

# Agenda

## 10 min: Project Overview

- **Introduction**
  - Intro Team
  - Intro Agenda
    - ◆ Agenda (DOC)
  - Intro Project
    - ◆ 1-Page Project Summary (DOC)
    - ◆ QFD (XLS)
  - Outline Subsystems to cover
    - ◆ Functional Block Diagram (VIS)
    - ◆ Critical Subfunctions (XLS)
    - ◆ Refer to: Concept Generation (XLS)

## 40 min: Functional Groups

- **Software Interface** (15 min)
  - Led by: Salim & Ryan & Travis
    - ◆ Software Interface (PPT)
    - ◆ Computer Presentation
  - Discussion with Panelists
- **Hardware** (15 min)
  - PCB, led by: Jeff
    - ◆ PC104 Product Comparison (XLS)
  - Discussion with Panelists
- **Software Coding** (5 min)
  - Led by: Suesie
  - Discussion with Panelists
- **Other notes** (5 min)
  - Battery: George
    - ◆ Power Components (XLS)
  - Touchscreen: Travis
  - Casing: Ryan
    - ◆ Thermal Analysis (DOC)
  - *Brief* discussion with Panelists

## 10 min: Wrap-up

- **Budget & BOM**
  - Led by: Ryan
    - ◆ Budget options & risks (XLS)
- **Next Steps**
  - Led by: Ryan
    - ◆ 11-Week Schedule (MPP)

## Senior Design Project Data Sheet

Project #	Project Name	Project Track	Project Family
P07001	ARC Communication Board	Assistive Devices	Bioengineering
Start Term	Team Guide	Project Sponsor	Doc. Revision
2006-1	Dr. E. DeBartolo	NSF	0

### Project Description

#### **Project Background:**

The ARC Communication Board project will be driven by motivation.

- Motivation: To improve an individual's quality of life and ability to communicate
- Past projects: P06206 – Wheelchair Tray, P06201: Modified Home Entry, P06202 – Adapted Computer Keyboard, P06205 – Standing Table
- Related Projects: P07002 – Two Way Communication Board, P07003 – Mobile Camera Control System, P07004 – Mobile Camera Positioning Platform

#### **Problem Statement:**

To design and manufacture an intuitive picture-based communication system for an individual with limited verbal and spelling capabilities. This device will serve a purpose to improve the quality of life by allowing the individual to express his/her needs.

#### **Objectives/Scope:**

1. Development of design of a robust, durable embedded system with touch input, audio output, reconfigurable image display and rechargeable battery based power supply to facilitate user interface with individual and caregiver that include control by individual as well as configuration by caregiver such as figures that will be displayed, volume control, and activation enable.
2. The individual will be able to easily express his/her needs on a daily basis.
3. The device should fit to a securing mechanism on the wheelchair tray and be conveniently stored away by the staff.
4. The battery based power supply should be able to run during the entire day at the ARC without recharging.
5. Long-term goal is for the individual to become more independent.
6. The final product should be robust, durable, waterproof, user-friendly and upgradeable.
7. Customer satisfaction is key.

#### **Deliverables:**

- Communication board
- User's manual
- Complete documentation regarding design, implementation, testing, & maintenance.

#### **Expected Project Benefits:**

- In completion to the Senior Design Project, the final product will be applied to improve the individual's quality of life, serving an improved solution to her current communication methods.
- During the process of product development, many new techniques will be learned by the team & design skills will be strengthened.
- The project will help to see how engineering coursework can be applied to translate consumer needs into a practical application.

#### **Core Team Members:**

- Ryan Larcom – ME (Project Leader)
- George Shieh – EE (Lead Engineer)
- Travis Driscoll – EE
- Jeff Park – EE
- Suesie Kim – EE
- Salim Maani – IE

