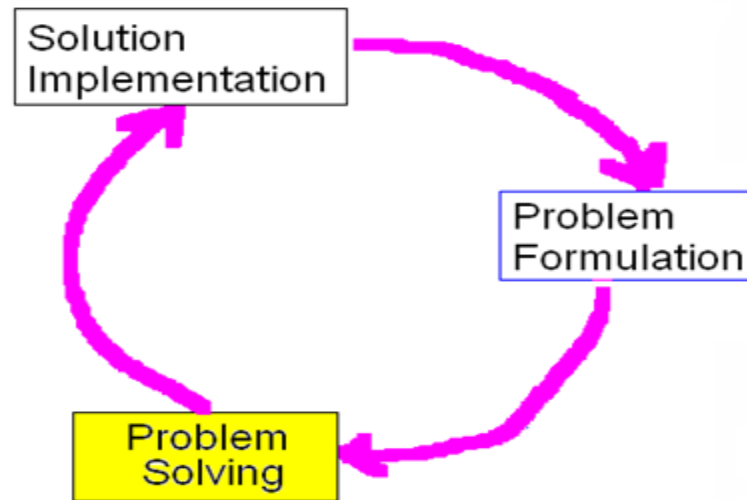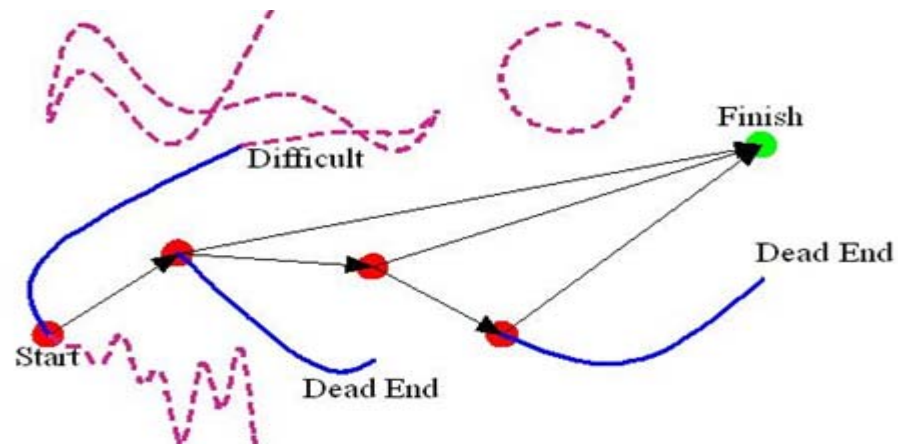# Solution Generation

www.mwftr.com/SD1819.html

Problem Solving → Solution Generation


- Objectives:
  - Solution Design Generation Steps
  - Solution Design Description

Steps for Solution Generation

- (   ) was defined
- (   ) were quantified
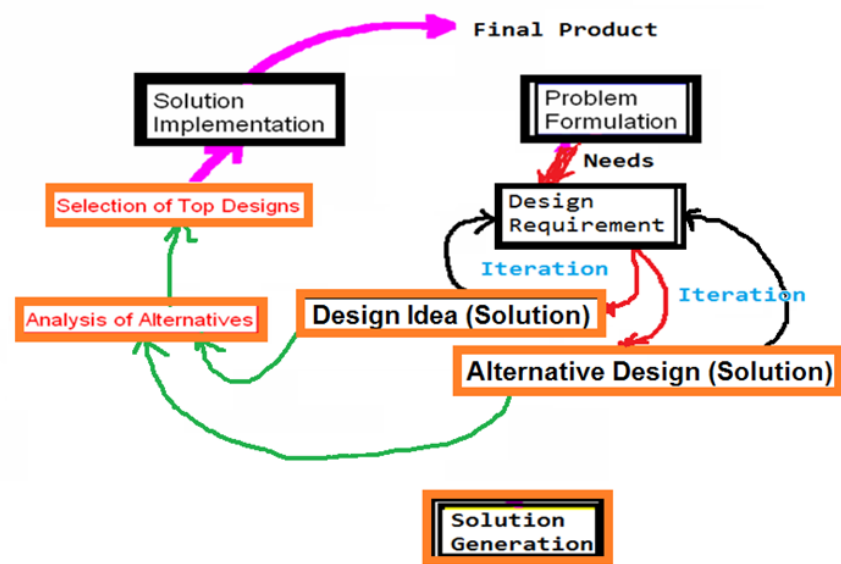   - Above 2 can be updated continuously (resubmission)
- Next Step: **Solution Generation** to meet the need
- Solution Generation Steps
    - 1. (   ) Solution Generation
    - 2. Generation of (   ) Design Solutions
    - 3. Selection of the (   ) Solution Design
    - 4. (   ) (Writing report) of the Top Solution Design

Steps for Solution Generation
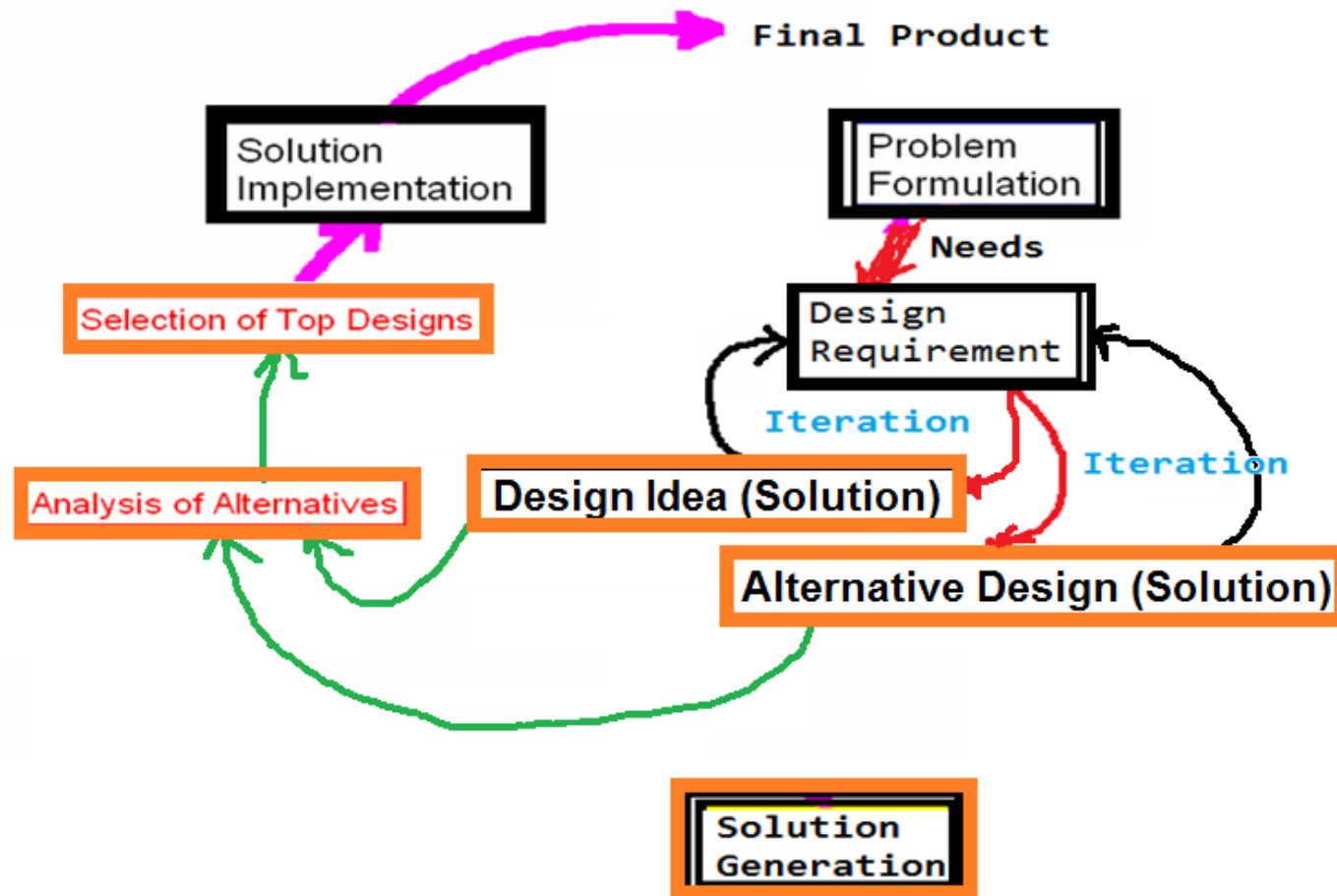
Solution Generation Steps

