Antoine Rocha

T.I.M 105 hw #6

T.I.M homework #6

Problem 1: Functional Decomposition of a personal computer

Perform a functional decomposition of a personal computer. First do a simple dissection of the product using a FAST technique, restrict this dissection to the major subsystems of the product. Then create a function structure (FS) for the product as follows. Start with a single block showing the overall function; Inputs and outputs of the product. Then decompose this product into sub-Functions, Draw the function structure (at least 3 levels deep) for the products. Clearly identify the material, Energy, and information flows into and out of each subsystem or component. Describe the differences between the FAST and Function Structure.

1. **Define** the problem

Perform a Functional Decomposition of personal Computer. This will consist of first performing the FAST diagram technique then creation of the function structure. Go three levels deep. Identify everything and how it flows. Define the difference between FAST and Function structure.

2. **Plan the Approach**
   - Research the personal computer Industry
   - Construct the FAST diagram
   - Identify the customer and technical needs
   - Create a function structure
   - Establish the customer and technical specifications from the HOQ
   - Identify the primary function of the product
   - Identify how information flows
   - Define the difference between the FAST diagram and Function Structure
3. **Execute** The Plan
   Step 1: Research the Personal Computer Industry (www.howstuffworks.com)
   Hardware: Monitor, Motherboard, GPU, Video card, Hard Drive, RAM/Memory, Battery, Speakers, Mouse Pad, Mouse, Webcam, CD/DVD Rom, Case, Keyboard, Power
   Software: Operating System and software Programs

Step 2: F.A.S.T Diagram

"The FAST diagram represents the functional relationships between all the functions of the system. It shows which ones are dependent on others and which functions ovule at similar times
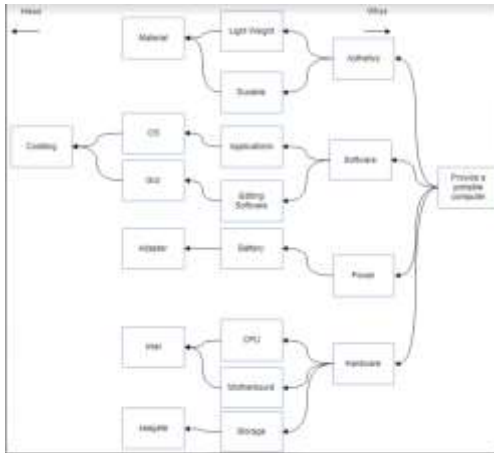
Step 2.1: Identify the customer and technical needs

Customer Metrics	Technical metrics
Storage	Usable OS
Battery life	CPU
Application and Accessible	Memory
Ease of use	Battery life
Durable	GUI
Lightweight	Display

Step 3: Function Structure

The function Structure gives a general overview of what makes the personal computer what it is. It shows a more generic idea of the individual parts. It shows the functions and allows us to focus on the specifics on what to create in a product.
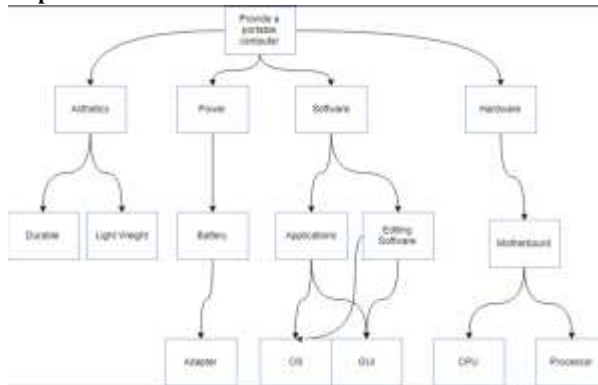
Step 3.1: Establish the customer and technical specifications from the HOQ (See previous step)

Step 3.2 : Identify the main or primary function of the product'

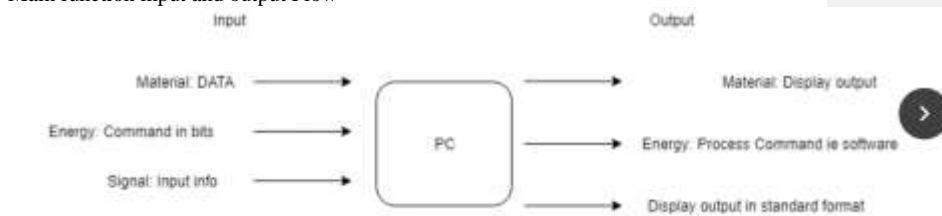The main function is "Provide a portable mode of computing"

