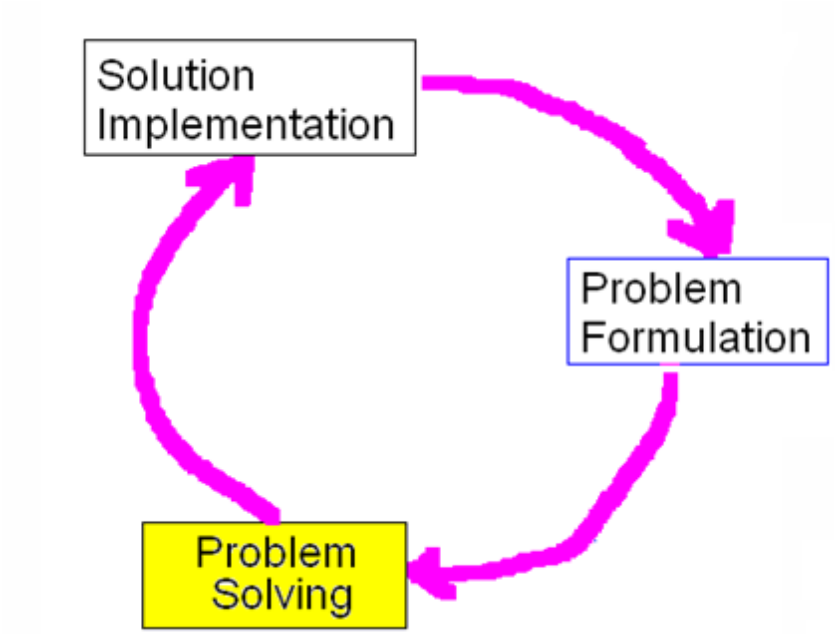
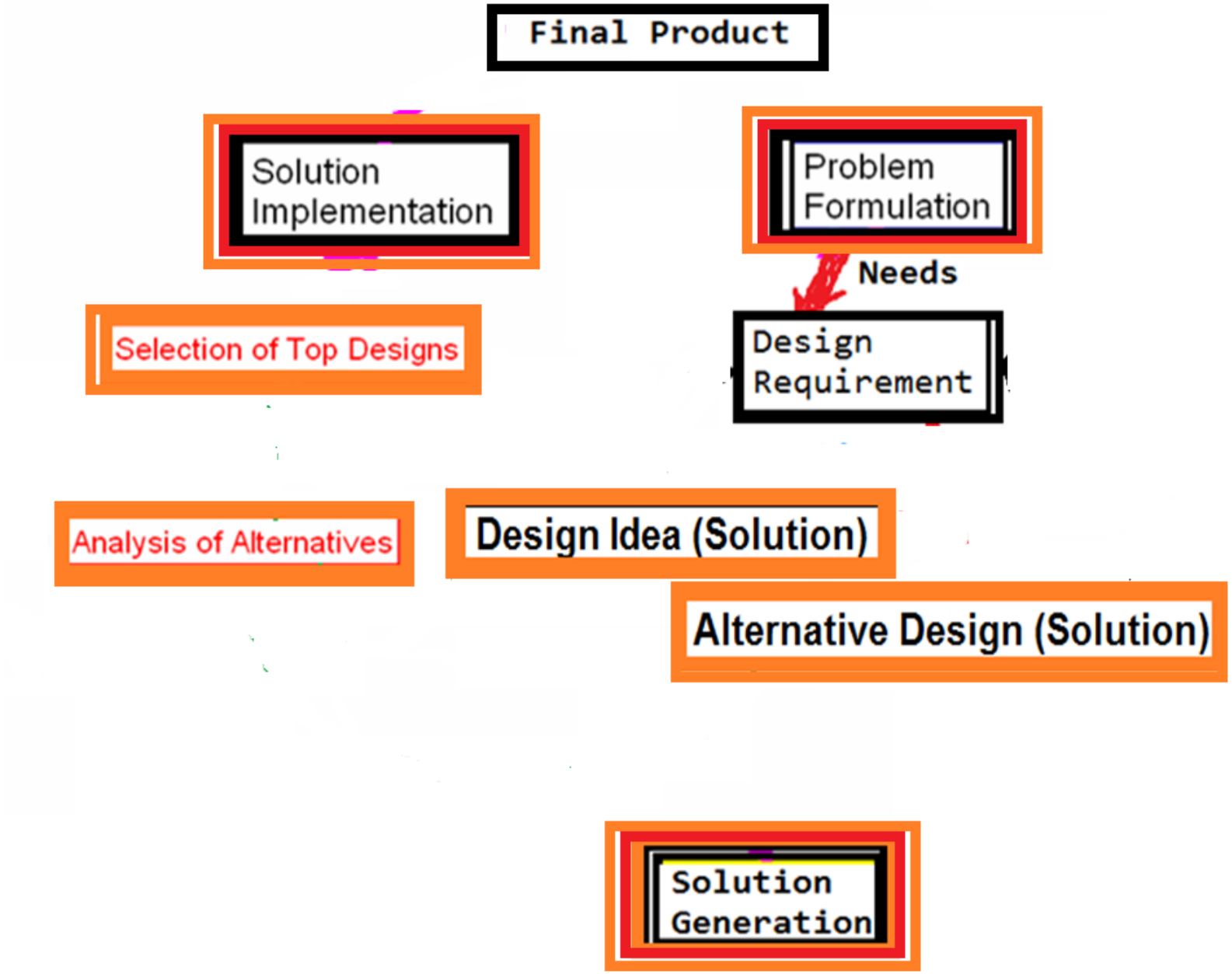
Problem Solving = Solution Generation



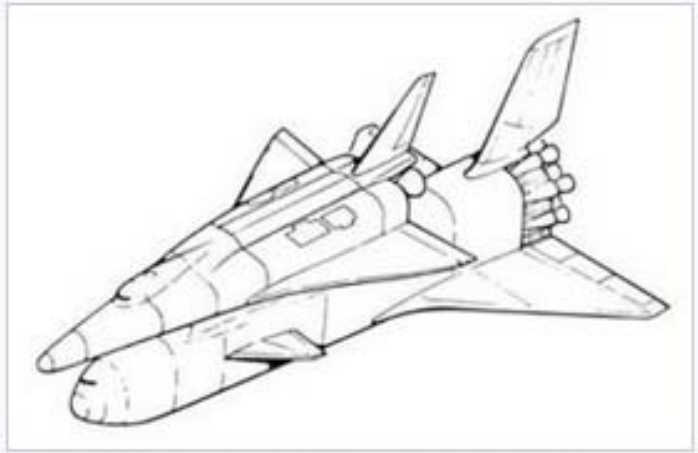
- Background:
  - (Problem Statement) was defined
  - (Design Requirements) were quantified
- Objectives:
  - –Solution Design Generation **Steps**
  - –Solution Design **Description → Solution Design Report → Solution Design Presentation**