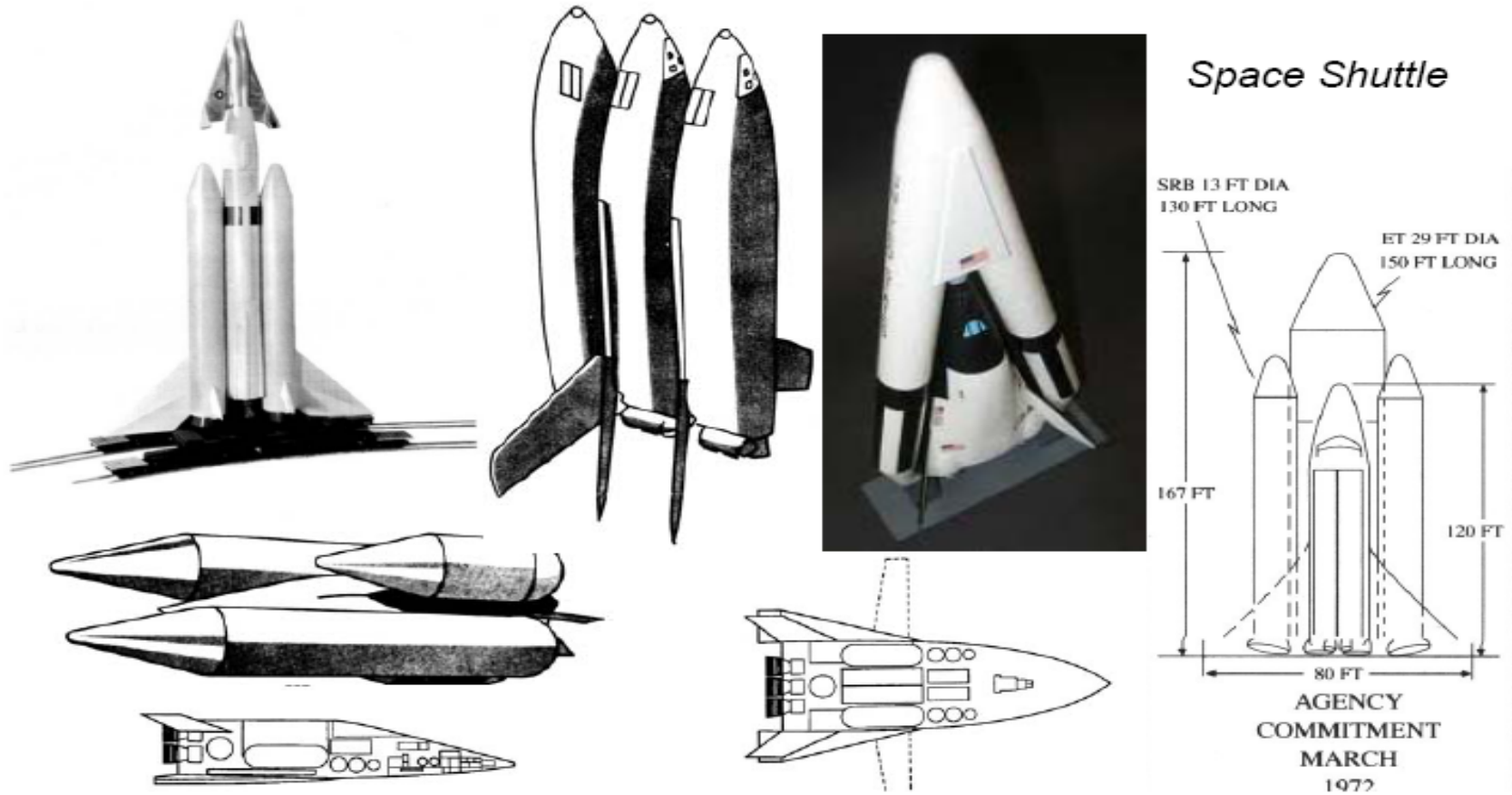1. Start from (   )

2. Come up with an (   )
   <u>solution design</u>

3. Expand of the solution space (or think more and explore more) and come up with an (   )
   <u>solution design</u>

4. (_____) the two solution designs using decision matrix

5. Select one of the two as the (   )
   <u>solution design</u>

Final Product

Solution Implementation

Problem Formulation

Needs

Selection of Top Designs

Design Requirement

Iteration

Iteration

Analysis of Alternatives

Design Idea (Solution)

Alternative Design (Solution)

Solution Generation

Generation of solutions (and Alternatives)

Remember the different designs of space shuttle?