Commented [A1]:

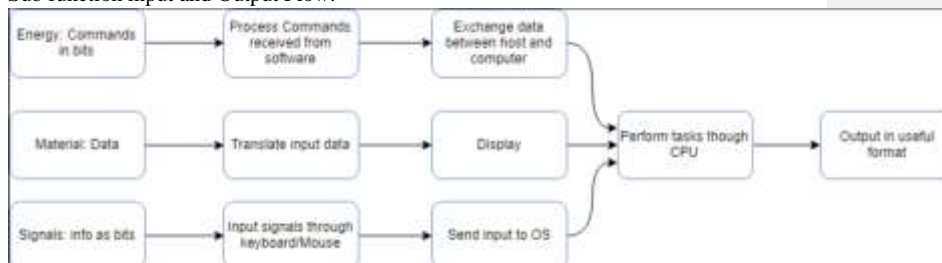**Step 3.3:** Create the function structure

Step 3.4 Identify how information Flows
Looking at the function Structure above:

Main function input and output Flow

Sub function input and Output Flow:

Step 4: Define the difference between the FAST Diagram and the Function Structure.
The Fast Diagram is more in depth where the Function Structure diagram is more abstract.

4. **Check your work**
   I have done everything based on my notes taken in class and listen all the steps to have completed this as per instruction. A possible fault would most likely have been done in the research portion of the steps and mis identification of the blocks need in the rest of the diagrams.

5. **Learn and Generalize**

   This type of function feature breaks down gets down to the nuts and bolts to accrue a detailed picture in a quick snapshot showing what and how the product is made up of. Both of these techniques are helpful to see what kind of product we are dealing with and all of its features.

   Problem 2 Conceptual Design for an Indoor Mobile Robot

   Design a Mobile robot capable of moving indoors, climbing stairs, and performing useful tasks like cleaning. Proceed as follows: First, using a structure process, develop 4-6 alternatives design concept. The, using an appropriate utility function, assess and compare these designs to select the "best" alternatives for further development.

1. **Define the Problem:**

   Do the conceptual design for an indoor mobile robot. Follow all appropriate steps necessary to do this design justice.

2. **Plan the approach:**

   Step 1: Do research into autonomous devices, and functionality and features.
   Step 2: Construct the conceptual design
   - Step 2.1: Using the HOQ model, establish the customer needs and technical specifications.
   - Step 2.2: Identify the primary function of the product.
   - Step 2.3: Develop the function Structure of the product.
   - Step 2.4: Develop the Functional Structure for the product
   - Step 2.5: Create solution principles for each sub function, using a morphological Matrix
   - Step 2.6: Generate 6-10 alternative product concepts. Indicate on the Matrix
   - Step 2.7/8 Develop selection criteria to generate the utility function to assess the alternatives and pick the top two must feasible concepts.

3. **Execute the Plan:**

   Step 1. Do research into autonomous devices, and functionality and features.
   After looking at the prompt autonomous devices, and functionality and features.
   Step 2. Construct the conceptual design
   **Step 2.1** Using the HOQ model, establish the customer needs and technical specifications.

Step 2.2. Identify the primary function of the product.

   - Primary function is to create an autonomous device capable of cleaning.

Customer Needs	Technical Specifications
Won't leave dents Detect obstacles	Bumper
Cleans	Motion Sensor
Retain Dirt	Charger
Retain Dirt	
Self-charge	

Step 2.3 Find related products and dissect using the FAST diagram technique.