Solution Generation



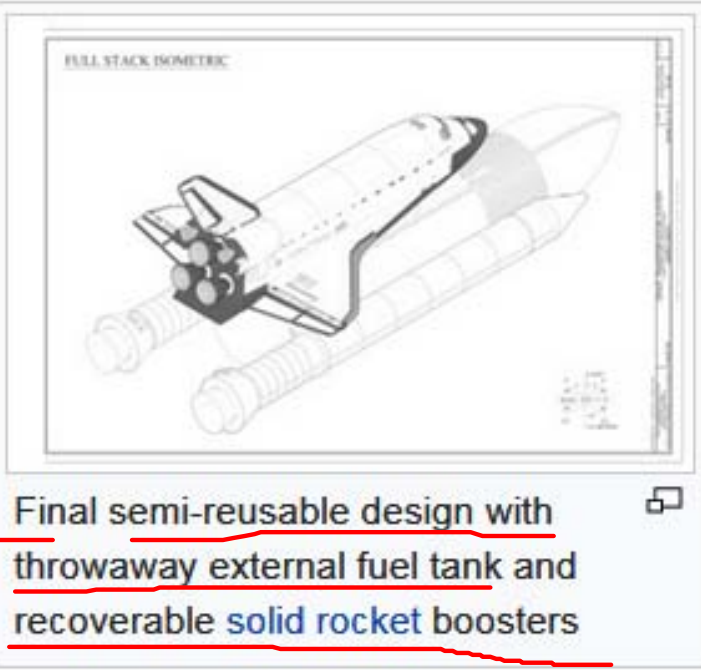
Solutions and Alternatives Solutions

Remember the different designs of space shuttle?



Original North American Rockwell Shuttle delta wing design, 1969: fully reusable, with a flyback manned booster

Maxime Faget's DC-3 concept employed conventional straight wings.

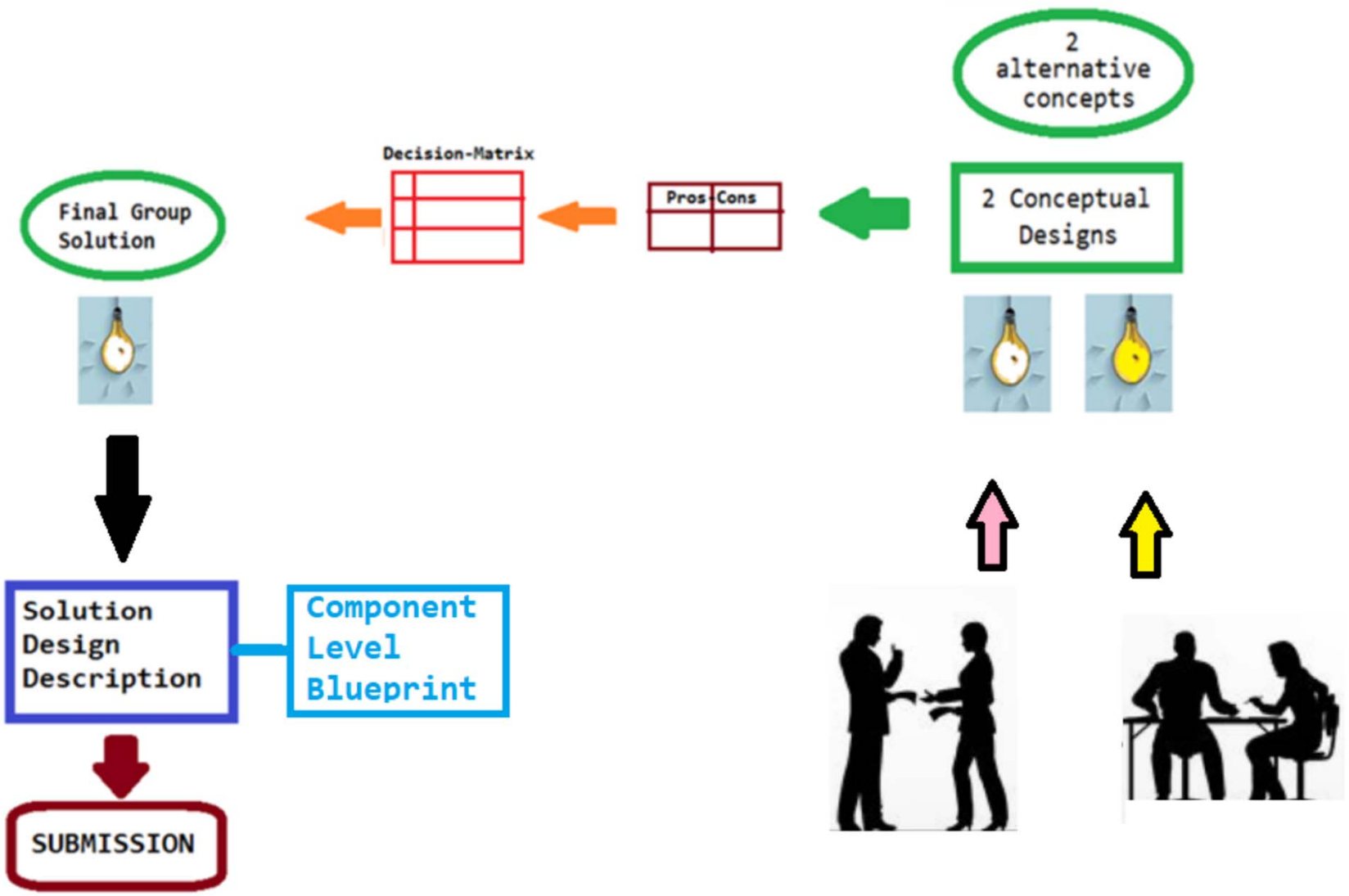


Final semi-reusable design with throwaway external fuel tank and recoverable solid rocket boosters