Space Shuttle

SRB 13 FT DIA
130 FT LONG

ET 29 FT DIA
150 FT LONG

167 FT

120 FT

80 FT

AGENCY
COMMITMENT
MARCH
1972

Generation of solutions (and Alternatives)
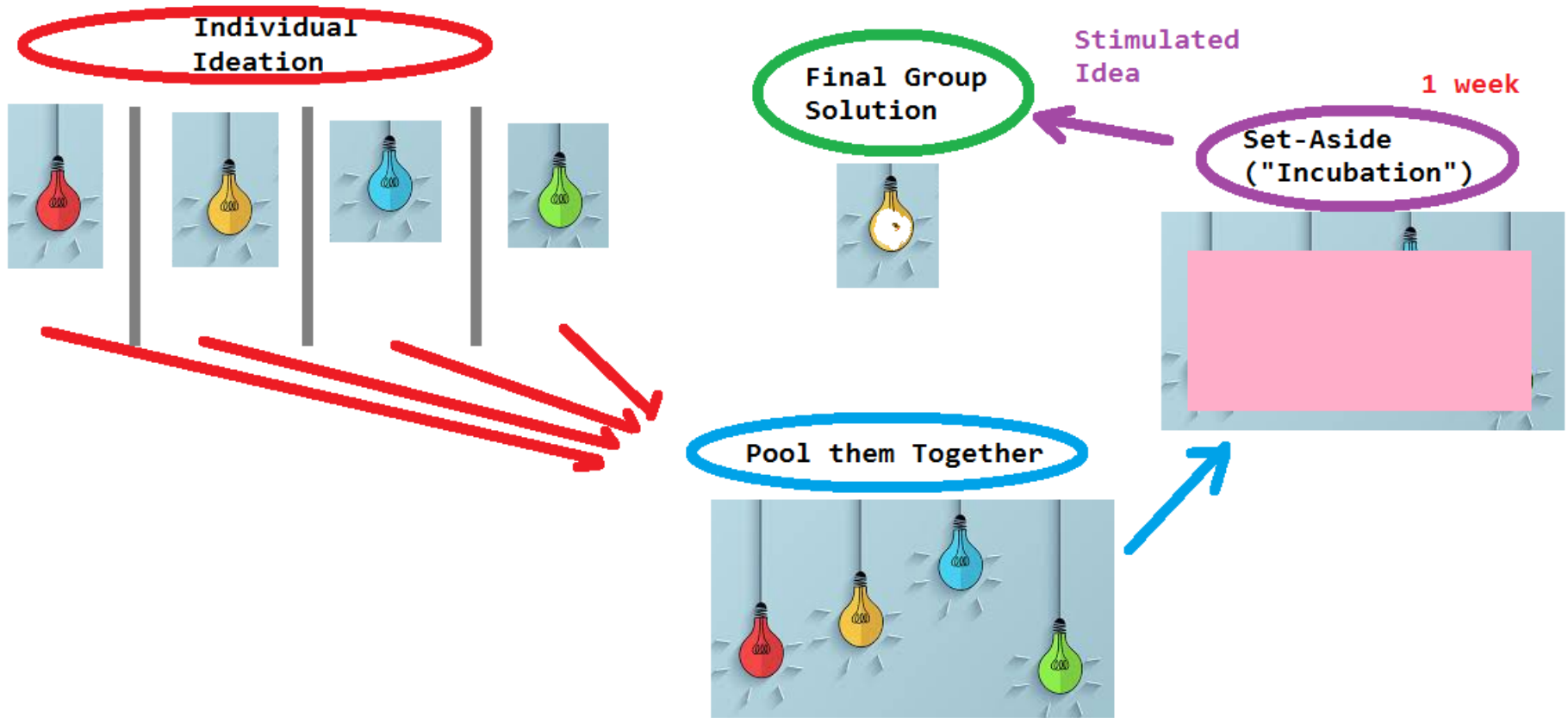
- The act of expansion - all possible solutions
- Overcome the temptation to adopt the first idea
- Building on the <u>initial conceptual design</u> and add <u>alternative ways</u> of achieving the solution
- Wide design space but <u>true to the problem</u> <u>(and functional requirements)</u> → better approach, better efficiency, economical way, etc.

How to generate solution design

- **Period of Ideation** is a period of conceptual idea

- Use **creativity** – remember that you're more creative than your daily life shows

- More ideas can be generated if team members first develop ideas (   ) and then (   ) them together

- Setting the problem aside (" **(   )** " period) and then returning to it helps (   ) more idea generation

How to generate solution design

Individual Ideation

Final Group Solution

Stimulated Idea

1 week

Set-Aside ("Incubation")

Pool them Together

10

Team Idea Generation Strategy

1. (Week 0) Individually, think of the problem and generate ideas – Individual Idea Generation

2. (Week 1) In the team meeting,

   a) present individually generated ideas - Pool

   b) Set the problem aside - Incubation

3. (Week 2) In the team meeting, work and build on the pooled ideas –Final Group Solution

4. If no satisfactory solution is achieved, go to Step 1 and do the steps again.
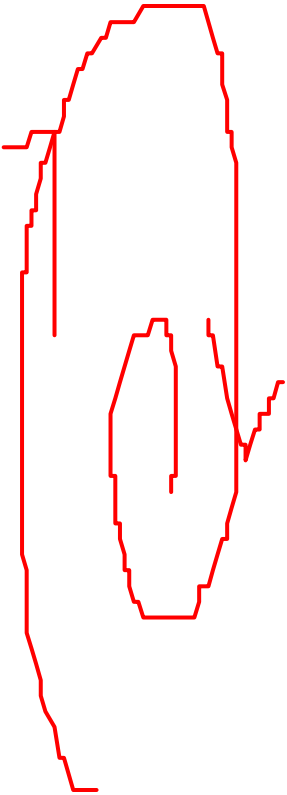
Team Activity -- "Team Design Solution Generation"

- **STEP 1 (Week 0): Give assignment to each team member to bring up Individual Solution Concept/Idea** – each team member <u>works separately</u> without discussion

  - Individual Solution Concepts and Ideas

  - Remember: The solution should satisfy the design requirements

  - Each member writes or sketches each solution idea and be ready to bring it to the next team meeting.
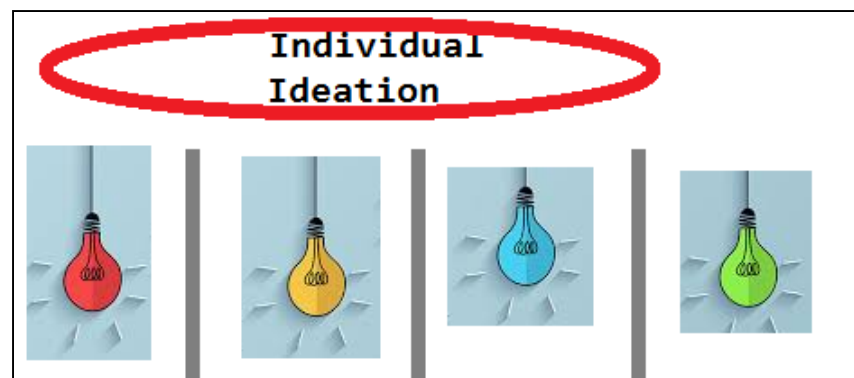
Individual Ideation

