Switch

Team

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Problem & Solution Overview

When it comes to road trips, everybody is excited to see their dream places. But the long-distance driving has never been an easy job. Many of us think we can keep our minds alert, even when we're feeling the tug of sleepiness on our brains and bodies. But the truth is that sleep is a powerful biological drive — one that can overtake even the best driver. Rolling down the windows and turning up the radio volume do not effectively wake the driver up. It's important to prevent drowsy driving beforehand to protect the safety of everyone on the road.

In order to prevent drowsy driving, we are designing a mobile application, called Switch, that helps users plan a driving/switching/resting schedule for participating drivers before a long distance trip. The app can also provide drivers with a gas and food schedule, which is incorporated into the driving schedule based on the fuel efficiency of the car and the route. In addition, Switch can measure a person's driving limit to provide users with a recommendation on numbers of drivers required for the trip or other commuting options. We hope that Switch can effectively prevent drowsy driving and assist users to experience a well-planned and enjoyable long-distance road trip.

Design Research Goals, Stakeholders, & Participants

We interviewed four participants for our design research and talked to other stakeholders such as their friends and family members to get the whole picture of drowsy driving during road trips. We were aiming at drivers who are 20-30 years old and frequently go on road trips with family and friends. Therefore, all of our interviewees are students or workers around the age of 25, who had the above-mentioned experience before. We primarily conducted interviews due to the following reasons: 1) contextual inquiry requires long-time observation, but we do not have the opportunity nor the time to follow a participant on a long-distance road trip. 2) interviews allow participants to answer open-ended questions where they can share their own road trip experience and help us design our tasks from different perspectives.

1. Mr. S
Our first interview participant, whose pseudonym is Mr. S, is a 21-year-old University of Washington senior undergraduate student who has been driving about 5 years and regularly drives long distances with his friends or by himself. We learned from the interview that Mr. S finds that it is hard to switch turns with his friends because sometimes they are on the highway and far away from next rest area or his friends are sleeping and he does not want to disturb them. He knows he would usually feel tired if he drives longer than 3 hours. Keep on driving after hitting his limit is really dangerous. He will lose his ability to judge distances, drive in a straight line, and remembering routes under that situation.

2. Mr. C
Our second interview participant, whose pseudonym is Mr. C, is a 24-year-old University of Washington senior undergraduate student who has been driving for more than 5 years. He likes to visit new places with his friends. Mr. C says every time before a long trip, planning would take them a long time. They do not know how much energy they would have for driving during the particular moments of the trip. They also do not want to miss any scenic spot, but this may cause more time to find gas stations or restaurants. Sometimes their plan can be totally messed up with a temporary change of route.

3. Mr. D
Our third interview participant, whose pseudonym is Mr.D, is a 24 –year-old store assistant manager. He moved to Seattle in February 2018 and he drove himself 36 hours from Texas to Seattle. Mr. D has been driving about 9 years, and his family frequently goes on road trips that require long-distance driving. We learned from this participant that he usually feels tired if he drives longer than 10 hours. If he drives at night, he would create a 'mind game' to keep track of time and keep his brain working. Mr. D mentioned that sometimes his family goes on long road trips that may take a few weeks. They find it challenging to collect rest area/ food/ gas information beforehand to help them make the schedule.

4. Ms. L

Our fourth interview participant, whose pseudonym is Ms. L, is a 22-year-old marketing assistant in her third month who has been driving for about 4 years. She has three very close friends (one girl and two guys) and they always hang out together. If they go for a road trip, the guys are always the main drivers who drive 80% of the overall distance because they think they have better driving stamina than girls. Ms. L worries about her friends when they keep driving for a long time, which may cause drowsy driving. Also, she knows she can drive longer than they thought, so she mentioned it would be helpful if they know each other's driving limits and use this to balance their driving schedule.

Design Research Results and Themes

Our interviewees gave us insight into what types of tasks nonprofessional long-distance drivers would desire to accomplish and what common practices, problems, and themes the drivers share.