### Strategy & Approach

#### **Assumptions & Constraints:**

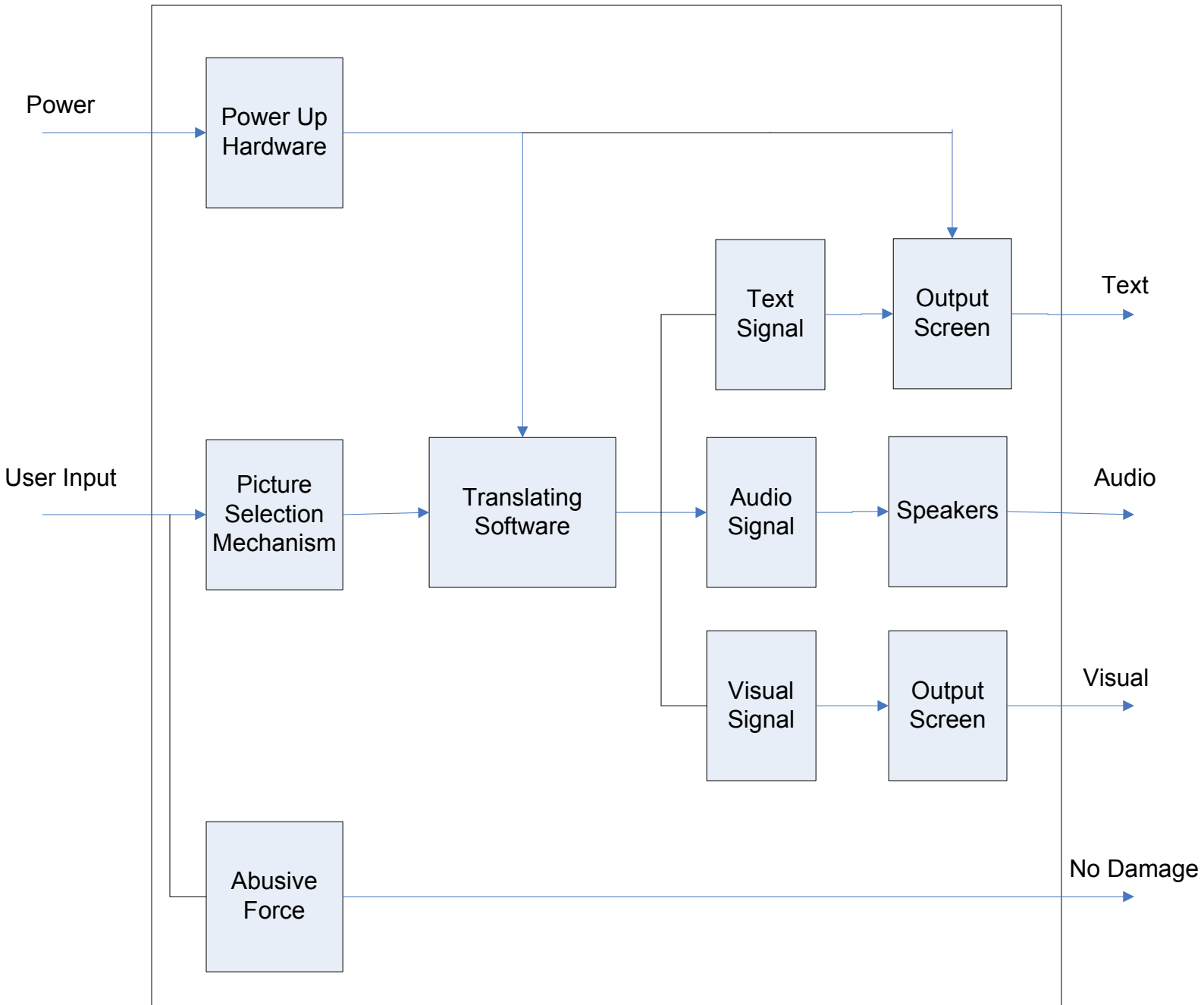
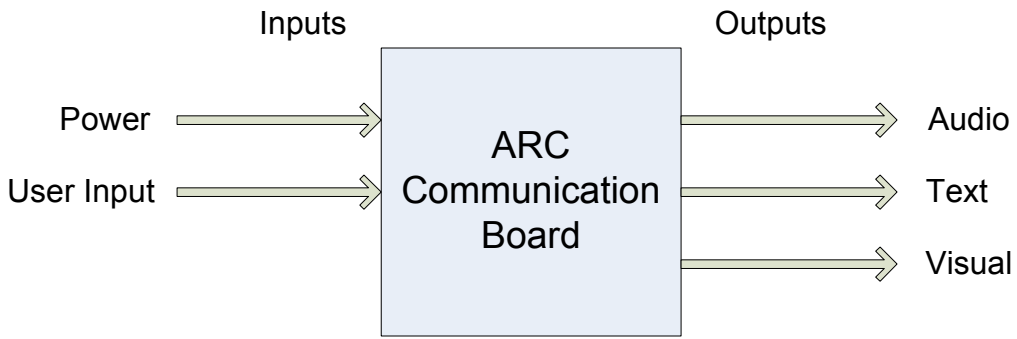
1. The objective (as well as the many possible solutions) make this project very ambitious.
2. Must stay within budget.
3. Power consumption by the communication board to allow 16-18 hour usage per day.
4. Failure analysis is crucial based on the user's interaction with the product.
5. A development of embedded software is a major part of this project.