- **Step 2 (Week 1):** Hold a team meeting to discuss ALL solution designs
  - Discuss on the individual concepts/ideas
  - Write and record the details of ALL solution designs
  - Incubation Period (Don't' think about them until the next team meeting) : do something else such as (___)

Pool them Together
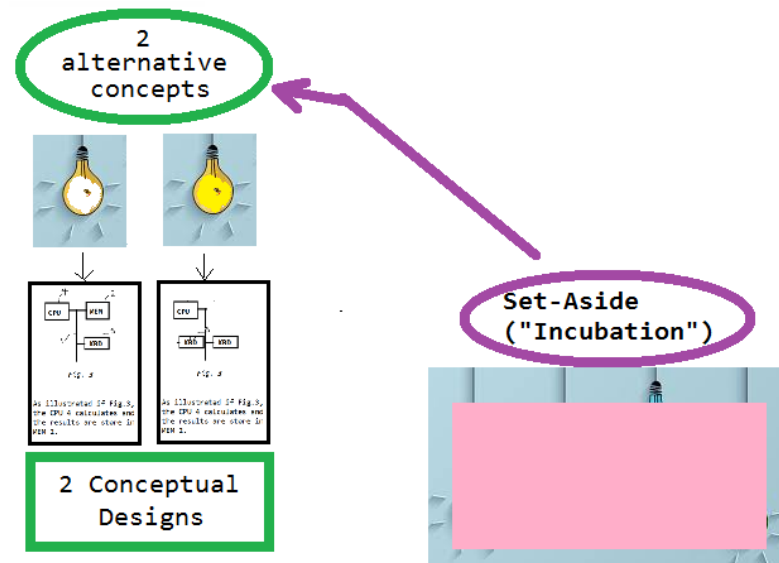
Set-Aside ("Incubation")

- **Step3 (Week 2): Selection of 2 best** Solution Designs
  - Develop into at least <u>2 team solution designs</u>
  - **<u>Describe with figures</u>** for <u>two (2) team solution designs</u>.

Timeline (Tentative)

Date	Activities
Week of Oct 8 - 12	Week 0: Individual Solution Generation and Ideation
Week of Oct 15 - 19	Week 1: Bring ALL individual ideas in to the team meeting
Week of Oct 22 – 26	Week 2: (1) Selection of 2 Top solution Designs (2) Analysis of Top 2 designs using decision matrix (3) Selection of the Top Solution Design
Week of Oct 29 – Nov 2	Week 3: Solution Design Description
M 11/5/2018	Week 4: Submission of the Solution Design Description
M 11/19/2018	Presentation of Solution Generation Process (including all the activities of week 0 – week 4)

Team Activity -- "Team Solution Design Generation"

- **Step 4 (Week 3):** Analysis of 2 Solution Designs and Selection of the Top Design Solution for the project
  - Top Design Selection is decision-making
  - Decision-making involves making trade-offs
    - The results of the analyses
    - Requirements from customer
    - Attribute Selection Criteria: which is more important in making decision?
  - **Decision Tool**
    - **Pros & Cons**
    - **Decision Matrix**

Selection of Top Designs

- iPhone vs Android Phone --- Example

Samsung I9300 Galaxy S III	Better? ← or →	Apple iPhone 5
4.8" screen	←	4.0" screen
4G LTE	← →	4G LTE
HD Super Amoled Display	→	Retina Display
1280 x 720 HD Resolution	←	1136 x 640 Resolution
Up to 790 hours standby time	←	Up to 225 hours standby time
Up to 11.4 hours talk time	←	Up to 8 hours talk time
Full HD 1080p video recording	← →	Full HD 1080p Video recording
4.7 oz weight	→	3.95 oz weight
2GB RAM	←	1GB RAM
S Voice	← →	Siri
16 or 32 fixed + up to 64GB expandable storage	←	16, 32, or 64GB fixed internal storage
Android 4.0 OS	NA	iOS 6.0 OS
Standard micro USB cable	←	Requires new accessories/adaptors
Removable battery	←	Camera: 8 megapixel,1.2MP front facing,
Camera: 8.0 megapixel, 1.9 MP front-facing,	←	Panoramic
Panoramic	←	

$ ← $$

Attributes

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Pros & Cons and Decision Matrix - Example

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

- Pros & Cons for the 3 cars
- Which car would you buy under the following two different weight scenarios (Choice of "Attributes")
  - You concerned about all four **attributes equally**.
  - You concerned about **cost** but fairly indifferent about **looks**.
  - Mileage and the mechanic's ratings are equally important for you.

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Solution Designs and Decision Making

An Example

SMART BACKPACK

- 2013 Intel-Cornell Cup "Honorable Mention" & 2013 23rd ECE Day 1st Place

Solution Design 1
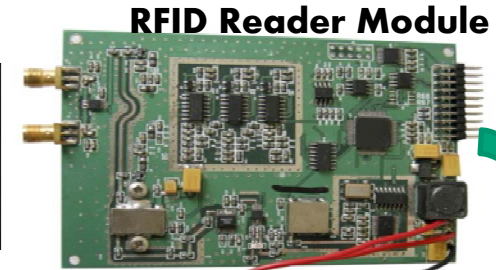
Smart Phone

Vibrating Motor

LCD Screen

Bluetooth

Wired

Pins

Arduino with Bluetooth shield

Sticker Tags

RFID Reader Module

Serial Connection

Wired

Intel Board with built in accelerometer

Solution Design 1: Pros and Cons

Pros	Cons
Convenient view/edit of schedule through smartphone	Interference with surrounding Wi-Fi using UHF tags and reader
Wireless connectivity through Bluetooth	Bluetooth battery consumption on the smartphone
Built in accelerometer to detect movement	Limited programming choice for application
Easy input and output connectivity through the Arduino	
Multiple notification (Smartphone, Vibrating motor, and LCD screen)	

Solution Design 2

RFID tags

RFID reader

Desktop/Laptop

WiFi

Serial Connection

Wired

LCD

Hello, world!
Ywrobot Arduino!
Arduino LCM IIC 2004
Power By Ec-yuan!