One common practice that we found among the interviewees is that they all attempt to somewhat plan ahead for long-distance road trips. Specifically, Mr. S tries to know who can switch after him during long-distance road trips, Mr. C spend a substantial amount of time planning ahead every time he goes on a trip, Mr. D prepares his mind-games and attempt to obtain rest area/ food/gas information in advance, and Ms. L mentioned a brief driving schedule that her friends would set up before the trip. All of them are planning for long-distance road trips in an attempt to make the trip safer and more enjoyable. However, each participant expressed dissatisfaction in their current practices. The participants seek to find better solutions to the problem that they face in their practices.

Two problems we found that the interviewees have in common are difficulty planning long-distance trips and understanding personal limits. Difficulty planning long-distance road trips can arise from many aspects and cause various troubles. Mr. C pointed out that long-distance road trips are hard to plan and a spontaneous change can ruin the whole plan. Mr. S mentioned that due to bad planning, it is hard to switch drivers on the road. Mr. D further stressed that he and his family have trouble gathering precise information regarding resting areas, restaurants, and gas stations prior to the road trip, which contributed to the difficulty to plan for the trip. Last but not least, Ms. L said that her difficulty in planning the trip arose from people not understanding how long each person can actually drive. The lack of understanding of each person's driving limit thus leads to bad planning on the drivers' switching schedule. Ms. L's experience of people not understanding each others' driving limit leads us to the second common problem — difficulty understanding personal limits. Although each participant has a general idea of approximately when they would start to feel tired when driving, the participants agree that it is very difficult to know in advance their personal limits in specific situations during a long-distance trip. The lack of understanding of personal limits leads to difficulty in planning ahead and increase the likelihood of drowsy driving during the trip.

These findings suggest that our design should have a theme that is mainly focused on tackling two tasks: 1) Planning time to drive, switch, and rest on long-distance trips and 2) Measure personal maximum driving time so knows if one should choose driving or other commuting options when going on long-distance trips. The theme that emerges from the design research is a design for long-distance road trips. The design should be able to help the user

construct long-distance road-trip plans or measure personal driving limits based on user input data or direct measurements.

Answers to Task Analysis Questions

Who is going to use the design?

The design is targeted towards non-professional long-distance drivers, though other general users that are interested in planning road trips or measuring personal driving limits are able to use the design as well. The design can be used with one driver or multiple drivers. The user should be financially comfortable enough to be able to afford whatever hardware our design operates on.

What tasks do they now perform?

Our participants perform one task in common, which is to plan for long-distance road-trips. The subtasks within the big task of planning for the trip includes: 1) Plan to switch drivers, 2) Plan for rest/food/task, 3) Plan to have time to visit scenic spots, and 4) Measure and understand the maximum driving limits of each driver participating in the road trip.

What tasks are desired?

There are two common tasks are most desirable for the participants and three other tasks that are specific to the participants. The two common tasks among the participants are: 1) Planning time to drive, switch, and rest on long-distance trips and 2) Measure personal maximum driving time so knows if one should choose driving or other commuting options when going on long-distance trips. The three other tasks that are specific to individual participants are: 3) Alert oneself to take breaks when one is tired during long-distance trips, 4) Assist oneself to drive without any rest when one is tired, 5) Always track one's tiredness during driving, and 6) Discover which personal symptoms signify drowsiness to stop oneself from driving during long-distance trips.

How are the tasks learned?

The task of planning for long-distance road-trips are generally learned through personal trial and error experience. The participants improve their planning according to how their last plan worked out during the actual road-trip. If a certain trip was not pleasant, the participants reflect back on what might have went wrong and try to learn from the experience to perform the task better next time. Particularly experienced participants such as Mr. D would even develop new ideas such as playing mind-games and incorporate those ideas into plannings for future trips.

Where are the tasks performed?

The general task of planning for the long-distance road trip is usually performed outside of vehicles and in areas where the participants can sit down and talk to each other or write the plans down on a piece of paper. The other subtasks under the general tasks (plan to switch drivers, plan for rest/food/task,

plan to have time to visit scenic spots, and measure and understand the drivers' maximum driving limits) can be performed on-the-spot in the car or anywhere that the participants take a break during the trip.