Solution Generation - Essence

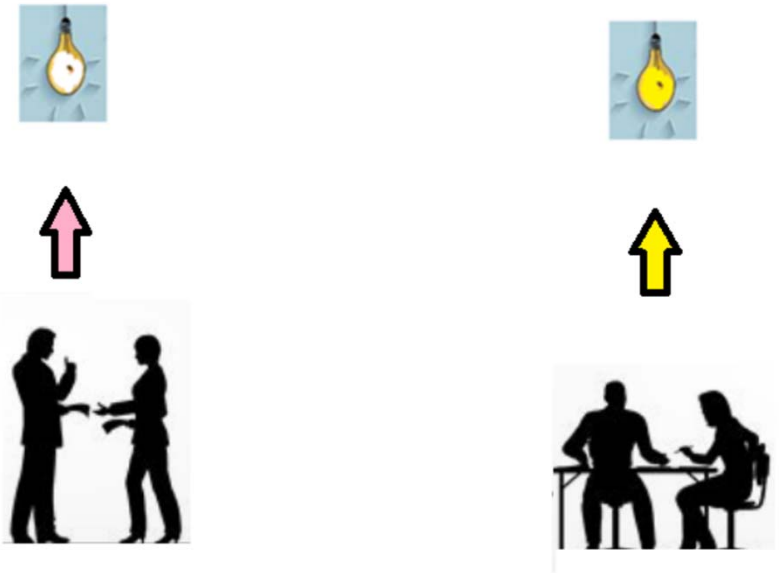
1. Start from ( )
2. Expand the solution space (or think more and explore more) and come up with (multiple (> 2) solution designs): Practical Approach:
   - Subgroup1 (2 members): work together and generate a solution idea
   - Subgroup2 (2 members): work together and generate another (alternative) solution idea
3. ( ) the solution designs using pros & cons ("qualitative") and decision matrix ("quantitative")
4. Select one of the designs as the ( ) solution design
5. ( ) all the solution generation steps (steps 2 – 4) in to a Report on Solution Generation

Practical solution generation approach



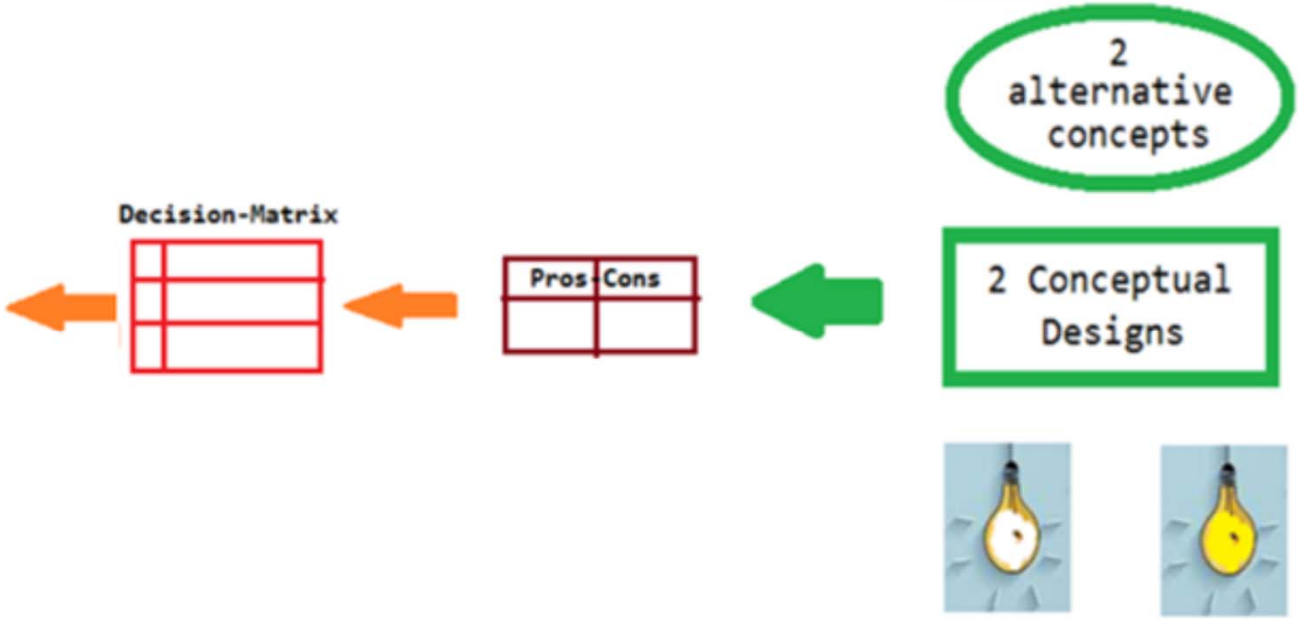
Team Activity -- "Solution Generation" – STEP 1

- **STEP 1: Give assignment to each sub-group to bring up a Solution Design** – each sub-group works separately without discussion
  - Remember: The solution should satisfy the design requirements
  - Each sub-group **writes** and sketches its solution idea and should be ready to bring it to the next team meeting.



Team Activity -- **"Solution Generation" – STEP 2**

- **Step 2: Analysis -** Hold a team meeting to discuss the 2 solution designs from the 2 sub-groups.
  - Discuss on the two (2) concepts/ideas/designs
  - Analyze the details of the solution designs
    - A) Qualitative Analysis: Pros & cons
    - B) Quantitative Analysis: Decision-Matrix
      - Attributes
      - weight



Pros and Cons - Example

Sub	Pros	Cons
Sub-1	• Use of ready-built frame saves time • No need of 3-D printer • Recycling the pervious frame with motors would save time and ease installation of parts and components	• May not compatible with existing motors. • Installation would face difficulties • Motor controller compatibility would be a problem
Sub-2	• Customized frame • Installation of components and parts would be easier • The report available would guide to success	• Need help with ME staff or help • It may take longer time than expected • Less freedom for new functions and features