#### **Issues & Risks:**

- No one on the team has a strong programming background so learning the desired language/software will be required.
- Much research must be completed on the power supply and recharging system.
- The choice of a "good" PCB early on in the project will be crucial.



# ARC Functional Block Diagram



**CRITICAL SUB-FUNCTIONS**

	<b>SOLUTION</b>	<b>JUSTIFICATION</b>	<b>OBSTACLES</b>	<b>List of Documents for first Review</b>
<b>EMBEDDED HARDWARE</b>	Embedian EBC-7050 (includes APC-7115)	<ol style="list-style-type: none"> <li>1. Affordable</li> <li>2. VGA with its own memory</li> <li>3. Has touch panel interface</li> <li>4. AC97 Compliant</li> <li>5. Debian ARM Linux included</li> <li>6. Specs meet requirements</li> </ol>	<ol style="list-style-type: none"> <li>1. Need to cross-compile on x86 Host for ARM Target</li> <li>2. Must find matching LVDS connector</li> <li>3. Downloading to target</li> </ol>	<ol style="list-style-type: none"> <li>1. PC/104 Comparison Spreadsheet</li> <li>2. Embedian APC-7115 Spec Sheet or Summary</li> </ol>
<b>EMBEDDED OS</b>	Debian GNU/Linux OS	<ol style="list-style-type: none"> <li>1. Free</li> <li>2. Open Source</li> <li>3. Uniformity with other SD groups</li> </ol>	<ol style="list-style-type: none"> <li>1. Unfamiliar with Linux</li> </ol>	
<b>SOFTWARE CODING</b>	▪ Apache Web Server with PHP as scripting language	<ol style="list-style-type: none"> <li>1. Ease of implementation</li> <li>2. Widely used</li> </ol>	Three solutions are currently being compared to determine best option.	
	▪ Tcl with TK toolkit	<ol style="list-style-type: none"> <li>1. Excellent tool for GUI application</li> </ol>		
	▪ QT	<ol style="list-style-type: none"> <li>1. Used for GUI development</li> </ol>		
<b>BATTERY-BASED RECHARGEABLE POWER SUPPLY DESIGN</b>	<ol style="list-style-type: none"> <li>1) 7.4V Lithium Ion Battery Pack</li> <li>2) DC-DC Converter</li> <li>3) Power Transformer (Charger)</li> </ol>	Initial comparison based on Dynavox DV4 (7.4V @ 13.2Ah) Need to Step DC power up to 12V due to LCD.	<ol style="list-style-type: none"> <li>1. Need to assemble battery pack</li> <li>2. Weight and size constraints</li> <li>3. Safety (circuit protection)</li> <li>4. Charging/Discharging circuit</li> </ol>	<ol style="list-style-type: none"> <li>1. Battery Spreadsheet</li> </ol>

## CONCEPT GENERATION

	SOLUTION	Notes
<b>Battery/Power</b>	Internal Battery: Last whole time (with Sleep Mode)	
	Changeable (multiple)	
	AC power (plug)	
	External (backpane)	
	Run off the wheelchair	
	Capacitive Batteries	
	Hamster Wheel	
	Solar	
	Diesel	
	Hydro	
	Wind	
	Pedal-driven	
<b>Menu/Interface</b>	Touchscreen	Refer to ME Concept Sketches
	Joystick	
	Buttons (fast-access)	
	Keyboard	
	Mouse: Optical	
	Trackball	
	Laser	
	Voice	
<b>Software</b>	Operating System: Linux/Unix	
	DOS/Windows	
	Microcontroller: BASIC Stamp	
	Web server: Apache	
	Programming Language: PHP	Programmer's choice
	Tcl	
	QT	
	C++ Java	
<b>Safety Features</b>	Deal with heat: Fan and sink	Ryan can do ANSYS analysis
	Rubbermaid	
	Plastic-cover: waterproof, no seams	Refer to ME Concept Sketches
	Rubber/squishy - gel pad	Gel leakage?
	No sharp corners	
	Leash: bungee cord	
	Screw on, clamp on, velcro on, hinge-latch	
	Carbon-fiber	
	Metal-covered	
	Magnet Attachment	Effect on components?
	Teflon covering	