What is the relationship between the person and data?

The relationship between the person and data is that the data (in other words, the result of the planning) provides the person insight into how to improve future planning and understand personal limits better. The data can also reflect the successfulness of the trip and the person's happiness level during the trip.

What other tools does the person have?

Participants have pen and paper, computer applications, and phone applications available to help them with planning. Other specific planning tools such as physical calendars, digital calendars (e.g., google calendar or Apple calendar), travel booklets, sleep trackers that can help user self-predict how tired they would be during the day are also available for the participants.

How do people communicate with each other?

The participants communicate with each other in person and verbally during the actual road trip. During the planning stage, the communication method can range anywhere from long-distance methods such as phone calls and emails to in-person methods such as gatherings and casual talks.

How often are the tasks performed?

The frequency that the tasks is performed varies widely among participants. For participants that go on long-distance road trips often, such as Mr. D, the task of planning for the long-distance trip can occur as often as once every month. For other participants that do not travel much, the task of planning can occur as infrequent as once per 6 months or once per year. The subtasks within the general tasks as discussed in the sections above are performed around an average of three times per day during the road trip.

What are the time constraints on the tasks?

The time constraint on the task of planning for a long-distance road trip mainly depends on how soon the participants begin to plan. The time limit that the task must be finished by is thus the time between the point when the user starts planning and the point when the user begins the trip. For other subtasks as elaborated in the above sections, the time constraints would be the amount of rest time the users have before they begin the next scheduled activity during the trip.

What happens when things go wrong?

Currently, if things go wrong and deviate from the original plan, participants usually experience chaos and strong distress. The mishap would

usually lead to an unpleasant trip or lots of tension and conflict between the traveling members

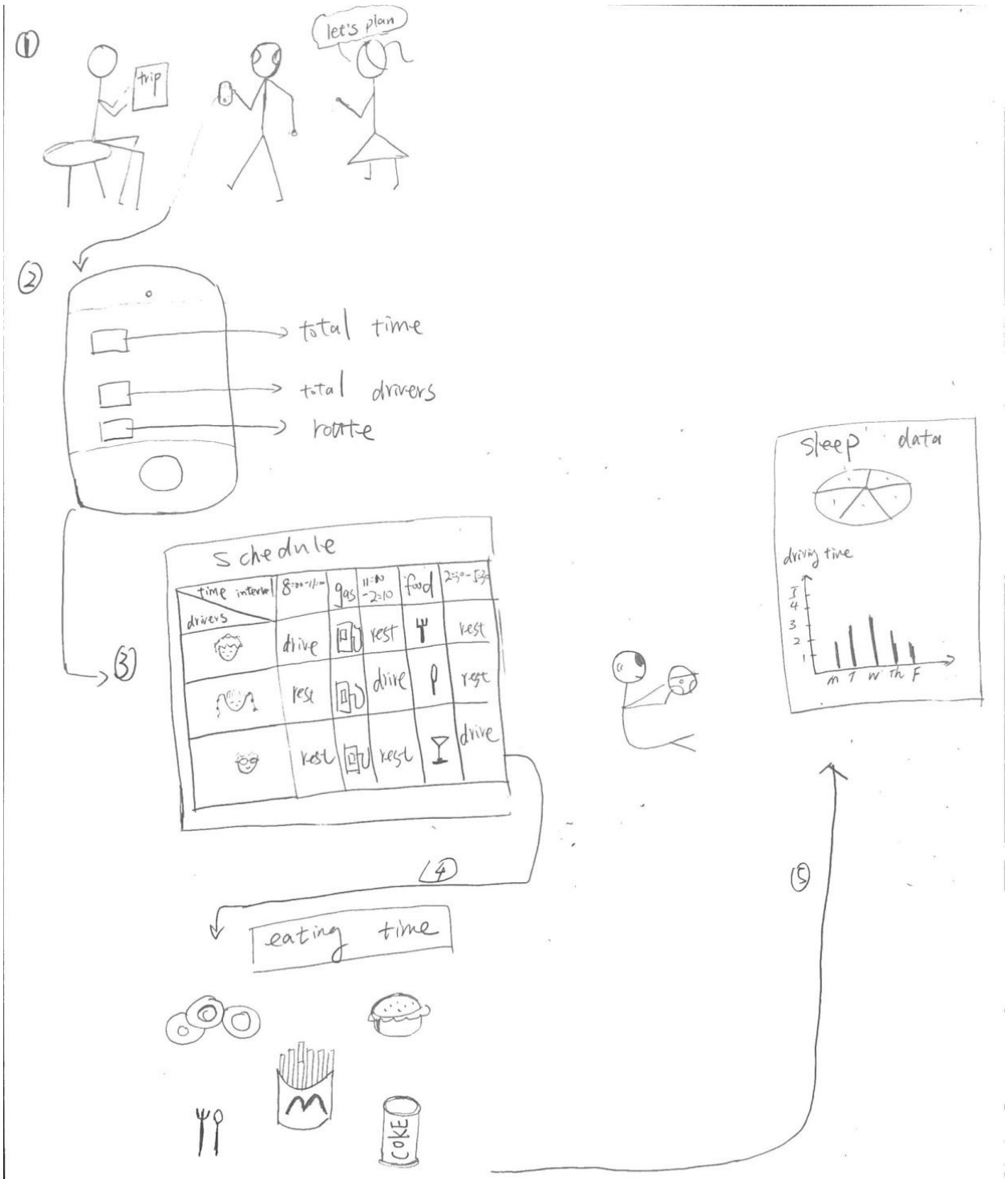
Proposed Design Sketches - "3x4"