Decision Matrix - Example

10: Best
1: Worst

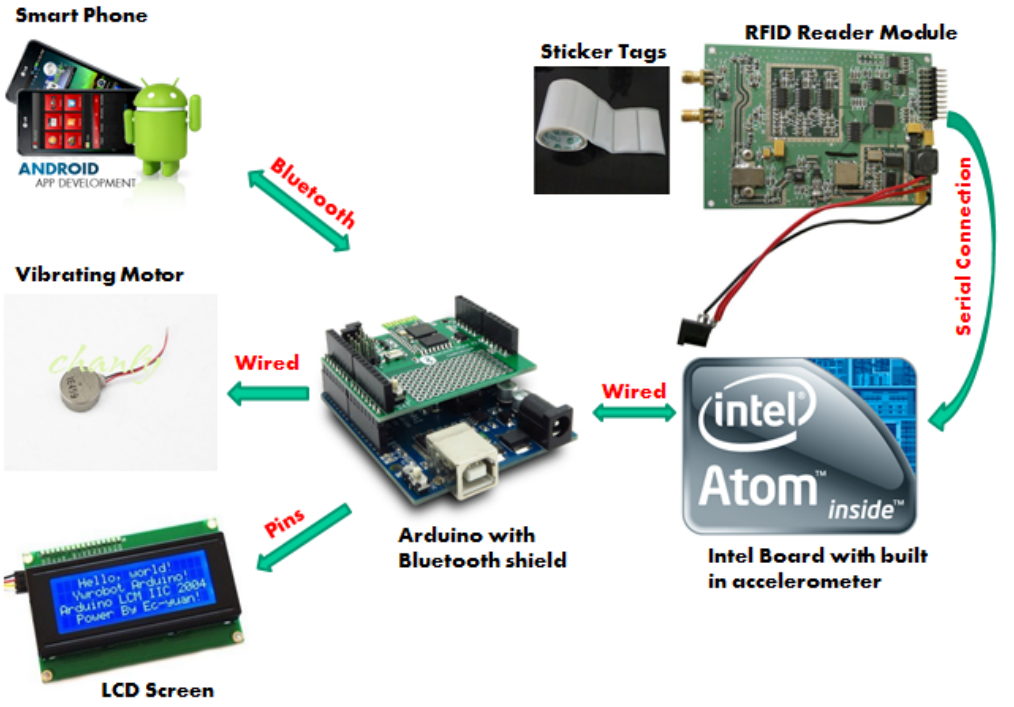
10: Best
1: Worst

Purchase of a used car

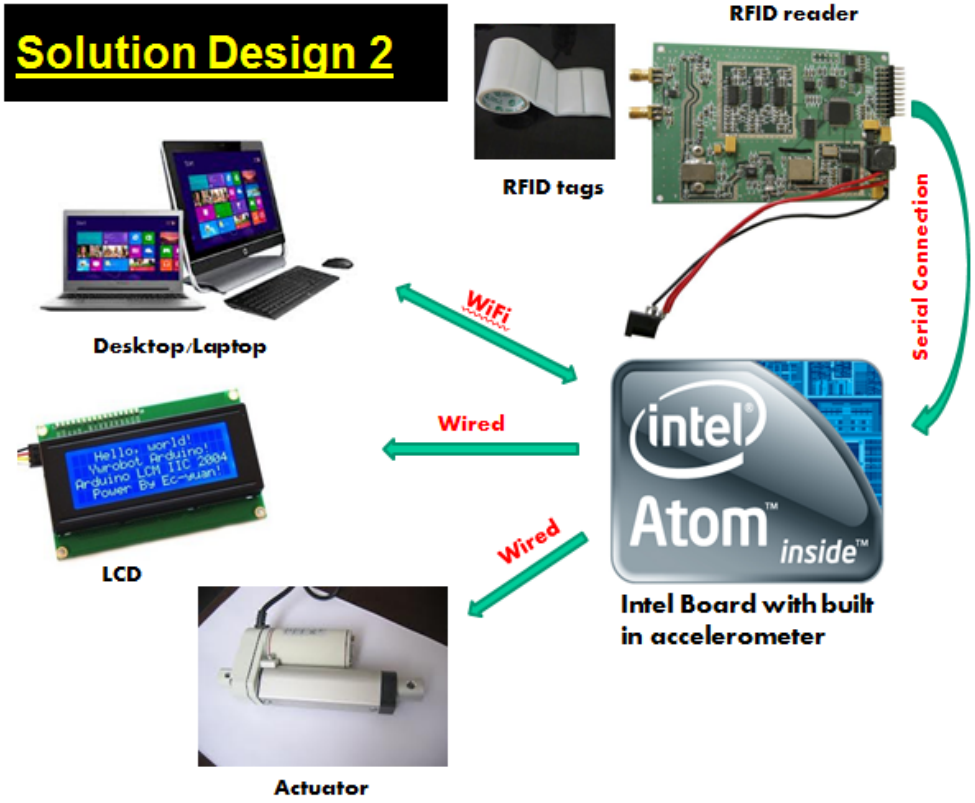
CAR	COST	ODOMETER READING	MECHANIC'S RATING (1 - 10)	LOOKS (1 - 10)
RED	$2000	50,000	7	5
BLACK	$2500	40,000	5	6
BLUE	$3000	20,000	8	8

Decision Matrix - Example

Solution Design 1



Solution Design 2

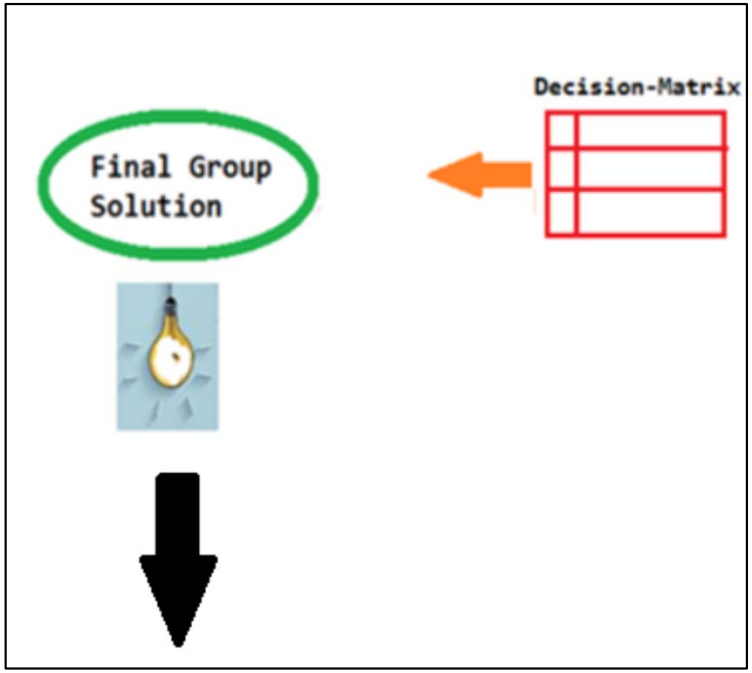


Design Decision Matrix

	Wt	Design 1	Score	Agg. Score	Design 2	Score	Agg. Score
Functionality	5	Smartphone Arduino Vibrating motor	5	**25**	Desktop Actuator	3	**15**
Connectivity	2	Bluetooth Wired Wi-Fi	5	**10**	Wired Wi-Fi	3	**6**
Weight	3	Approx. 940g	4	**12**	Approx. 890g	5	**15**
Power	4	More components to be powered	3	**12**	Fewer components to be powered	5	**20**
Convenience	1	On the go edit	5	**5**	At home edit	3	**3**
TOTAL				**64**			**59**