# ARC Communication Device

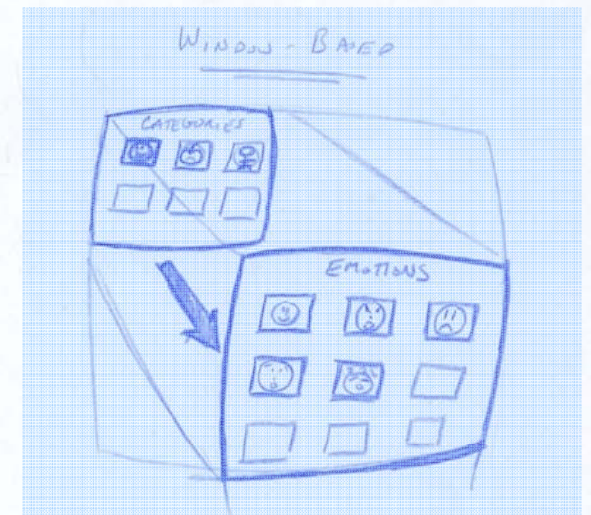
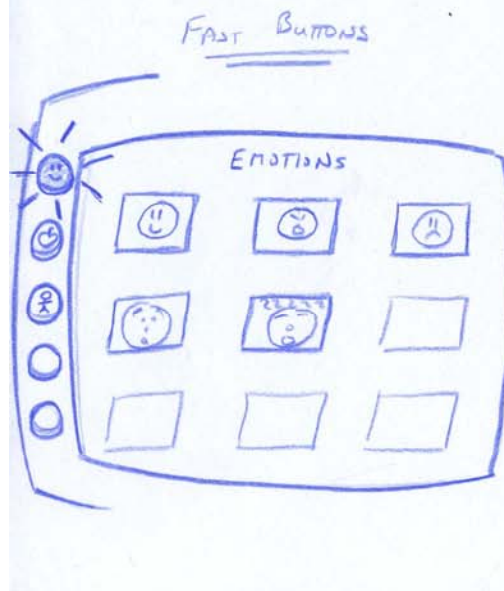
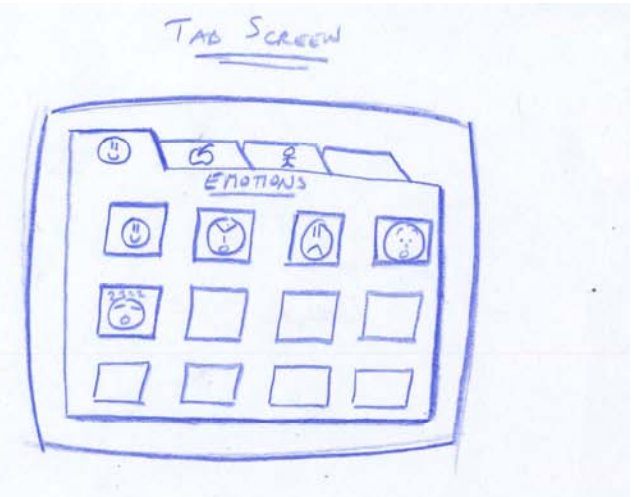
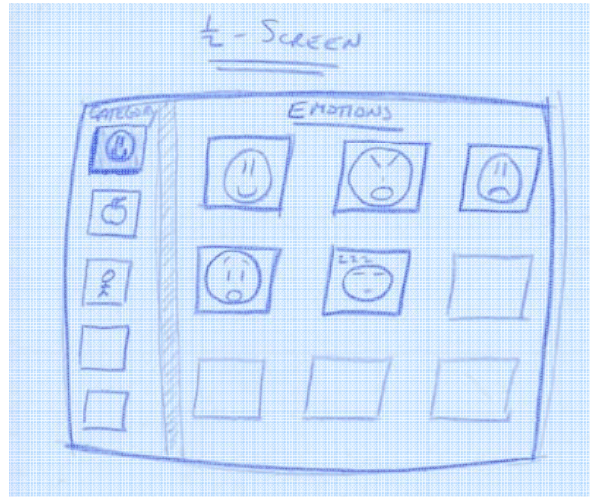
## Software Concepts & Development

Prepared by:

