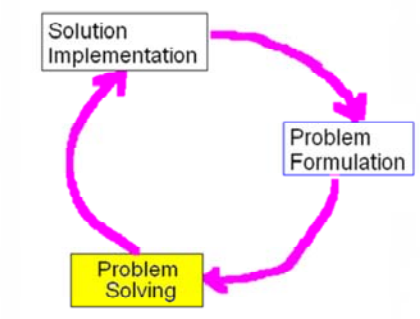
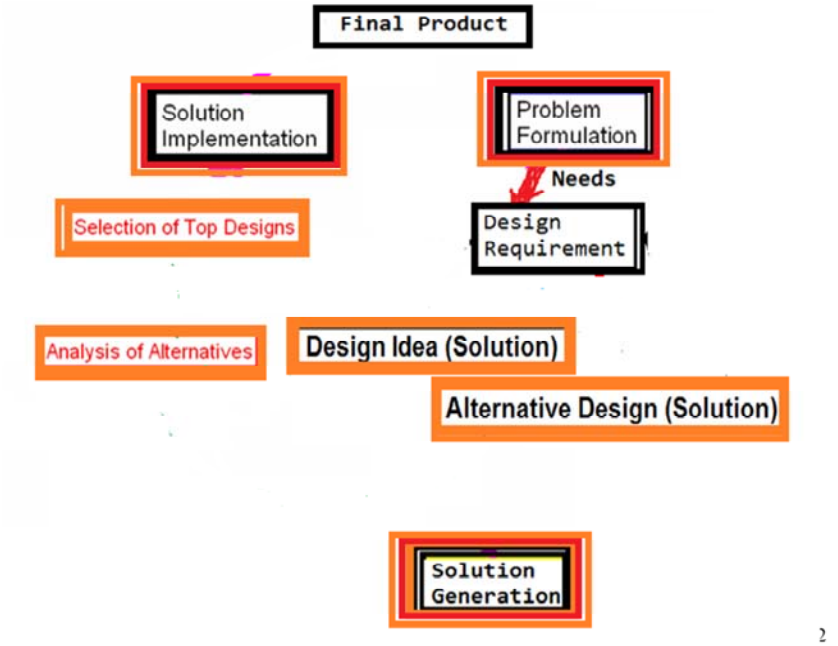
Problem Solving = Solution Generation



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

1

Solution Generation



2

Solutions and Alternatives Solutions

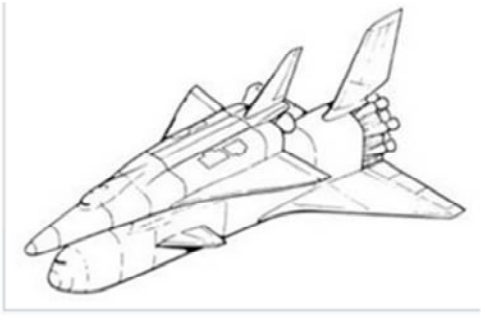
3

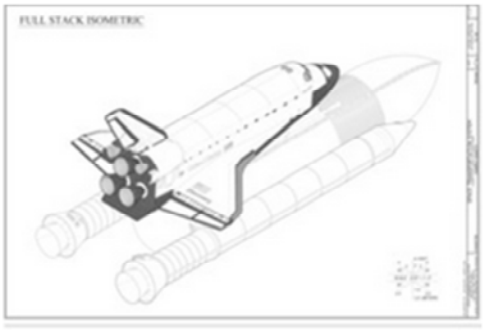
How do we generate solution?

- **Expand the Solution Space**
  - All possible solutions
  - Wide design space **but** true to the problem (and design requirements)
- **Overcome the Temptation to Adopt the First Idea**
  - Bring up the initial design
  - Add different (alternative) designs

4

Remember the different designs of space shuttle?





