Computer Engineering Applications, Fall 2017

Homework 3: Concept Generation and Selection Due Wednesday, 10/18/2017

Concept generation questions:

1. Prepare an external search plan for the problem of attaching identification to all “things” in the Internet of Things problem.

* Interview lead users:
  + Presumably, software engineers and network engineers are the lead users. These individuals would potentially be using the identification when writing a program or building a network. These individuals may already have ideas on how to improve upon existing identification systems. Therefore, these groups of individuals may offer useful insight into solving the problem at hand.
    - The software engineer may request that certain information be encoded into the identification, such as the manufacturer.
    - The network engineer may suggest that a unique identifier is applied to each device such as an IP address or a MAC address. They may also request that the information is easily accessible and easy to communicate across devices.
* Consult Experts:
  + Individuals who design standards may provide useful input. Since there are numerous “things” that would be connected to the IoT, it would be useful to have a standard for how the identification is stored and transmitted. Input from individuals who design standards could suggest solutions that would keep the attached identification safe and secure as well as easily accessible. For example, we wouldn’t want to allow someone to modify the attached identification on a device for security purposes. However, the identification must still be easily accessible. Someone who has experience designing standards, specifically someone who helped design IEEE 802.11, may have a solid understanding of how to fulfill the requirements since they have likely satisfied similar requirements in the development of previous standards.
* Search Patents/Standards:
  + Some patents that may be useful to research are those of QR codes. QR codes can contain a lot of useful information. Therefore, it may be useful to assign each “thing” something similar to a QR code so that the information on the device is easily accessible.
  + It may be useful to research standards germane to MAC addresses and IP addresses, since they deal with identification as well. These standards may lay the groundwork for the identification
* Search Published Literature:
  + Since the IoT is an important and relevant topic in the industry, it may be useful to consume literature from different websites, online forums, and technologically-focused magazines. It may also be useful to search for published papers and journals to gather information from previous attempts to solve this problem.
* Benchmark related products:
  + Similar unique identifiers are IP addresses and MAC addresses. Evaluating the performance of these identifiers may provide a solid foundation for the identification of each device connected to the IoT.
  + As previously mentioned, QR codes may also be useful to benchmark if one if looking for physical identifiers.

1. What are the prospects of computer support for the concept generation activities? Can you think of technology tools that can make the process more efficient and effective?
   * Tools that streamline this process do exist.
     + One tool that could be used is the project management tool, JIRA. JIRA allows for multiple individuals to collaborate and brainstorm ideas for a concept. JIRA also includes a way to manage the workflow of a project. This could be useful when it comes to tracking a concept as it moves through the different stages of development.
     + Similarly, Microsoft Project and IBM DOORS could also be used to help track a concept as it moves through different stages.
     + Other programs that are catered specifically to concept generation also exist. Some of these programs are Quip, Brightidea, and Spigit Idea Management. Since these programs are designed to cater to idea management over project management, they may work better than other solutions when it comes to concept generation.
2. Apply the 4-step process to the problem of designing a system that allows automatic garbage collection of GPS-guided trucks:
   * Clarify the problem and problem decomposition
     + The garbage truck should be able to automatically navigate the streets with GPS guidance.
     + The garbage truck should be tracked via GPS.
     + The garbage truck should be able to identify trash cans.
     + The garbage truck should be able to automatically collect trash from a range of different trash cans.
     + The garbage truck should be able to separate recyclable items.
     + The garbage truck should be able to navigate obstacles that it may encounter on the road.
     + The garbage truck should move according to a set schedule.
     + The garbage truck should be able lift 300 pounds of trash.
     + The garbage truck should be able to lift garbage cans with a 2 to 3 foot diameter and a height of 3 to 5 feet.
     + The garbage truck should be able to haul 5 tons of trash.
   * Search externally
     + Interview sanitation workers to address any problems that they regularly encounter.
     + Consult different garbage collection companies to get data on routes and procedures. Also consult different companies that are building self-driving cars.
     + Study garbage truck design and any relevant patents
     + Search published literature on autonomous vehicles.
     + Review existing garbage trucks and self-driving cars.
   * Search internally
     + The team can brainstorm designs for an arm that will lift trash cans that weigh a certain amount and be of certain dimensions.
     + The team can also brainstorm ideas for how the truck will use the GPS module to navigate roads.
   * Explore systematically
     + There are multiple approaches to solving this problem. There are multiple choices for the design of the garbage truck (front loader, side loader, and rear loader), multiple choices for the arm that collects trash (forklift arm and claw arm), and multiple choices for the sensors that can be used (laser vs ultrasonic). A combination table with these options may look like this.

|  |  |  |
| --- | --- | --- |
| **Truck Design** | **Means of Collecting Trash** | **Sensors** |
| Front Loader | "Forklift" arm | Laser |
| Side Loader | "Claw" arm | Ultrasonic |
| Rear Loader |  | Combination of Ultrasonic and Laser |

Concept selection questions:

1. How can the concept selection methods be used to benchmark or evaluate existing products? Perform such an evaluation for five laptops you might consider purchasing. Make sure that at least two of the laptops have different battery technologies
   * The concept selection methods can be used to benchmark an existing product by comparing its features with an exiting product. The methods that could be used for existing products are external decision, multi-voting, web-based survey, pros and cons, and decision matrices. When it comes to benchmarking an existing laptop, for example, an external decision may come from an online forum or a review of the product. Multi-voting can apply in this case as well if the customer asks their peers which product they should buy. A web-based survey can also be used to determine if there is a preference for one product over another. A pros and cons list can evaluate the benefits and detriments of one product over another. Finally, a decision matrix could also be used to compare one product to another.