Team Activity -- "Solution Generation" – STEP 3

- **Step 3 : Selection of the Top Design Solution** for the project
  - Top Design Selection is decision-making process
  - Decision-making involves making trade-offs
    - The results of the analyses
    - Requirements from customer
    - Attribute and weight
      - Selection Criteria: which is more important in making decision?



Team Activity -- "Solution Generation" - STEP 4

- **Step 4: Write Solution Design Description**
  - **Description** of the Top Solution Design
- **A good Solution Design Description should:**
  - Provide integrated ideas and concepts about how the desired system behaves [functionality] and looks [aesthetics]
  - Use drawings and/or models and/or proto-types

How to write a solution design with description and figures?

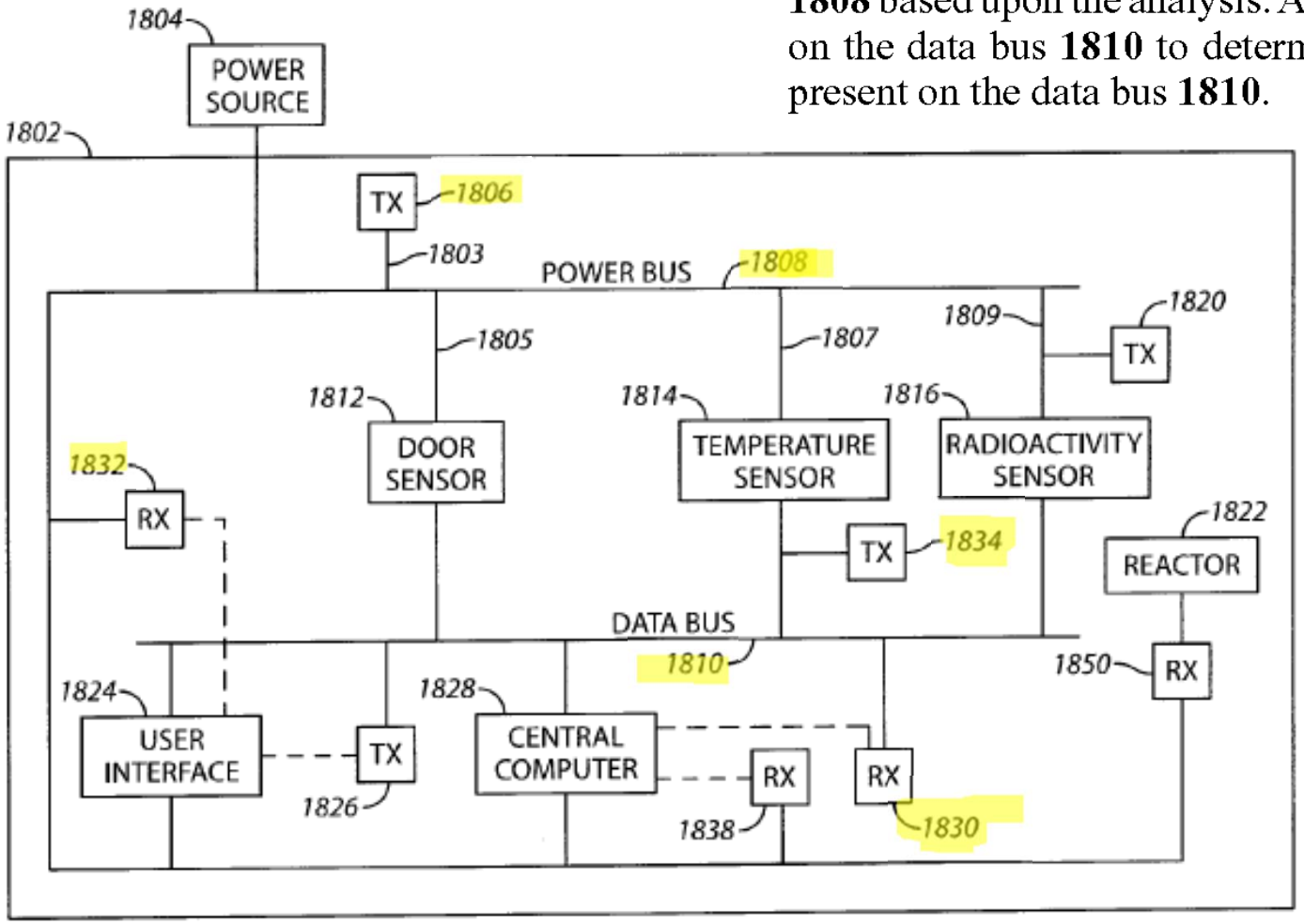
"Solution Design Description" Examples from Patents

- **Learn from Patents for a good solution design description**
  - Follow Patent description: Figures and their Descriptions using the Figures
- **Examples**
  - **Next** will show different ways **of (1) drawing figures** (for different purposes and different elements such as structure, H/W, S/W, operation flow, network, etc) and **of (2) describing the solution design using the figures**.