Salim Maani, ISE & Ryan Larcom, ME

# Software Concepts

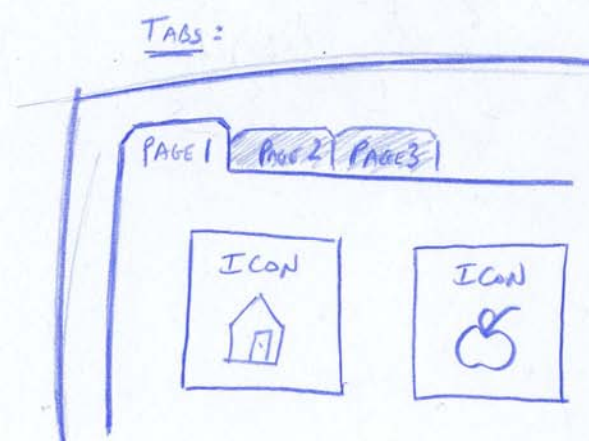
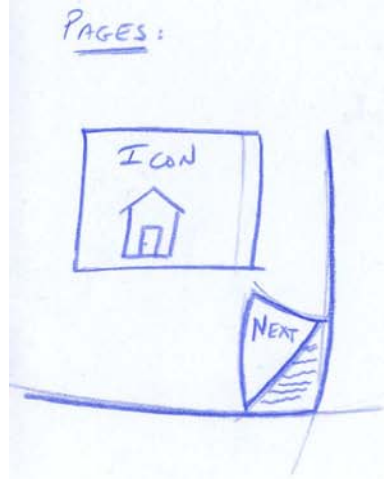
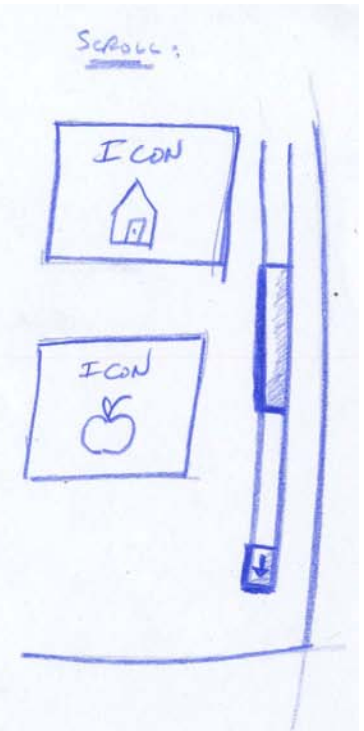
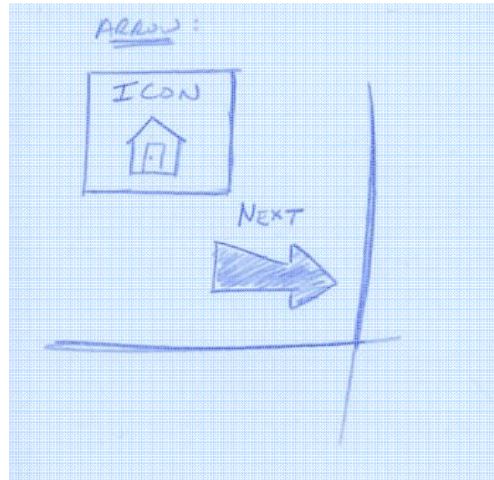
## GUI Concepts





# Software Concepts

## Navigation Concepts



# Summary of Software Concepts

- Feedback from ARC

- Like as much on screen as possible → minimize # of buttons
- Easy-access “Help” button → voice (“I need help”) & light
- Most-used category?
- Special FX: lights, sounds, MIDI files, piano software?

# Software Concept Development

## Based on ARC's feedback:

- Design two different interface flow set up.
  - Use Mayor-Johnson symbols (MS Visio file)
  - **Option 1:** Web page navigation – “forward” & “backward” arrows
  - **Option 2:** Tabbed navigation – tabs on corner open folder of interest in center
- Heuristics evaluation
  - Survey average individuals' ability to use the program
  - Count the number of errors/time to complete an action
  - Two variable t-test
- Conclusions