Design 1
Name: Switch (Inspired from the switch driver function of the design)
Structure: Mobile App that helps drivers to plan on their driving times and switch drivers during a long distance trip

Design 1 is a mobile phone app that can access users' sleep data and allow users to input their driving information. Before a long distance trip, users can input the route, the total time to drive, and the total number of drivers. Then the app can plan a driving/switching/resting schedule for the drivers. The app can also plan a gas and food schedule based on the fuel efficiency of the car and route. When a car comes to a complete stop, the app will remind the driver to switch if the app notices that the driver is almost at his driving limit. Therefore, the drivers would not be concerned about waking other people up or being overconfident in their ability to drowsy drive. In addition, this app can access users' sleep data, such as the quality and quantity of sleep, to keep track of their tiredness and avoid scheduling a person to drive at times when the person would normally be sleeping or does not have enough sleep. Finally, this app can store users' driving history to recognize drowsiness symptoms and generate an analysis to measure the user's driving limit.

Support Tasks:

1. Planning
    - Provide users with a switching plan based on number of drivers.
    - Provide users with a gas/food plan based on the route.
2. Alert
    - Provide users with general alerts and suggestions when driving time exceeds personal limit.
3. Measure personal limit
    - Provide users with their driving limit based on their driving history.
4. Discover drowsiness symptoms
    - Find out users' drowsiness symptoms based on their sleep data and their input info.


①
let's plan
trip
②
total time
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time interval
drivers
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food
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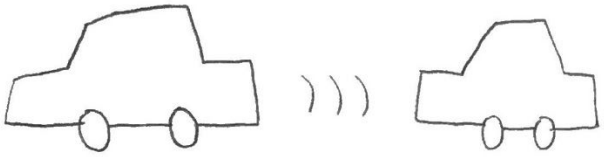
Design 2
Name: Soteria (Inspired from the name of the greek god of safety)
Structure: Vehicle-Based Measures + Smart Speaker Integration

The second design has a vehicle-based measurement. It measures the distance between cars around the driver and helps the driver to maintain the safety distance between the cars. The device also measures the steering wheel movement and tracks the speed of the car. When a driver is drowsy, he usually has less steering wheel adjustment movement than normal and drives faster or slower than his usual driving speed. When the car detects the driver is not maintaining the safety distance between cars, have less steering wheel movement, and drive too fast or too slow, it will trigger the smart speaker in the car to play trivia games to help the driver stay awake.

