent for every 10 percent it is under-inflated," thereby dramatically reducing fuel economy (AA1Car). A diagram in the left corner compares the actual tire pressure to the preferred pressure based on the weight of the vehicle. When tires are under-inflated, the tire pressure sensor will relay a message to the dashboard, notifying the driver. A button allows the driver to fill the tires within the comfortable confinements of the vehicle. The Self-Inflating Tire technology introduced at the SAE World Congress uses the vehicle's weight to move outside air into the tires via peristaltic tubing (SIT Technology). With this convenient option, drivers are more inclined to maintain an optimal tire pressure.

How did the individual strengths and interests of your team members result in a collaborative effort?

Our team's five members were Isaac, Christine, Vishesh, Wilbur, and Prag.

Christine worked mainly on the Photoshop drawing of the dashboard and navigator as well as researching fuel-efficient driving habits around which eHEART could be designed to promote. She worked on the how the design could measure and visually display data to raise the driver's awareness of the vehicle conditions.

Vishesh took the intro video for the team, and also worked on the Technical Plan. He also worked on the design for the Nav system's fuel stats page, and the overall design for the dashboard.

Wilbur worked on creating the design of the dashboard and other features for the driver to be more environmentally-friendly. He did the Photoshop line-art and the 3D imaging, including the animation shown in the video.

Prag worked on brainstorming innovative ideas for the dashboard, focusing on implementing feedback mechanisms to support driver behavior change without being too distracting while on the road. He also helped coordinate the efforts of the rest of the team to maintain cohesion for the project as a whole and answered the second question about driver behavior change to maximize fuel efficiency and reduce environmental impact. He thought of the ideas regarding fuel costs, alternative routes, and charts on the fuel statistics tab in the navigation system, as explained in question 2.