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Solution Generation - Essence

1. Start from (Design Requirements)
2. Come up with an (_____) solution design
3. Expand the solution space (or think more and explore more) and come up with (_____) solution designs
4. (Analyze) the solution designs using pros & cons and decision matrix
5. Select one of the designs as the (___) solution design
6. (Combine) all the solution generation steps (steps 2 – 5) in to a Report on Solution Generation

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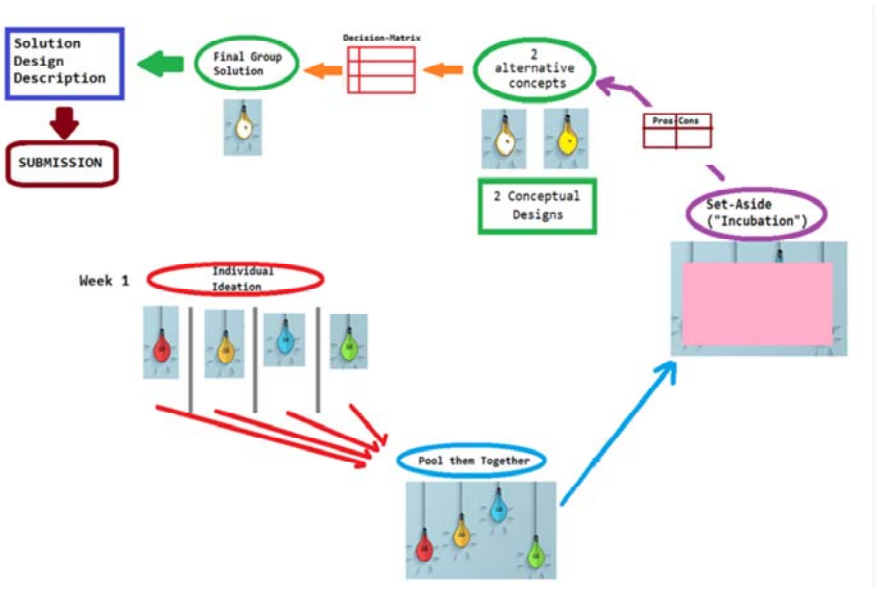
Practical solution generation approach



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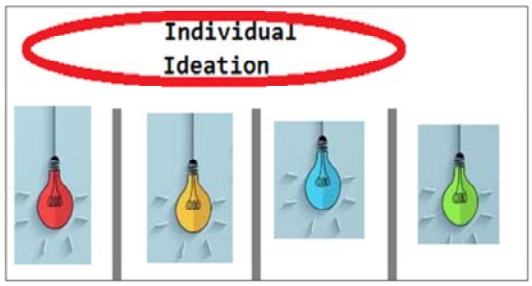
Team Activity -- "Solution Generation" – STEP 1

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



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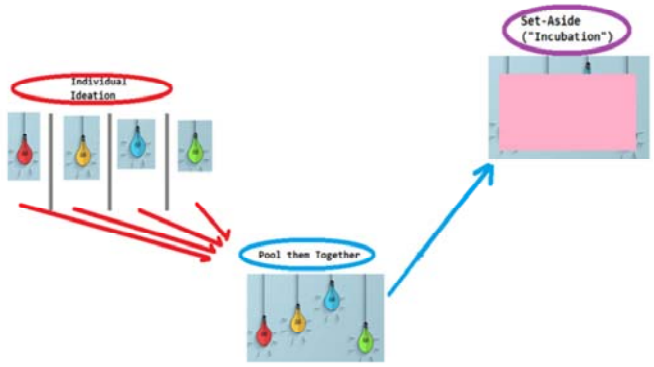
Team Activity -- "Solution Generation" – STEP 2

- **Step 2: Pool Together -** Hold a team meeting to discuss ALL solution designs
  - Discuss on the individual concepts/ideas/designs
  - Analyze the details of ALL solution designs
  - **Incubation Period** (Don't' think about them until the next team meeting)



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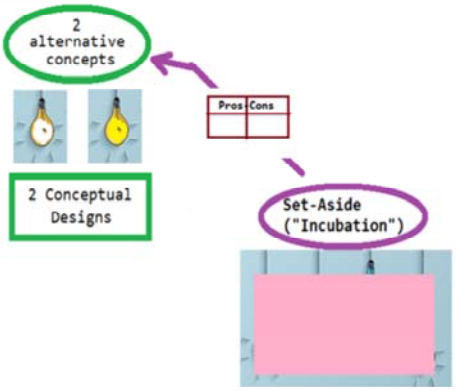
Team Activity -- "Solution Generation" – STEP 3

- **Step 3: Selection of 2 best** Solution Designs from the Individual Ideas
  - Select/Develop into at least 2 team solution designs
    - Description of all individual initial solution designs
    - Selection of Top 2 designs with Pros & Cons
    - Write Part 1 of the Solution Report



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Pros and Cons - Example

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

Team Activity -- "Solution Generation" – STEP 4

- **Step 4 :** Analysis of 2 Solution Designs and **Selection of the Top Design Solution** for the project
  - Top Design Selection is decision-making process
  - Decision-making involves making trade-offs
  - **Decision Tools**
    - **Decision Matrix**