Hows   **Whys**
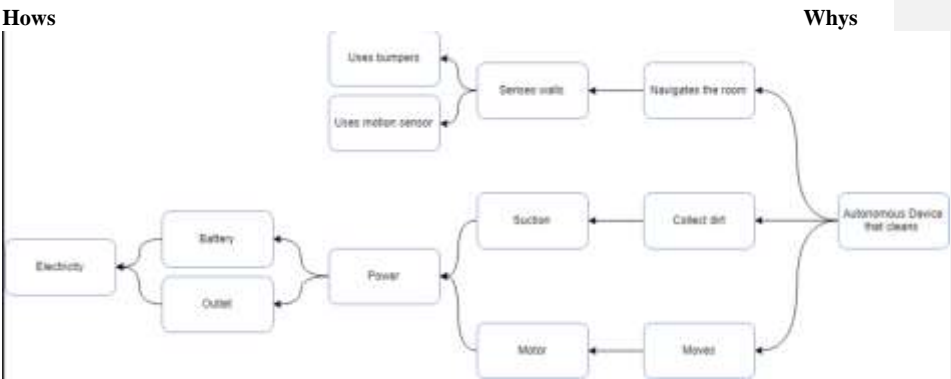
Step 2.4: Develop the function Structure for the product
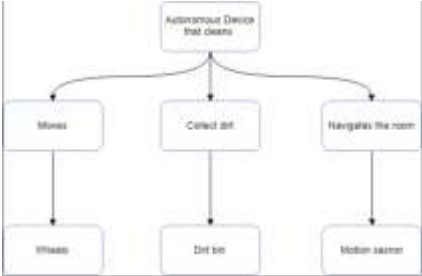
The utility Function-Primary

The utility Function-Sub Functions:

Step 2.5: Create solution principles for each sub function, using a morphological matrix.
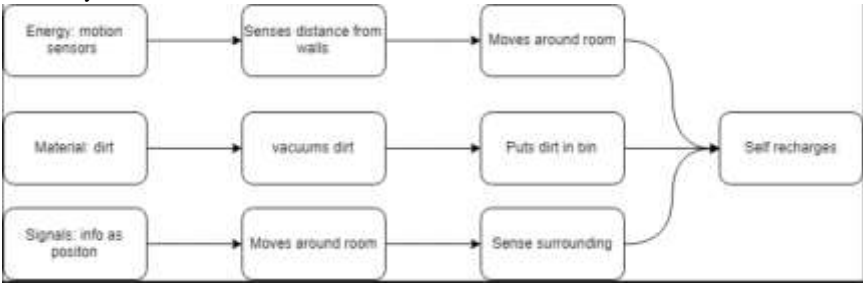
SP	Sp1	Sp2	Sp3	Sp4
SF				
SF1	Wheels	Hover	Rail	Controller
SF2	Rotating Brush	Mop	Vacuum fan	Suction pump
SF3	Sensors	Camera	Mag strip	Distance sensor

Step 2.6: Generate alternatives product concepts. Indicate on the Matrix.
1: wheels, vacuum fan, sensors,
2: wheels, rotating brush, Sensors
3: wheels, Suction pump, Touch

Step 2.7/8: Develop selection criteria to generate the utility Function to asses the alternatives,
And pick the top two most feasible concepts.

The selection criteria are indicated in the table concepts

Customer needs (Weight)
Price (.24)
Easy to function (.12)
Space (.16)
Effective (.36)
Noise (.12)

Using the Utility Function to compare and select between alternative concepts

Criteria	Absolute weight	Concept 1		Concept 2		Concept 3	
Price	.24	4	.96	3	.72	2	.48
Easy to function	.12	3	.36	4	.48	2	.24
Space	.16	2	.32	4	.64	3.	.48
Effective	.36	2	.72	2	.72	4	1.44
Noise	.12	2	.24	3	.36	4	.48
Total			2.6		2.92		3.12

4. **Check your work:**
   All the work based I did was based on the class notes and I believe that based on that premise the work should be correct per what was being asked for form the class in this specific problem. The only variation I can see would be in some diagrams I boxed while the notes they were in text form without a box and possibly some of my calculations could be wrong

5. **Learn and Generalize:**
   Using the structured approach to come up with the different features and identify the functionality of the product allows us to break down what we are trying to create and get in depth and creative with what we as a company might be investing in, helping us identify all the aspects.

Problem 3: Conceptual Design

Step 1: Establish customer needs and technical metrics (specifications) for the new product using the HOQ.
- See HOQ above.