Wired

Actuator

intel® Atom™ *inside*™

Intel Board with built in accelerometer
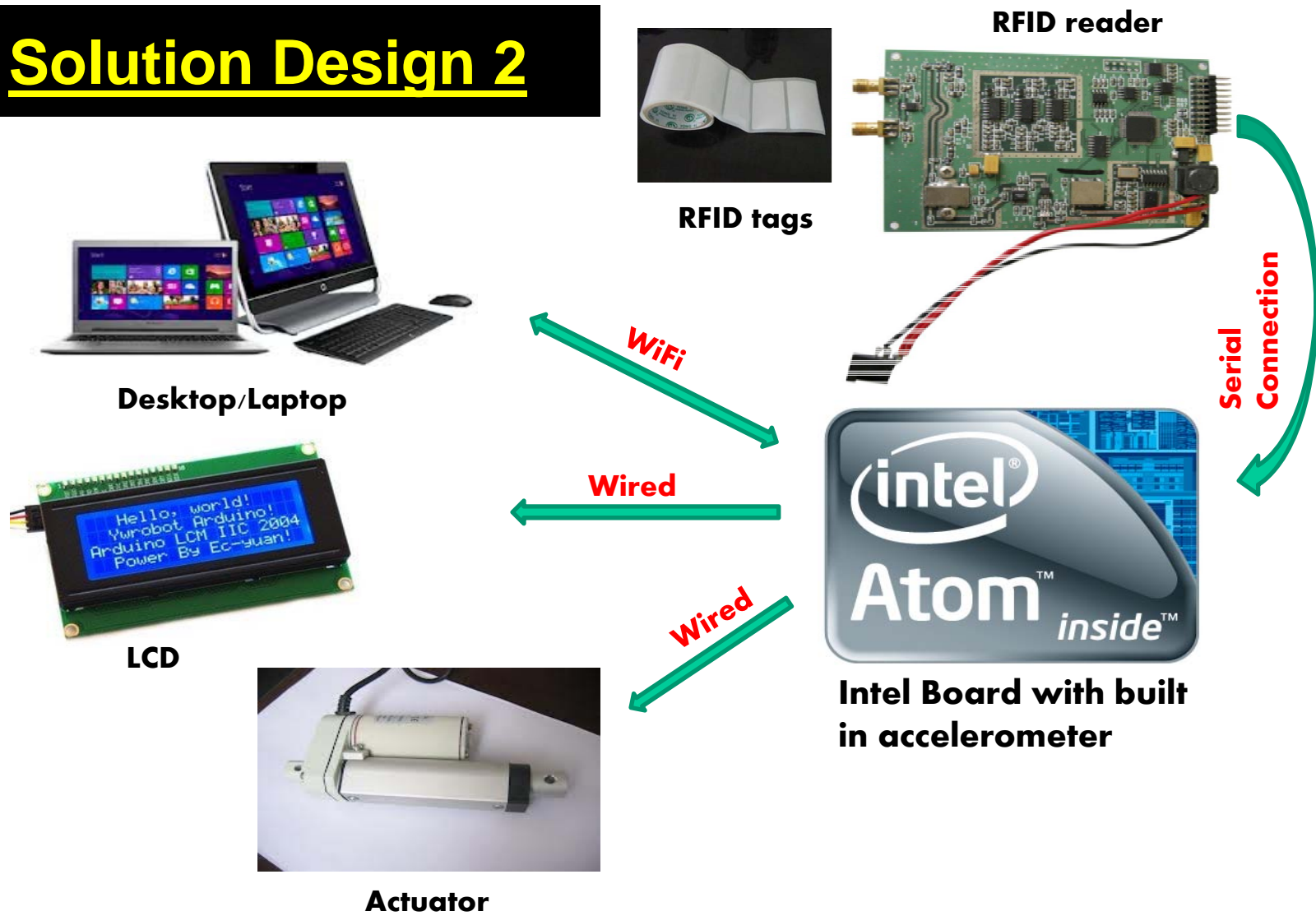
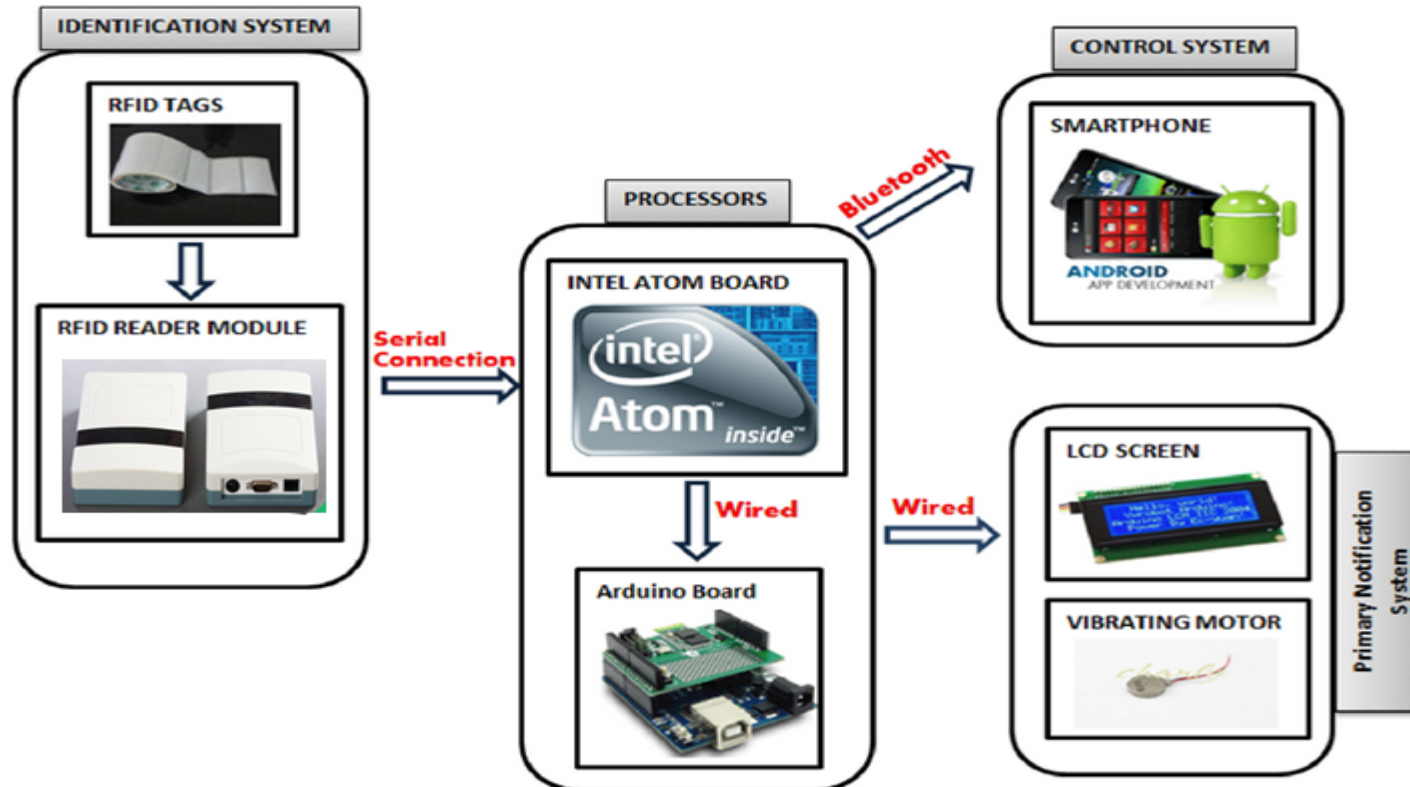# Solution Design 2: Pros and Cons