Solution Design Description- Examples

(10) Patent No.: US 8,711,711 B2
(45) Date of Patent: Apr. 29, 2014

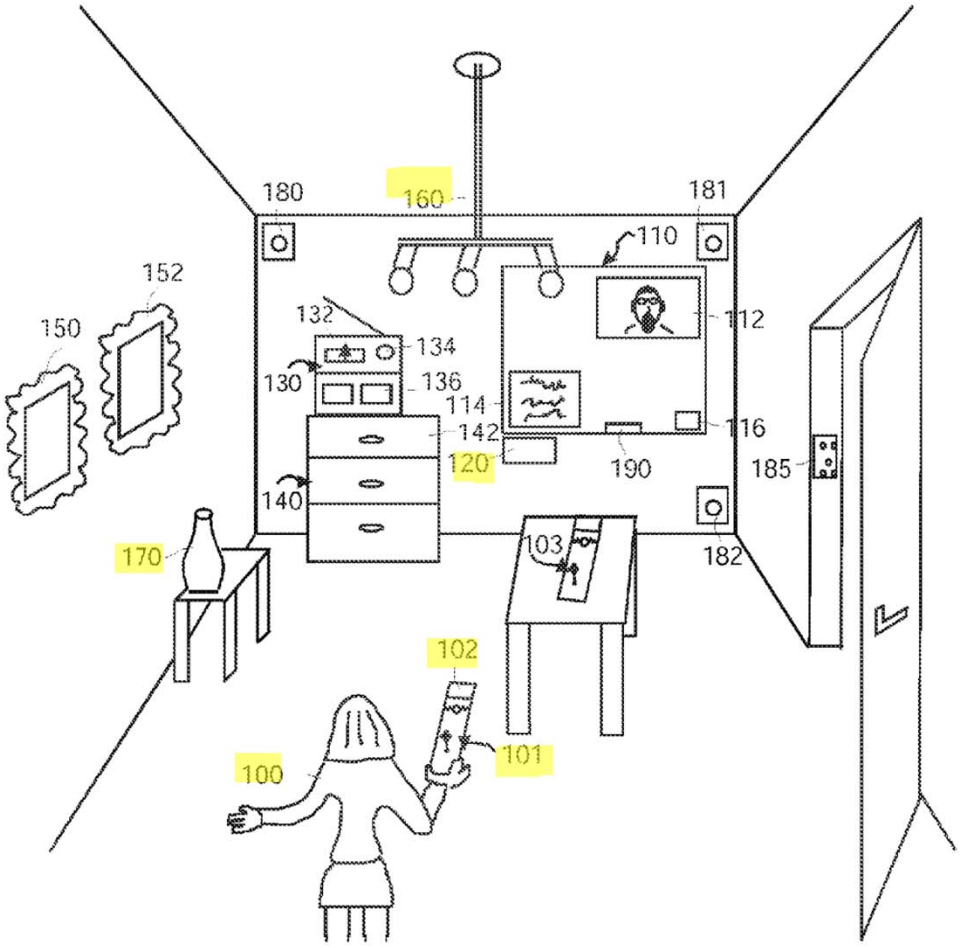
In other aspects, a modulated signal is transmitted from the transmitter **1834** or **1806** and across the power bus **1808** that is coupled to the sensors **1812**, **1814**, or **1816**. The modulated signal is received at the receiver **1832**. The receiver **1832** analyzes the received modulated signal and determines whether an intermittent fault has occurred on the power bus **1808** based upon the analysis. A similar approach can be used on the data bus **1810** to determine if intermittent faults are present on the data bus **1810**.



Solution Design Description- Examples

- User Interface System Based on Pointing Device

(10) **Pub. No.: US 2014/0062879 A1**
(43) **Pub. Date: Mar. 6, 2014**



[0049] According to the invention, the pointing device **101** contains a camera **102**, and can send pictures of regions of a room or objects in those regions to a digital signal processor (DSP) **120**, which can identify the regions or objects on the basis of one or more pictures imaged by the camera **102**. The camera is connected to the pointing device **101** in such a way, that it images well the region pointed to. E.g. it can typically reside at the far end of the pointing device **101**, but it could also be mounted on the side under an angle. The user **100** has the freedom to point to whatever object he wants, and in such a way a very user-friendly and powerful user interaction system can be realized.

[0051] The DSP **120** is designed to send user interface information I, e.g. apparatus control data ac, to an identified apparatus. E.g. user **100** can point the pointing device **101** to light **160** and push an on-button on the pointing device **101**, which results in the DSP **120** sending an on-command to the identified light **160**. The object identified needs not be the apparatus to be controlled itself. E.g. pointing at vase **170** may

Solution Design Description – "How To"

- **1.In figure**, each component in a figure must have a number (marked by a number).
  - If the **component** is used in another figure, the component should keep the same number.
- 2. **In description**, whenever a numbered component is used, the named component **must be followed by the number attached to the component**.
  - **Description must be descriptive - not** bullet itemized. **Complete sentences** and paragraphs are to be used as in technical paper or essay.