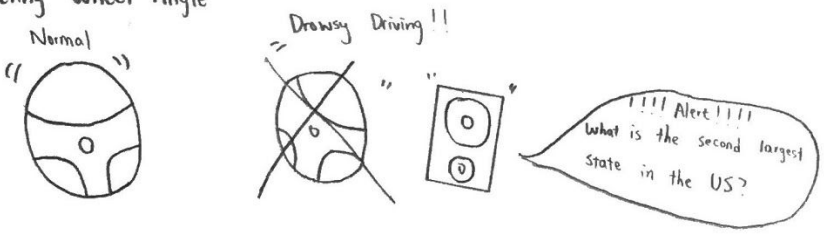
Support Tasks:

1. Track tiredness
    - The distance between cars, steering wheel movement, and car speed.
2. Discover drowsiness symptoms
    - The car detects drowsiness symptom if the driver is not maintaining the safety distance between cars, have less steering wheel movement, or drives faster or slower.
3. Assist
    - Helps the driver to maintain safety distance between the cars.
4. Alert
    - Smart speaker plays trivia games to help the driver stay awake.

① Safety distance



② Steering Wheel Angle



③ Speed Monitoring

④ Smart Speaker that plays mind game when detects drowsy driving (Symptoms above)

Design 3
Name: CLY (Composed of the first characters of the group members' last name)
Structure: Intelligent Personal Assistant + Physiological Sensors

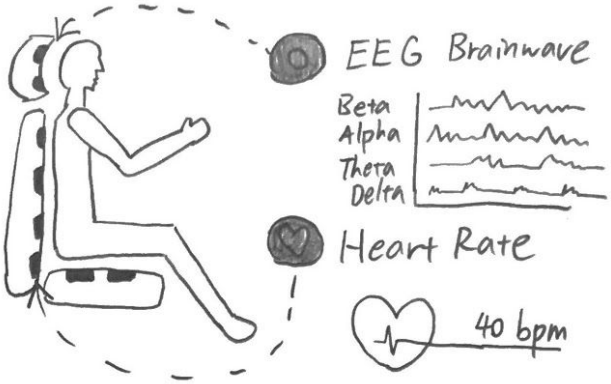
The third design involves two components: 1) Physiological sensors and 2) An intelligent personal assistant software. This design is targeted to general non-professional users who are able to afford cars that support the installations. The sensors are installed all over the driver's seat and can track physiological activities such as heart rates and EEG brainwaves. When the system detects physiological signs that signify the onset of sleep, the sensors will notify the intelligent personal assistant, CLY. CLY will then alert and/or assist the driver. Personal driving limits are also calculated by CLY and reported to the user.

Support Tasks:

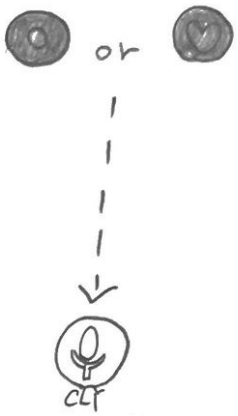
1. Alert
    - Vocal alerts provided by CLY.
2. Assist
    - Intelligent driving assistance provided by CLY.
    - Car environmental adjustments provided by CLY.
    - GPS navigation to the nearest resting place provided by CLY.
3. Track Tiredness
    - Seat sensors that track heart rate and EEG brainwaves.
4. Measure personal limit
    - Past driving data interpreted by CLY to recognize the average maximum time a driver can drive before getting too tired.

Sensor

① Track Tiredness



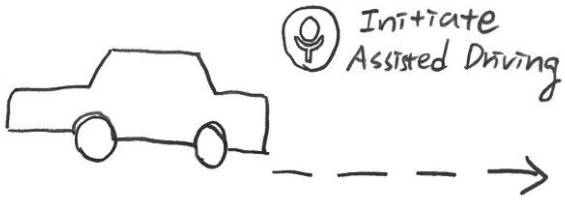
② Send Data To CLY



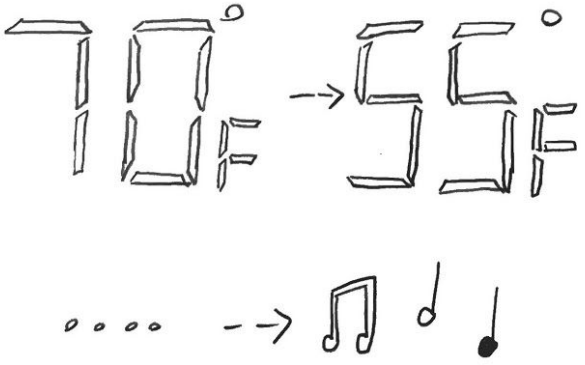
Intelligent Personal Assistant (CLY)