Pros	Cons
More choices of programming languages for the application development	Since the user's schedule is pulled from a calendar on the desktop, changes cannot be made on the go.
Using the built-in accelerometer reduces cost.	Mode of communication between the backpack and the CPU is limited to Wi-Fi.
Desktop computers are less susceptible to theft than smartphones.	Standard ports on the Intel board (USB ports, VGA ports)

Design Decision Matrix

	Weight	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

Final Solution Design

IDENTIFICATION SYSTEM
- RFID TAGS
- RFID READER MODULE

Serial Connection →

PROCESSORS
- INTEL ATOM BOARD
- intel Atom inside
- Wired ↓
- Arduino Board

Bluetooth →

CONTROL SYSTEM
- SMARTPHONE
- ANDROID APP DEVELOPMENT

Wired →

- LCD SCREEN
- VIBRATING MOTOR

Primary Notification System

Final Result

Timeline (Tentative)

Date	Activities
Week of Oct 8 - 12	Week 0: Individual Solution Generation and Ideation
Week of Oct 15 - 19	Week 1: Bring ALL individual ideas in to the team meeting
Week of Oct 22 – 26	Week 2: (1) Selection of 2 Top solution Designs (2) Analysis of Top 2 designs using decision matrix (3) Selection of the Top Solution Design
Week of Oct 29 – Nov 2	Week 3: Solution Design Description
M 11/5/2018	Week 4: Submission of the Solution Design Description
M 11/19/2018	Presentation of Solution Generation Process (including all the activities of week 0 – week 4)

- **Step 4 (week 4): Write <u>Solution Design Description</u>**

- **A good <u>Solution Design Description</u> should:**
  - Provide a <u>description</u> of a desired system which satisfies the design requirements
  - Provide <u>integrated ideas and concepts</u> about how the desired system behaves [functionality] and looks [aesthetics]
  - Use <u>drawings</u> and/or <u>models</u> and/or <u>proto-types</u>

How to write a solution design with description and figures?

"Solution Design Description" Examples from Patents

- **Learn from Patents for a good <u>solution design description</u>**
  - Follow <u>Patent Figures</u> and their <u>Descriptions using the Figures</u>
  - Use <u>different figure types</u> (for structure, logic diagram, flowchart, hardware, software, etc) to describe <u>different aspects of the concept(or idea)</u>
- **Examples**
  - Next slides (a lot of them) will show different ways **of (1) drawing figures** (for different purposes and different elements such as <u>structure</u>, <u>H/W</u>, <u>S/W,</u> <u>operation flow</u>, <u>network</u>, etc) and **of (2) describing the solution design using the figures**.

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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**.

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

30
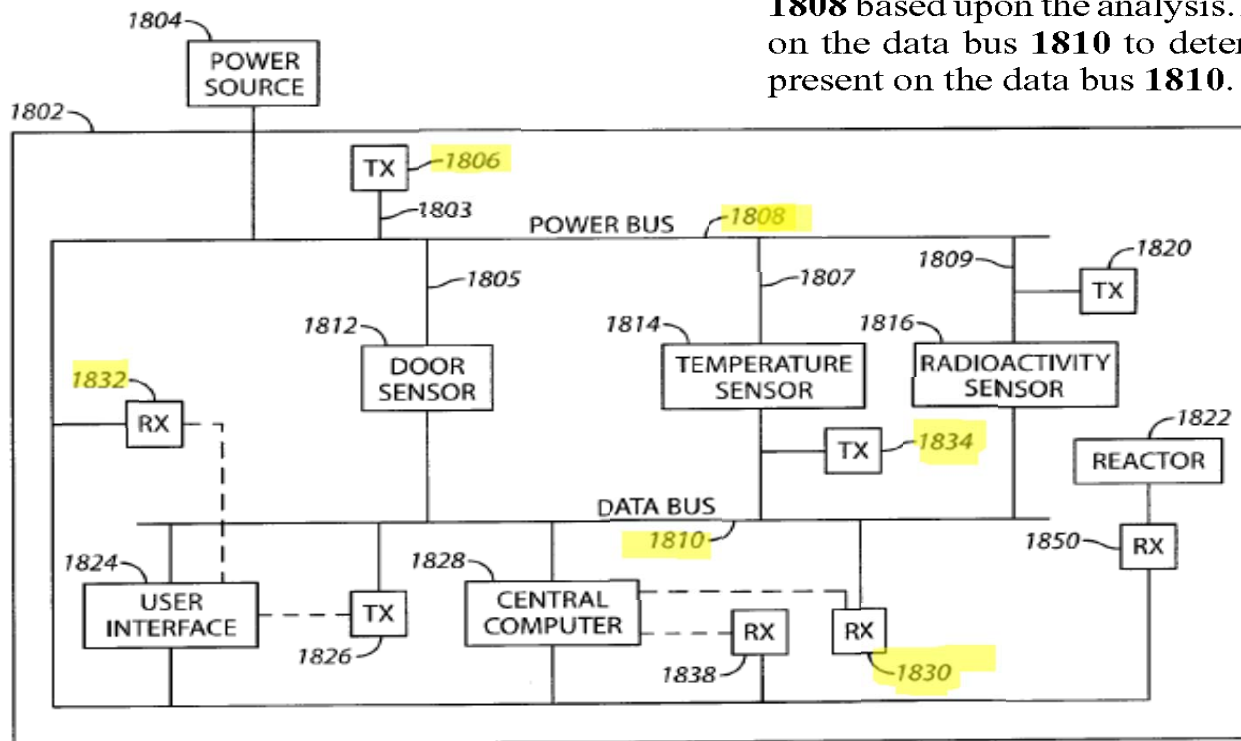
Solution Design Description- Examples