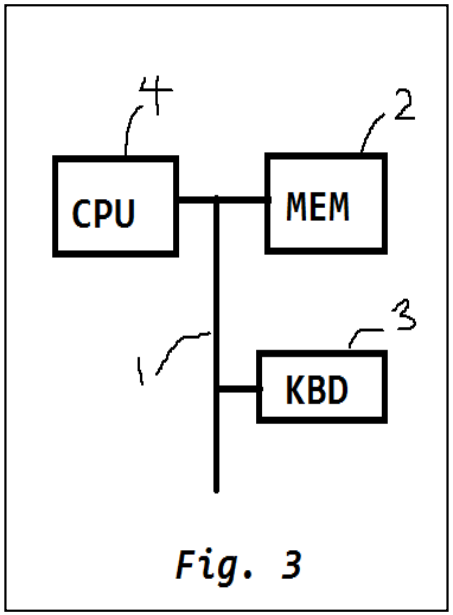
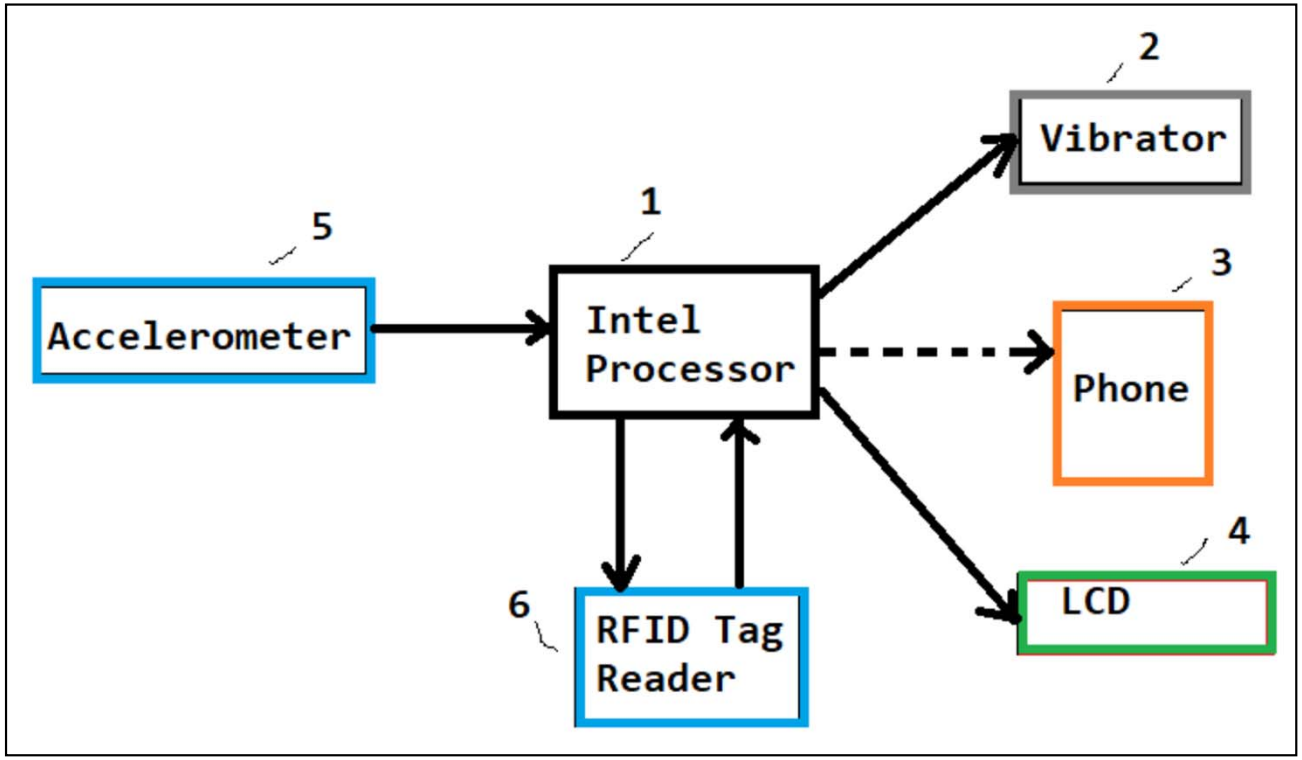


Fig. 3

As illustrated in Fig.3, the CPU 4 calculates and the results are store in MEM 2.

Description (Example from team Backpack)



Outside, a stationary positioning of the backpack as determined by the accelerometer (5) will keep the RFID Reader (6) in standby mode. When motion is detected, the reader (6) will again scan for the tags in the reading range and make a comparison with the expected tags that should be in close proximity to the backpack. A mismatch found the processor (1) between what is expected and what is actually read will trigger the vibrator (2) of the backpack, the display of the identifier/name of the missing items on the backpack's LCD (4) screen as well as a notification set to the user's phone (3).

Description - Practice (team work)

Q) Rephrase the following statement as a patent-style document, which means description and figure.

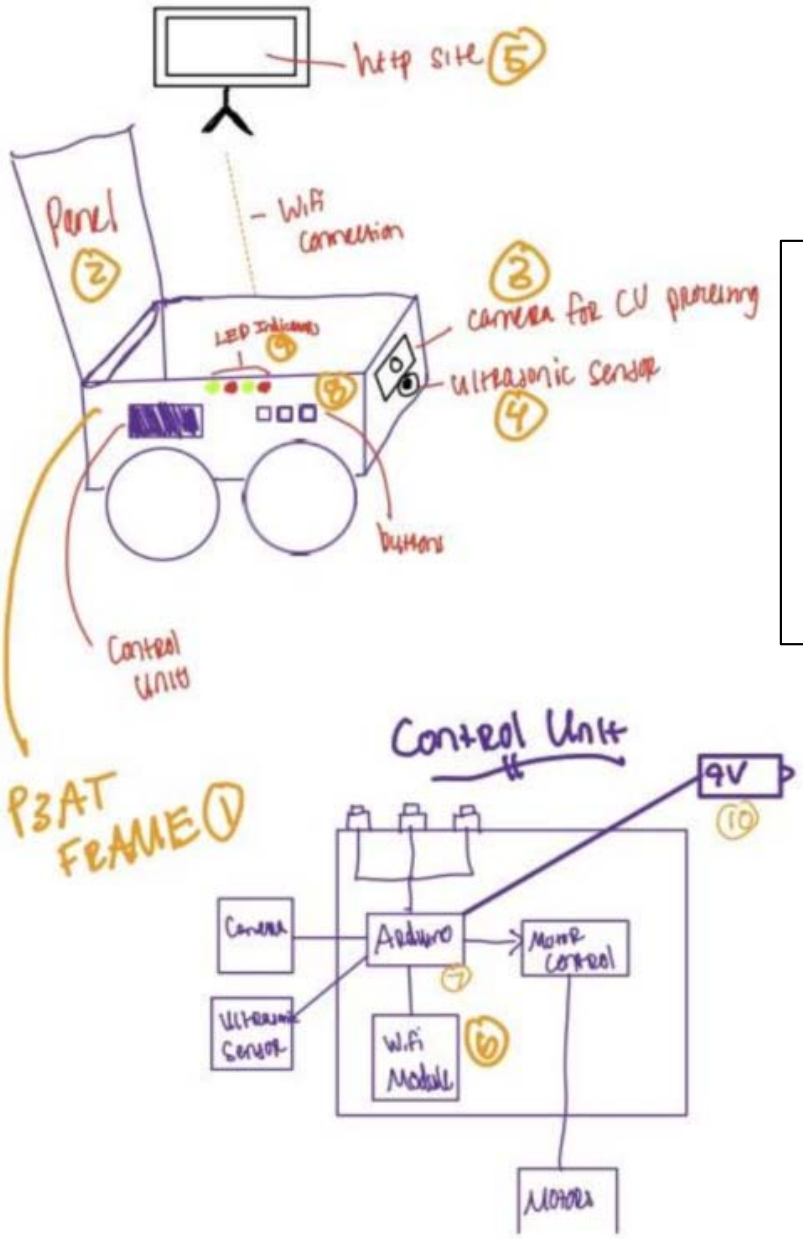
Submission – Required

Statement: A case for a smart phone incorporates an extended rod for use as a selfies stick and includes a recess in which the telescopic rod locates when not in use. Typically, the rod includes at least one hinge about which it can pivot.