③ Vocal Alerts

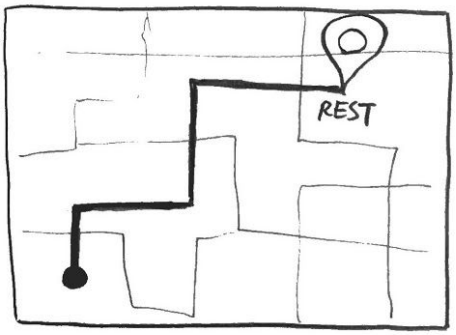
④ Driving Assistance



⑤ Environmental Adjustment



⑥ GPS Navigation



Selected Design and Tasks

We chose to focus on Design 1, which is a mobile app called "Switch". Switch can access users' sleep data and allow users to input their driving information. The 2 tasks that we chose to focus on is Task 1: Planning breaks and driver rotations on long-distance drives and Task 2: measuring personal maximum driving time so knows if one should choose driving or other commuting options when going on long-distance trips. We chose Design 1 (Switch) over the others due to 5 reasons. Firstly, Design 1 requires a smartphone, which is something that is very prevalent in the general population. Secondly, participant feedback suggests that users want a convenient and affordable solution. Thirdly, we believe Design 1 (Switch) is a relatively unique design that has not yet to be created. Fourthly, Design 1 (Switch) focuses on preventing drowsy driving before it happens, which may be more effective than trying to change the driver's action during drowsy driving. Lastly, our primary research suggests that users prefer a solution that does not require consistent attention. Task 1 was chosen because our interview participants find it difficult to plan long distance trips and switch drivers. Task 2 was chosen because understanding personal limits are critical for planning long-distance trips. In summary, the two tasks are chosen due to their feasibility, prevention mindset, and safety.

Written Scenarios - "1x2"

Scenario 1: Planning time to drive, switch, and rest on a long-distance trip from home to Los Angeles.