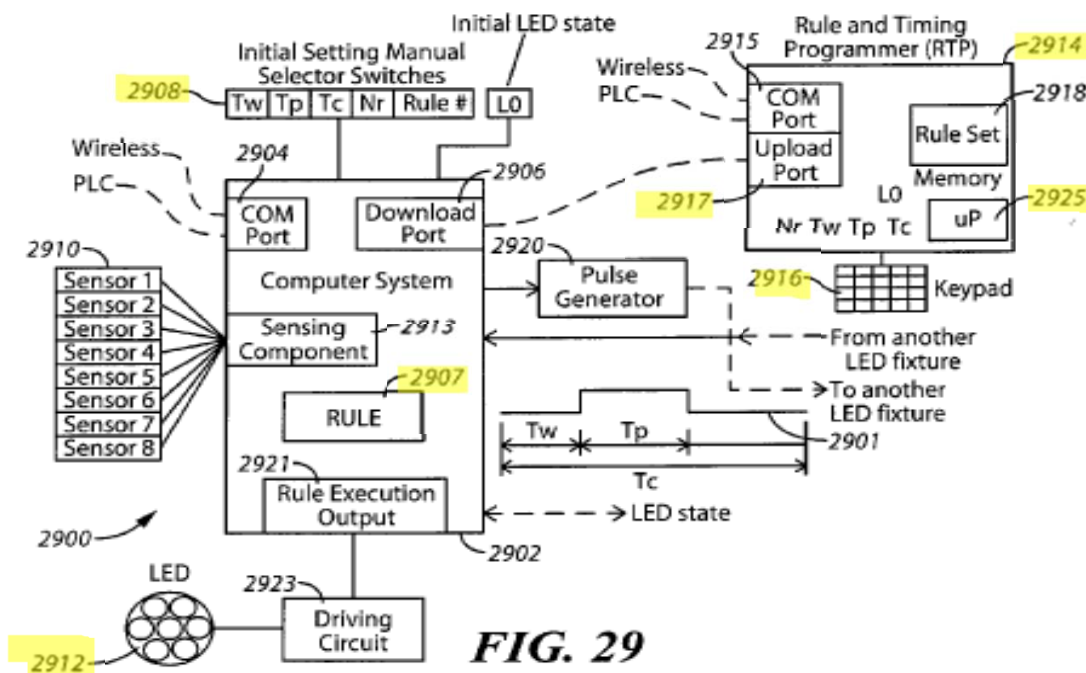- Evolving light patterns in the canvas of LEDs

FIG. 29

The initial items can be either determined by the manual selector switches **2908** separately placed in the LED fixture or by downloaded from a Rule and Timing Programmer (RTP) **2914**, a separate system not installed in LED fixture. The RTP **2914** includes a processor **2925** and can be realized by a computer system which is capable of wired communication downloading and wireless or PLC communication of the items needed in the LED fixtures that can be typed in by a keypad **2916** attached to the RTP **2914** or available in a memory **2918** inside the RTP **2914**. The RTP **2914** includes a COM port (to receive wireless or PLC data) and an upload port **2917** (to upload information to the download port **2906**). A rule **2907** is downloaded via COM port **2904**. The information from the sensors is processed by sensing components **2913**. A rule execution output **2921** (with instructions as to how to drive the LED **2912**) drives a driving circuit **2923** that converts the instructions to electrical signals to control the LED **2912**.

Another approach for initializing the items mentioned above, whether via manual selector switches **2908** or by RTP **2914**, is to obtain the row number (Nr) and a table of the row number and the timing pulse information for the row number, which is stored inside the memory of the controller and retrievable to the computer system, instead of reading them all separately. This alternative approach is advantageous if the initial setting values are to be downloaded or communicated from the RTP **2914**.
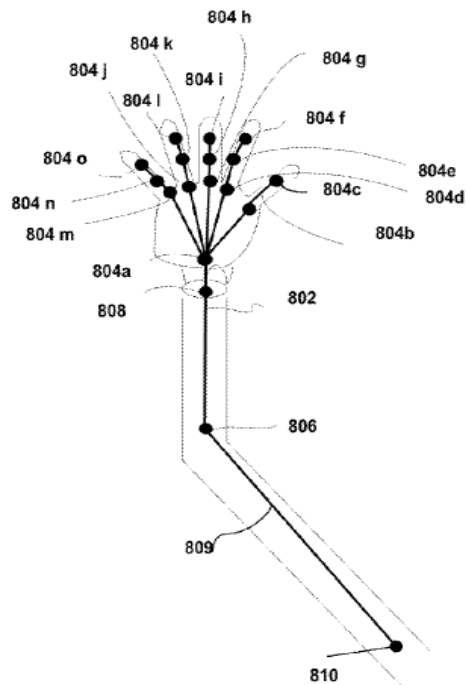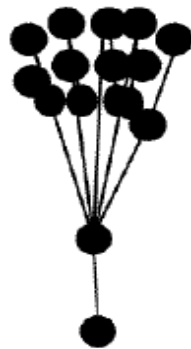
31

Sign Language Interpreter
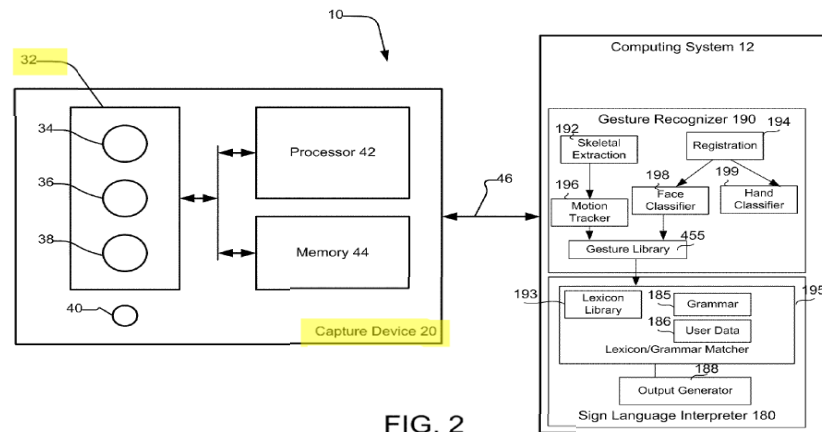
FIG. 1B

FIG. 10D

FIG. 2

As shown in FIG. 2, the capture device 20 may include an image camera component 32. According to an example embodiment, the image camera component 32 may be a depth camera that may capture the depth image of a scene. The depth image may include a two-dimensional (2-D) pixel area of the captured scene where each pixel in the 2-D pixel area may represent a depth value such as a length or distance in, for example, centimeters, millimeters, or the like of an object in the captured scene from the camera.

Solution Design Description – "How To"

- **1.In figure**, each component in a figure must have a number (marked by a number).

- 2. If the <u>component </u>is used in another figure, the component should keep the same number.

- 3. A **process is also** to be described in detail the process <u>numbered</u>.

- 4**. In description**, whenever a numbered component/process is used, the named component/process must be followed by the component/process number.