Team Activity -- **"Solution Generation" – STEP 5**

- **Step 5: Component-Level Blueprint**
  - This is the blueprint for implementation of the solution using hardware components
  - Selection of hardware components for the solution
  - Start with schematic diagram of the hardware components
  - Find a specific part for each hardware component
  - Make out a list file which shows all the parts, web link to the part store, unit price, quantity, total price.

Team Activity -- **"Solution Generation" – STEP 5**



Example

Parts:

A. 5.5V Solar Panel

a. https://www.amazon.com/Polysilicon-Charging-95x95mm-3-7V-5V-Battery/dp/B099RSWRKS

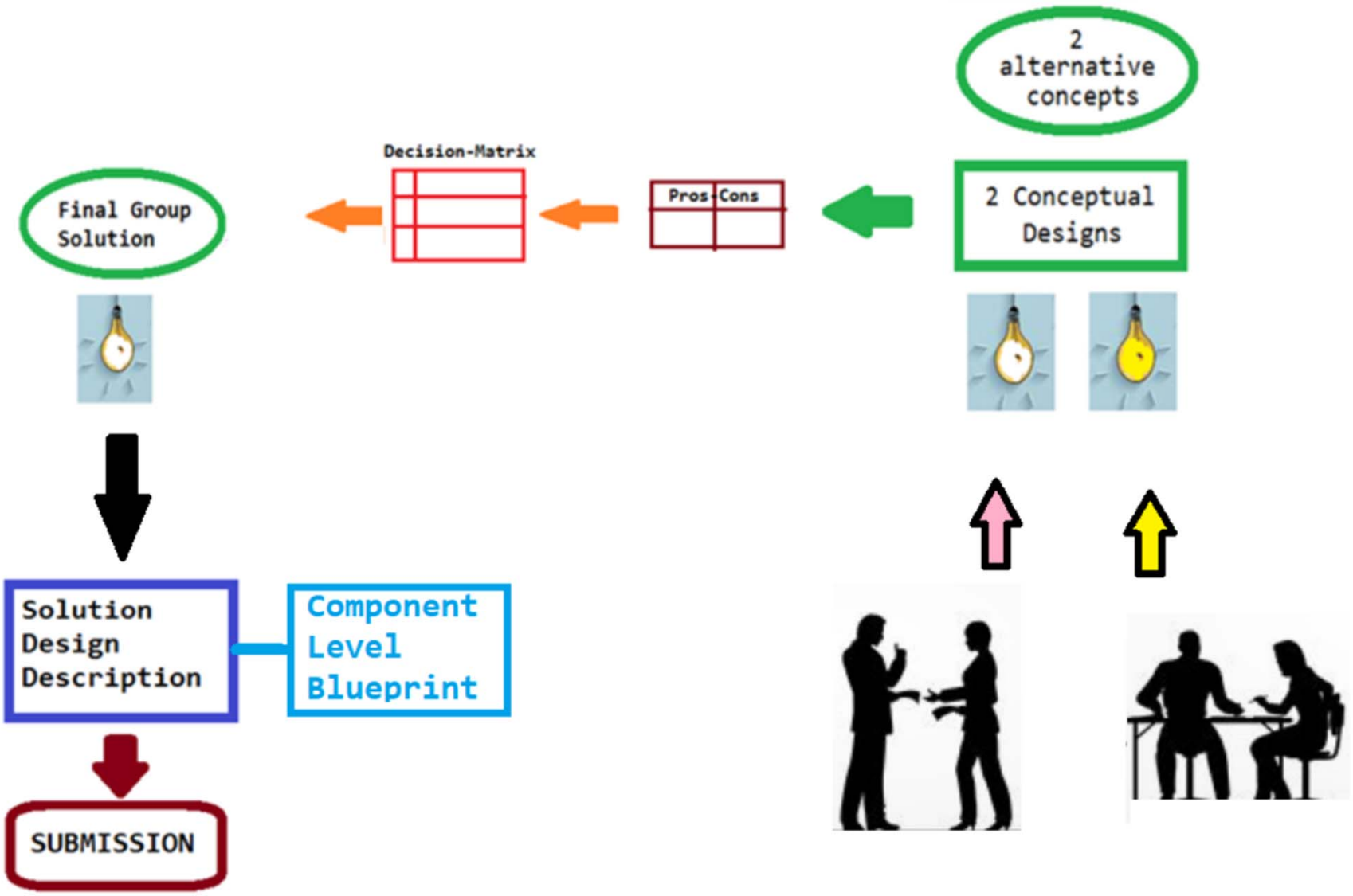
B. 12V Water Pump

a. https://www.amazon.com/bayite-Diaphragm-Priming-Pressure-Adjustable/dp/B074MZYS37/ref=pd_bxgy_vft_none_sccl_2/138-1128159-3676002?pd_rd_w=Mdm21&content-id=amzn1.sym.7f0cf323-50c6-49e3-b3f9-63546bb79c92&pf_rd_p=7f0cf323-50c6-49e3-b3f9-63546bb79c92&pf_rd

Team Activity -- **"Solution Generation" – STEP 6**

- **Step 6: Submission of <u>Solution Design Report</u>**
  - Section 1: Brief description of two solution designs
  - Section 2: Description on the analysis of the 2 design by Pros & Cons
  - Section 3: Description on the analysis of the 2 designs by decision-matrix
  - Section 4: Detailed description of the Top solution design (following patent description practice) + Component Level blueprint

Recap: Solution Generation Process



Team Activity Timeline and Milestones

	Activity milestones
A	1) Two sub-group ideas are collected. 2) The two designs are review and, via pros and cons and decision-matrix. 3) Selection of the top solution design **Submission (due TBD) :** Brief description of the 2 design ideas **and** the selection process of Top design solution.
B	1) **Detailed** description of the Top Design using the **patent format**. **Submission(due TBD):** Detailed description of the Top design solution.
C	1) Component-Level Blueprint **Submission: (due TBD)** Component-Level Blueprint
D	1) Combine A, B, and C above and make a Solution Design Report. **Submission: (due TBD)** Final Report on Solution Design
E	Presentation of Solution Design: **(TBD)**