Step 2: Identify the main or primary function of the product (the product intent).
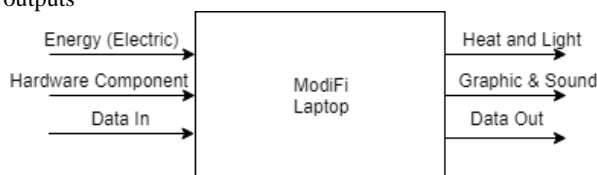- Primary function (product intent):
  - To serve as a fully modular, functioning laptop that can be upgraded or repaired piece by piece.

Step 3: Identify one or more related products, and then reverse engineer (dissect) these product using FAST.
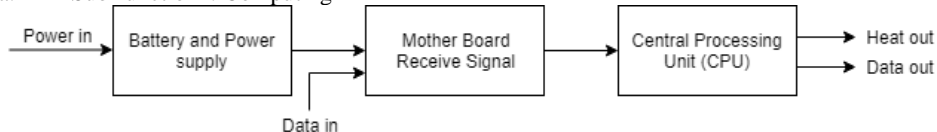- See FAST dissection above.

Step 4: Create an abstract functional representation of the new (intended) product, called the Function Structure (FS).
1. Express the overall function for the design in terms of the conversion of inputs into outputs

Energy (Electric) → | ModiFi Laptop | → Heat and Light
Hardware Component → | | → Graphic & Sound
Data In → | | → Data Out

2. Break down the overall function into a set of essential subfunctions
a. Sub-function1: Computing

Power in → | Battery and Power supply | → | Mother Board Receive Signal | → | Central Processing Unit (CPU) | → Heat out / Data out

Data in

b. Sub-function 2: Graphic

Power in → | Battery and Power supply | → | Mother Board Receive Signal | → | Central Processing Unit (CPU) | → | Graphic Card (GPU) | → | Monitor | → Graphic

Data in

c. Sub-function 3: Sound

Power in → | Battery and Power supply | → | Mother Board Receive Signal | → | Central Processing Unit (CPU) | → | Sound Card | → | Speaker | → Sound / | 3.5mm jack for Headphones |

Data in
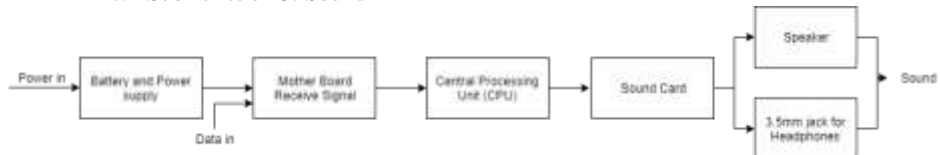
3. Draw a block diagram showing the interactions between subfunctions
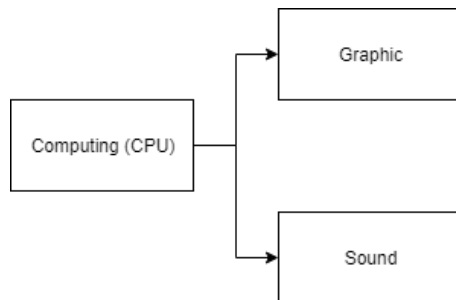
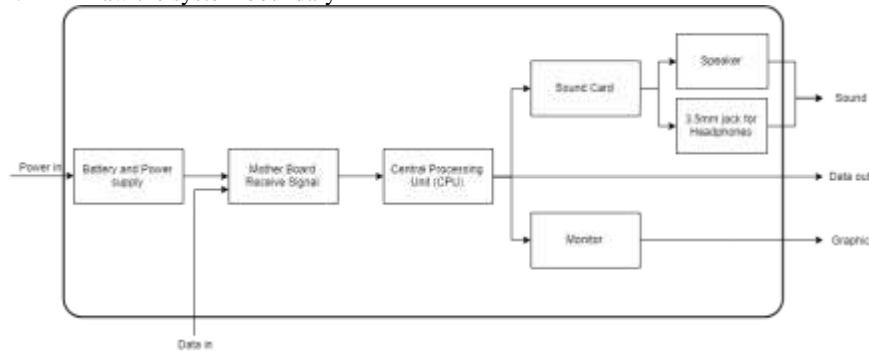4.   Draw the system boundary

5.   Search for appropriate components for performing the subfunctions and their interactions
- Computing - Central processing unit/Motherboard/Battery
- Graphic - Central processing unit/Motherboard/DRAM/Graphics processing unit/Monitor/Battery
- Sound - Central processing unit/Sound card/Speakers/Battery/Motherboard

Step 5: Solution Principles.
(i) For each sub-functions, generate alternative solution principles (SPs) for realizing that sub-functions.
(ii) Organize these solution principles (SPs) in a morphological matrix (MM).