# Software Concept Development

## Concepts #1 – Web Navigation

### Front Screen

- Contains folders
- Selecting a folder opens new window

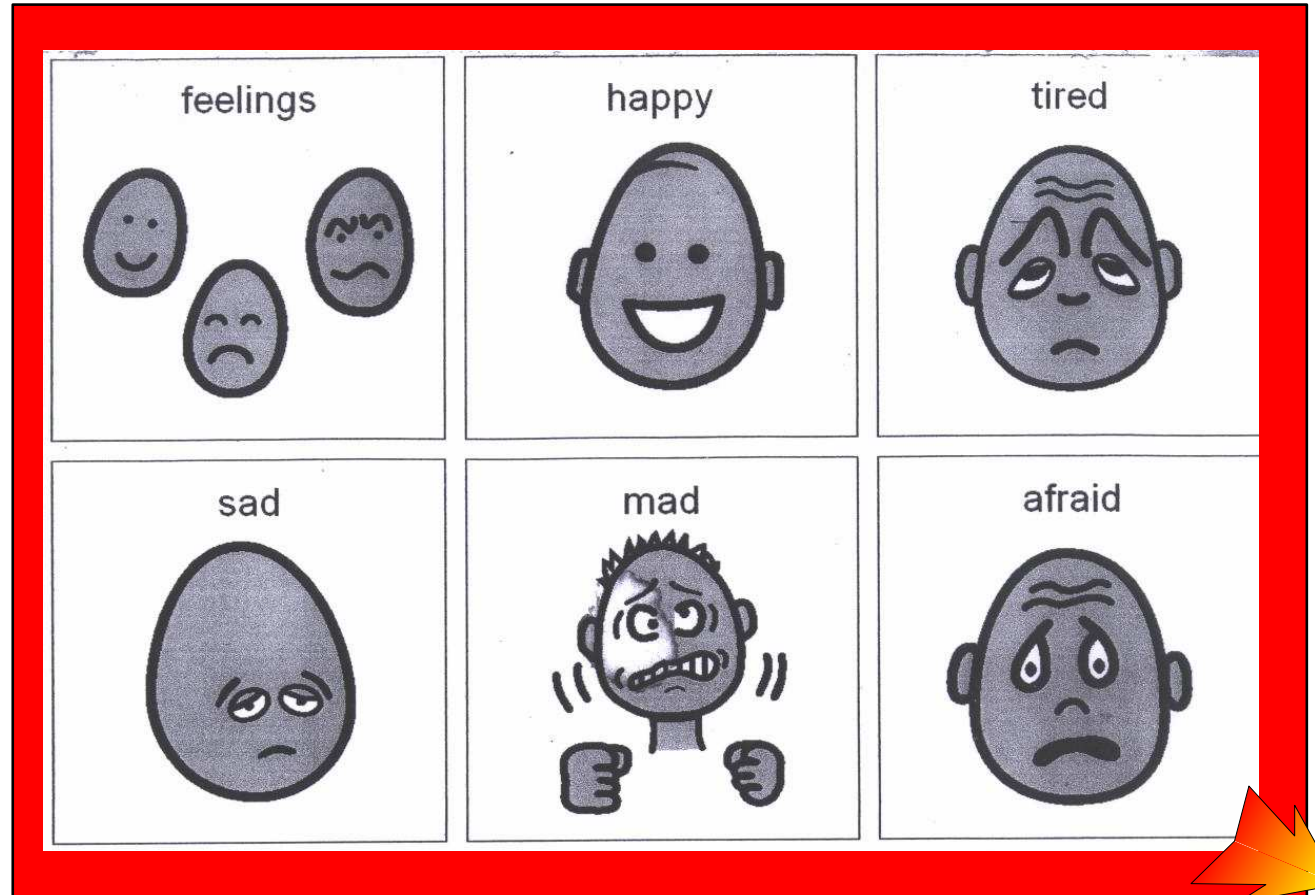


# Software Concept Development

## Concepts #1 – Web Navigation

### Emotions Menu

- Contains emotions
- Select an emotion
- Hit next arrow to go to next screen of icons