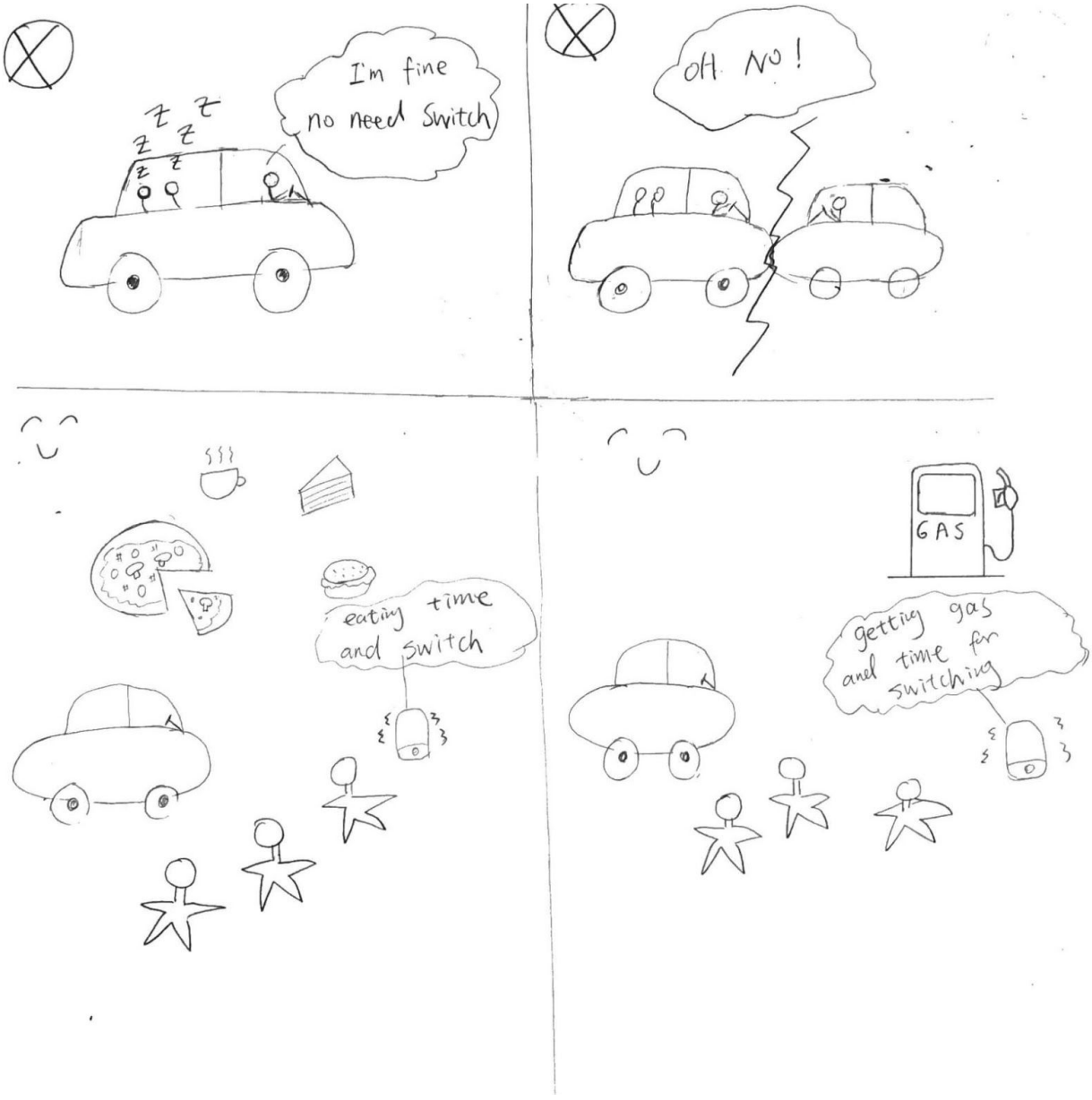
John, Jack, and Alan drove down to Los Angeles last Spring break. One time, when John was driving, he realized that he is too tired to drive. He did not want to wake his friends up because they are still sleeping. He decided to keep driving. Eventually, they got into a serious car accident and suffered from some injuries. This spring break, they decided to drive down to Los Angeles again. But this time, they decided to plan out their trip and make sure everyone is not drowsy driving by using Switch. Switch plans out their route and where they should get gas and food. During a particular moment of the trip, Jack was driving and both John and Alan were sleeping. Switch notified Jack it is time to get some food and gas and Jack followed the instructions. When they arrived to get some food and gas, all of them woke up and Switch suggested Jack to switch because he is almost at his driving limits. Therefore, Jack switched with Alan and they successfully drove to Los Angeles without any accidents and had a wonderful trip.

Scenario 2: Measure personal maximum driving time so knows if one should choose driving or other commuting options when going on long-distance trips.

Jean, Ashley, and Jess are planning on driving down to Los Angeles this summer break. They decided to use Switch to help them plan. However, when they were planning, they looked at their driving limit and realized that they all do not have a long driving limit time. Switch thus suggested them to have a fourth driver or consider taking the train or airplane because it is much safer and easier to do so. After several discussion, they decided to take the airplane down to Los Angeles. They arrived safely had a good time in Los Angeles. They are also glad that they took Switch's advice by taking the airplane down to Los Angeles. If they had decided to drive down to Los Angeles, they might not have the energy to explore and have fun when they arrive to their destination.

Storyboards of the Selected Design

Scenario 1: Planning time to drive, switch, and rest on a long-distance trip from home to Los Angeles.



Scenario 2: Measure personal maximum driving time so knows if one should choose driving or other commuting options when going on long-distance trips.