The five laptops I might consider purchasing are:

1. Microsoft Surface Pro 12.3" 2-in-1 Laptop Computer - Silver; Intel Core i7 Processor; Microsoft Windows 10 Pro; 16GB RAM; 512GB Solid State Drive
2. ASUS ROG Zephyrus GX501VI-XS74 15.6" Gaming Laptop Computer - Black; Intel Core i7-7700HQ Processor 2.8GHz; NVIDIA GeForce GTX 1080 8GB GDDR5; 16GB RAM; 512GB SSD
3. ASUS ROG GL702VI-MH72 17.3" Gaming Laptop Computer - Black; Intel Core i7-7700HQ Processor 2.8GHz; NVIDIA GeForce GTX 1080 8GB GDDR5; 16GB DDR4-2400 RAM; 1TB HDD+256GB SSD
4. Microsoft Surface Book with Performance Base 13.5" 2-in-1 Laptop Computer - Silver; Intel Core i7 Processor; NVIDIA GeForce GTX 965M 2GB GDDR5; 16GB RAM; 1TB SSD
5. HP EliteBook x360 1030 G2 13.3" 2-in-1 Laptop Computer - Silver; Intel Core i5-7200U Processor 2.5GHz; Microsoft Windows 10 Pro 64-bit; 8GB DDR4-2133 RAM; 256GB NVMe Solid State Drive
6. Propose a set of selection criteria for the choice of battery technology for use in a laptop.
   * Time to full charge
   * Battery life
   * Cost
7. Apply concept scoring for the battery technologies in problem 1 against the set of criteria in problem 2.

For the below table, a “+” was awarded for battery life greater than 12 hours, while a 0 was given for anything from 8 to 10 hours, and anything less than 8 hours was given a “-“.

Time to full charge was relatively similar across all laptops, so a “0” was given for all laptops.

Since the cost of the battery influences the cost of the laptop, the cost of the laptop was evaluated. Any laptop less than $2,000 was given a “+”, while laptops between $2,000 and $2,800 were given a “0” and laptops greater than $2,800 were given a “-“.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Laptop 1** | **Laptop 2** | **Laptop 3** | **Laptop 4** | **Laptop 5** |
| **Time to Full Charge** | 0 | 0 | 0 | 0 | 0 |
| **Hours of video playback (battery life)** | + | - | - | + | + |
| **Cost** | + | 0 | + | - | + |
| **Total** | 2 | -1 | 0 | 0 | 2 |

1. How might you use concept selection and/or concept scoring to determine which features should be default and which should be optional or add-ons?

* You can use concept selection and concept scoring to determine which features are default and which are optional by performing concept screening. If a row is filled mostly with 0’s, it is likely that the corresponding feature should be a default feature. This makes sense if one wants to make a product that is competitive with others on the market. If the time to charge a battery, for example, is the same across nearly all laptops, it should not be advertised as a bonus feature. If a default feature is listed as a bonus, you will likely lose the trust of your customer and they may turn to a competitor’s product instead. Ideally, the default device should perform similarly to the competitor’s product.
* Additionally, one can see the features that may be better served as bonus features from the concept screening as well. The features that may serve best as bonus features are those marked with a “+”. In the case of laptop 3, it may be worthwhile for the manufacturer to go with a more expensive model that allows for a greater battery life. Similarly, laptop 4 may benefit from a cheaper model that has a shorter batter life.

1. What could cause a situation in which a development team uses the concept section/scoring method on a concept that then results in commercial failure?
   * It is possible for a concept/scoring method to end in commercial failure. If a company is not comparing their product with similar products on the market, the data they will calculate will be inaccurate. For example, if a company is comparing their high-end laptop to an iPad, they will be making inadequate comparisons since a high-end laptop is expected to perform different functions than an iPad. The high-end laptop may out perform the iPad, but it may not fare so well in comparisons with other high-end laptops.
   * Another potential mistake that could be made would be the selection of inappropriate criteria. If the selection criteria used is not relevant to the problem being solved, it is likely that the concept will be a failure. One does not want to evaluate a laptop based solely on its size, for instance. While more compact laptops are preferable, if the hardware is inadequate when compared to similar devices, the size will not matter to the user. Most users will likely prefer a laptop that performs well over a laptop that is compact.
   * Therefore, it is important to ensure that appropriate comparisons are being made between concepts to ensure that the concept does not result in a failure.