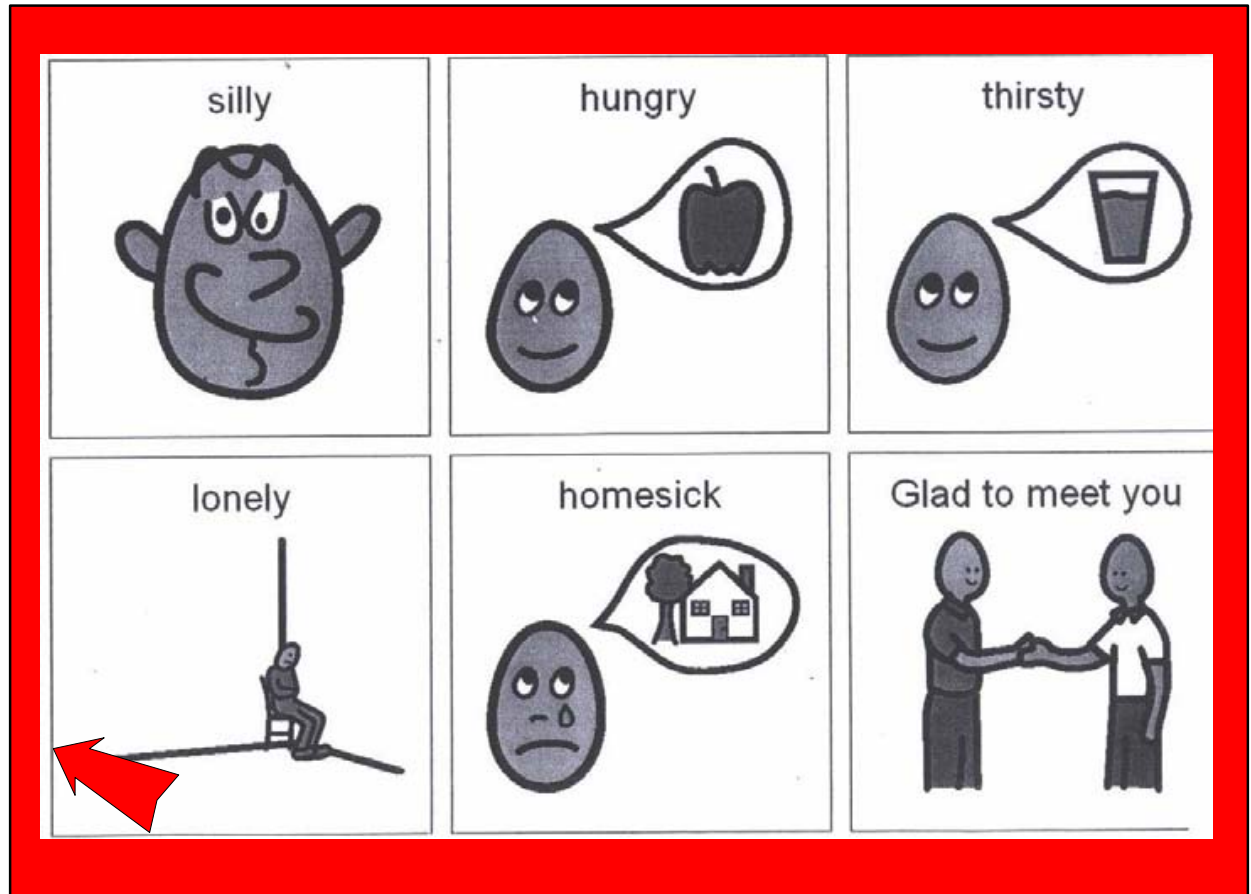


# Software Concept Development

## Concepts #1 – Web Navigation

### Emotions Menu continued

- Contains emotions
- Select an emotion
- Hit back arrow to go to last screen of icons