Solution Principles \ Sub-functions	Solution Principle 1	Solution Principle 2	Solution Principle 3
SF1 (Computing)	CPU	ARM Processor	X86
SF1 (Provide Graphic)	Dedicated Graphic Card	Integrated Graphic Card	External Graphic Card
SF3 (Provide Sound)	Dedicated Sound Card	Integrated Sound Card	External Sound Card

Step 6: Generate 6-10 alternative concepts by suitably combining the solution principles in the MM.

Solution Principles \ Sub-functions	Solution Principle 1	Solution Principle 2	Solution Principle 3
SF1 (Computing)	CPU	ARM Processor	X86
SF1 (Provide Graphic)	Dedicated Graphic Card	Integrated Graphic Card	External Graphic Card
SF3 (Provide Sound)	Dedicated Sound Card	Integrated Sound Card	External Sound Card

Alternative concepts:
1. CPU - Dedicated GPU - Dedicated Sound Card
2. CPU - Dedicated GPU - Integrated Sound Card
3. CPU - Dedicated GPU - External Sound Card

4. CPU - Integrated GPU - Dedicated Sound Card
5. CPU - Integrated GPU - Integrated Sound Card
6. CPU - Integrated GPU - External Sound Card
7. CPU - External GPU - Dedicated Sound Card
8. CPU - External GPU - Integrated Sound Card
9. CPU - External GPU - External Sound Card

Step 7: Identify an appropriate set of selection criteria to assess/compare the alternative (from step 6); and use these criteria to create a utility function (UF).
1. Selection criteria:

2.   Utility Function (UF):

Step 8: Use the UF to compare the alternatives (from step 6) and select one (or two) feasible concepts for further development.
    1.   Alternative comparison (with UF):
a.   CPU - Dedicated GPU - Dedicated Sound Card (1)
b.   CPU - Dedicated GPU - Integrated Sound Card (2)
c.   CPU - Dedicated GPU - External Sound Card
d.   CPU - Integrated GPU - Dedicated Sound Card (3)
e.   CPU - Integrated GPU - Integrated Sound Card (4)
f.   CPU - Integrated GPU - External Sound Card
g.   CPU - External GPU - Dedicated Sound Card
h.   CPU - External GPU - Integrated Sound Card (5)
i.   CPU - External GPU - External Sound Card (6)

Compare the design alternatives w.r.t. each selection criteria
- *Concept Rating Scale: 1-5*

Selection	Absolute	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6

Criteria	Weight	Concept Rating	Utility	Concept Rating	Utility	Concept Rating	Utility	Concept Rating	Utility	Concept Rating	Utility	Concept Rating	Utility
S₁ (Portability)	0.42	4	1.68	5	2.1	4	1.68	3	1.26	4	1.68	4	1.68
S₂ (Part Size)	0.14	5	0.70	5	0.70	4	0.56	3	0.42	2	0.28	1	0.14
S₃ (Weight)	0.14	4	0.56	4	0.56	2	0.28	2	0.28	2	0.28	1	0.14
S₄ (Product Costs)	0.12	5	0.60	4	0.48	4	0.48	4	0.48	3	0.36	2	0.24
S₅ (Quality Material Costs)	0.18	5	0.90	5	0.90	5	0.90	5	0.9	4	0.72	4	0.72
CUs = ∑(utility)	1.0		4.44		4.74		3.9		3.34		3.32		2.92

2.   Final selections (Select 1-2 feasible concepts with highest CUs):
a.   The two most feasible concepts with the highest CUs will be Concept 1 and Concept 2.

Check your work:

From our perspective, the work overall is correct, except some of the concept rating of the selection criteria is subjective. All work left are correct and make sense.

Learn your Generalize:

Though all the work shown above and the resources listen below we have learned a lot about the steps making a conceptual design, how to decomposition a product, how to make a function structure for the product and how to compare several alternatives using UF.