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Decision Matrix - Example

10: Best 10: Best
1: Worst 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

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Decision Matrix - Example

Purchase of a used car

10: Best
1: Worst

10: Best
1: Worst

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

	Cost	Cost Wt	Odometer	Odo Wt	Engine	Engine Wt	Total Score	
RED	5	0.5	2	0.2	4	0.3	4.1	X
BLACK	4		3		3		3.5	
BLUE	3		5		5		4.0	

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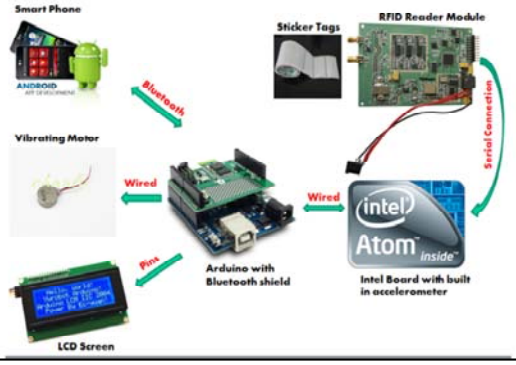
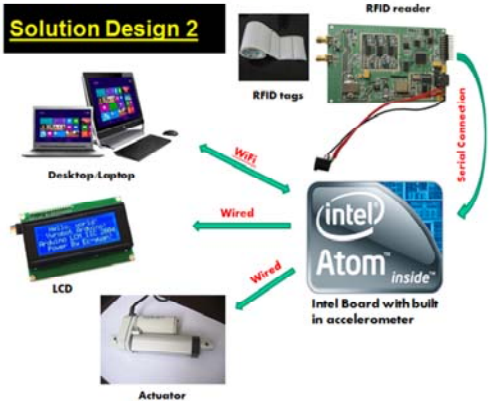
Decision Matrix - Example

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 5

- **Step 5: Write Part 2 of the Report**
  - Decision Matrix for Top Design Selection
  - **Description** of the Top Solution Design
- **A good Solution Design Description should:**
  - Provide integrated ideas and concepts about how the desired system behaves – features and operations (*Note: think about product manual)
  - Use drawings and/or models and/or proto-types

How to write a solution design with description and figures?

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"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**.

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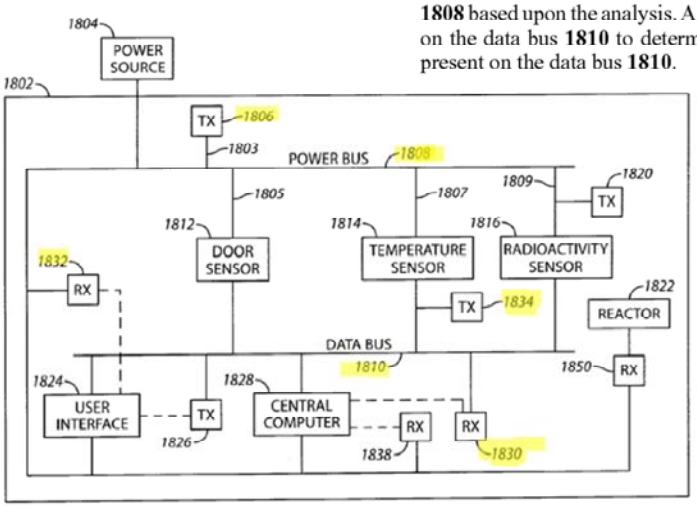
Solution Design Description- Examples

(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**.



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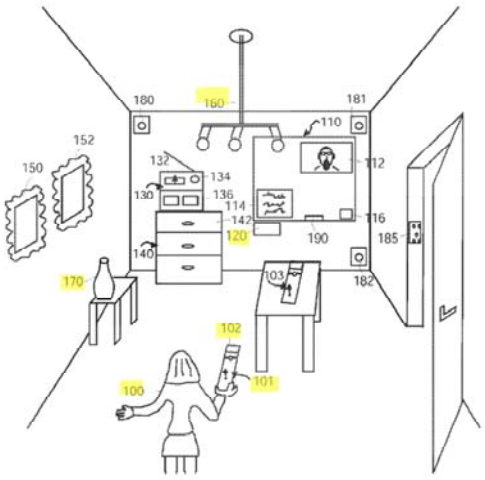
Solution Design Description- Examples

- 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



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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.