- 5. **Description must be <u>narrative</u>** - **not** bullet itemized. **Complete sentences** and paragraphs are to be used as in technical paper or essay.
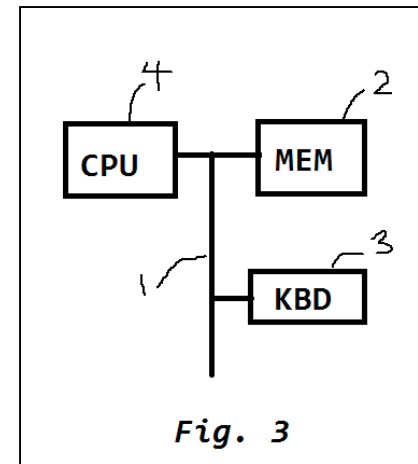

Fig. 3

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

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Solution Design Description- Practice

- 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.
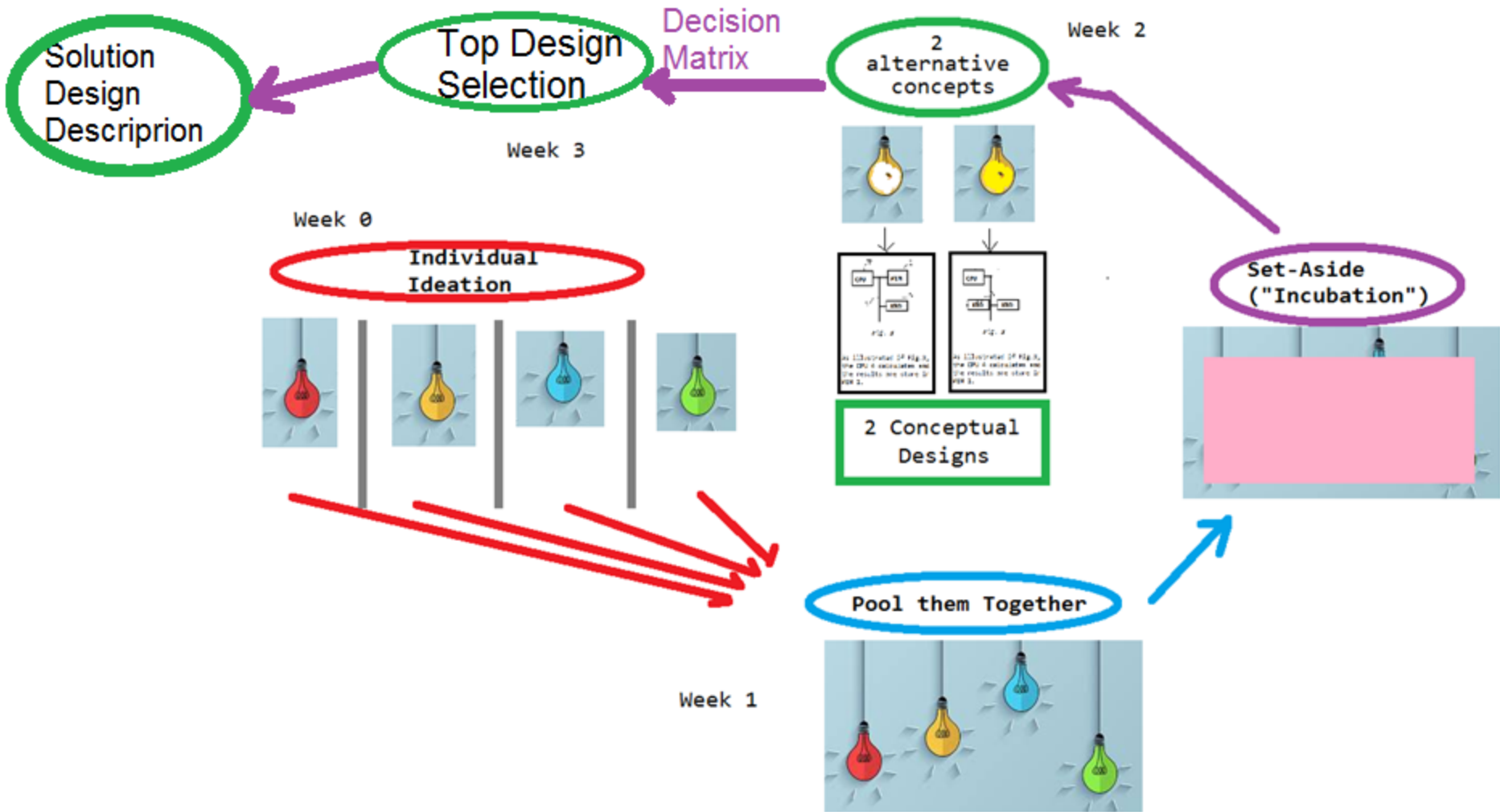
[0051] The DSP **120** is designed to send user interface information I, e.g. apparatus control data ac, to an identified apparatus. E.g. user **100** can point the pointing device **101** to light **160** and push an on-button on the pointing device **101**, which results in the DSP **120** sending 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

34
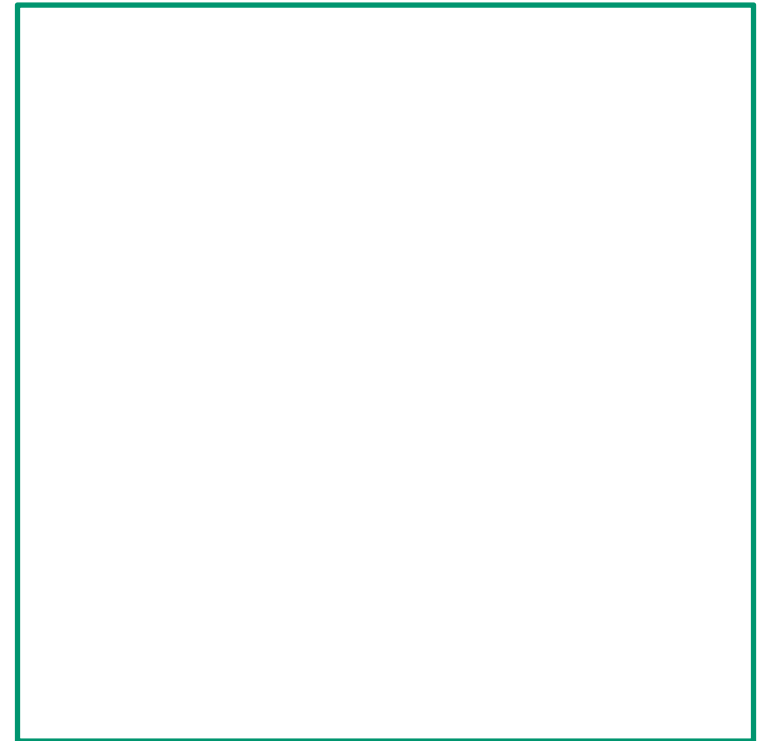
Team Activity -- "Team Solution Design Generation"

- **Step 5 (week 5): Submission of <u>Report on Solution Design Description</u>**
  - Section 1: Copy of ALL initial individual solution designs (Scanned images inserted in the main body of the report)
  - Section 2: Description of Top 2 designs wit Pros & Cons
  - Section 3: Decision Matrix for Top Design Selection
  - Section 4: Solution Design Description for the Top Design

Recap: Team Solution Generation Process

Solution Design Descriprion

Top Design Selection

Week 3

Decision Matrix

2 alternative concepts

Week 2

Set-Aside ("Incubation")

Week 0

Individual Ideation

2 Conceptual Designs

Pool them Together

Week 1

Timeline (Tentative)

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