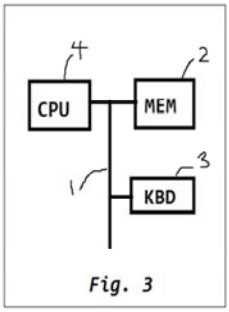

Fig. 3

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

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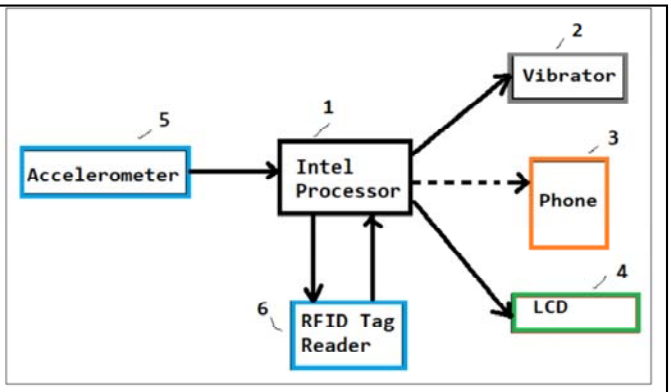
Description (Example from team Backpack)



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 (description + 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 6

- **Step 6: Submission of <u>Solution Design Report</u>**
  - **Part 1** (From steps 1 – 3)
    - Description of all individual initial solution designs
    - Description of Top 2 designs with Pros & Cons
  - **Part 2** (From steps 4-5)
    - Decision Matrix for Top Design Selection
    - **Description (Following the Patent example)** of the Top Solution Design

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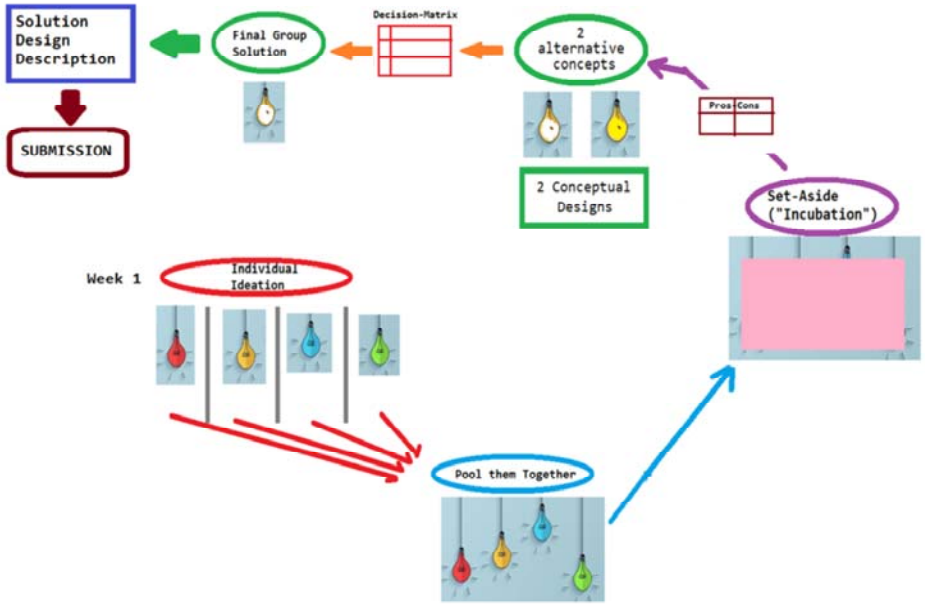
Recap: Solution Generation Process



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Team Activity Timeline and Milestones

Steps	Activity milestones
1 - 3	1) All individual ideas are collected from all members of your team. 2) All individual designs are review and, via pros and cons rubric, best 2 designs are selected **Submission (due (M) Oct 24) : Part 1:** Description of all individual designs and the selection of Top 2 using Pros and Cons rubric)
4 - 5	1) From the top 2 individual designs selected, using decision-making criteria (attributes) and their weights, the top design of the team is selected. 2) If necessary, two designs may be combined to the top design. 3) Describe the Top Design using the patent format. **Submission(due (M) Nov 7): Part 2:** (1) Description of the Decision Matrix for Top design selection and 2) Description of the Top Design in the patent format)
6	1) **Part 1** and **Part 2** are combined together to the Final Report on Solution Design. **Submission: (due (M) Nov 14)** Final Report on Solution Design
7	**Presentation of Solution Design: (M) Nov 21/28**

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