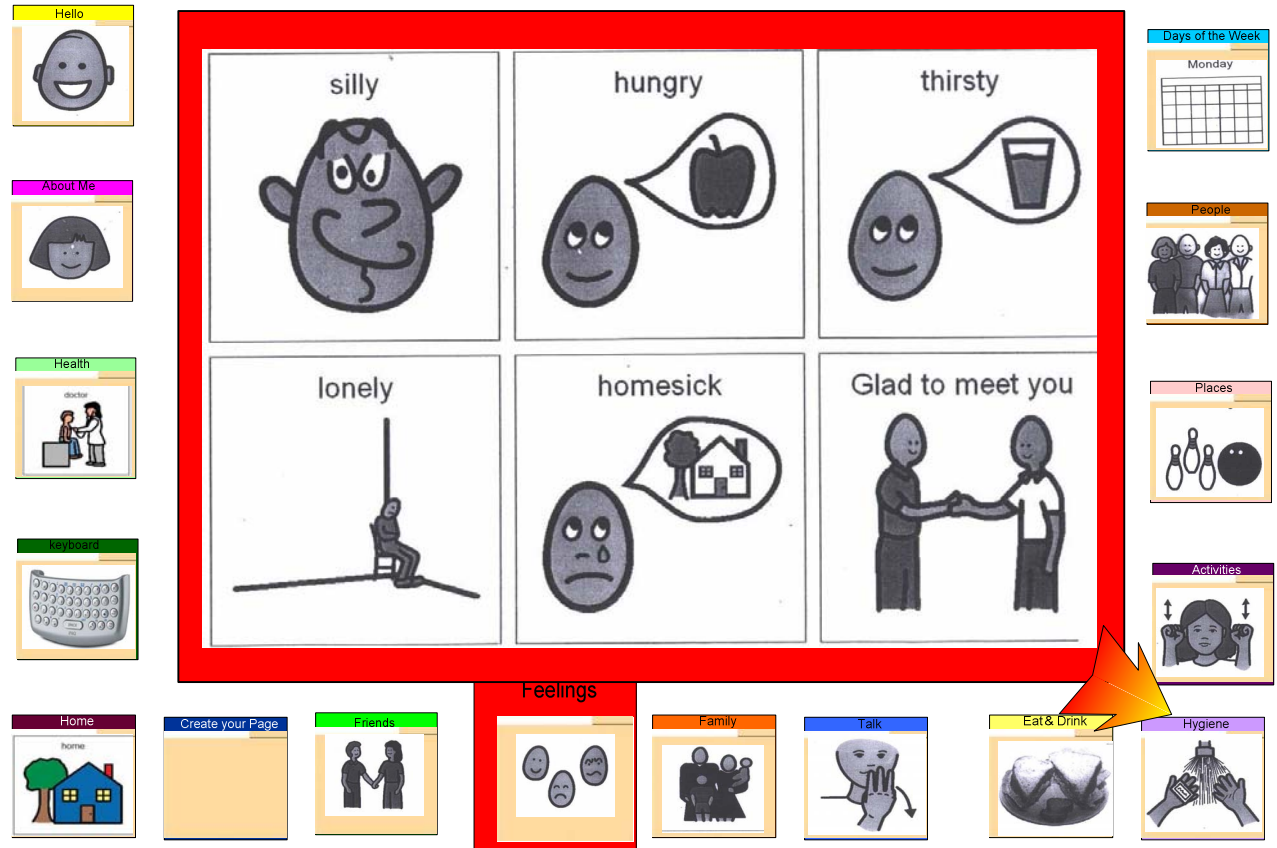


# Software Concept Development

## Concepts #2 – Tab Navigation

### Front Page

- Contains category tabs
- Select a tab to view category
- Hit next arrow to go to next screen of icons



# Software Concept Development

## Concepts #2 – Tab Navigation

### Next Page

- STILL contains category tabs
- Hit back arrow to go to last screen of icons
- Select another tab to view category





PC/104 List (revised 10/18/2006)

Requirements: Display, (LCD), Touchscreen, Voice output, Loger usable duration, size

Company	Emac	Embedian	Embedian	CompuLab	Advanced Digital Logic	Compulab	NorhTec	Versallogic	Technologic Systems
<b>Model</b>	PCM-9371	APC-7115	<b>EBC-7050</b>	SBC-X270	MSM800SVD	SBC-X255	MicroClient Jr.	Lynx EPM-4	TS-7300
<b>PC/104/PC104+</b>	SBC/PC/104	SBC	<b>SBC</b>	PC104+ (opt)	PC104+(opt)	PC104+	SBC	PC/104+	PC104
<b>CPU Type</b>	ULV Celeron	ARM920T	<b>ARM920T</b>	PXA270	AMD Geode LX800	PXA255	SiS550 SoC	586	ARM9
<b>CPU [MHz]</b>	400	400	<b>400</b>	520	500	400	200	133	200
<b>RAM [MB]</b>	Upto 512 (add)	128	<b>128</b>	128 (addition)	128-1024 (addition)	64	128	64	32-128 (addition)
<b>Bus Speed [MHz]</b>	100/133	133	<b>133</b>	100	333	100	?	66	"High speed"
<b>Flash Disk [MB]</b>	?	.5 NOR/ 32 NAND	<b>.5 NOR/ 32 NAND</b>	512	None	4 NOR/128 NAND	?	?	8mb Strata Flash
<b>SD Flash Socket</b>	No	NO	<b>NO</b>	NO	NO	NONE	No	NO	NO
<b>Comp. Flash Socket</b>	Yes	YES	<b>YES</b>	YES	OPTION	OPTION	Yes	YES	YES
<b>VGA Graphics Controller Support</b>	LCD/CRT	TTL/LVDS/CRT	<b>TTL/LVDS/CRT</b>	LCD and CRT	LCD	TFT LCD	D-Sub 15-pin VGA connector	NO	LCD
<b>VGA Graphics Res.</b>	1280x1024 (upto 32MB shared)	Upto 1280x1024 (8MB)	<b>Upto 1280x1024 (8MB)</b>	1280x1024	1600 x 1200	UPTO 1024x768	?	Need Module 1024 x 768	VGA/LCD Video Out
<b>Linux OS Support</b>	YES	YES	<b>YES</b>	YES	YES	YES	YES	YES	YES
<b>Sound</b>	AC97 ver 2.0 compliant	AC97 Codec	<b>AC97 Codec</b>	Audio Codec In and Out	Audio Codec In and Out	AC97/AMC97 REV2.1 COMP	AC97 codec compliant 2.1	?	NO
<b>USB Port</b>	2	4	<b>4</b>	4	4	3	3	4	2
<b>Touchscreen</b>	No	YES	<b>YES</b>	YES	YES	YES	No	?	NO
<b>Size</b>	145 x 102 mm	102 x 145 mm	<b>210 x 110 x 45 mm</b>	Front panel - 111 x 91 mm	95 x 90 mm	96mm x 91 mm	115 x 115 x 35 mm	3.55"x3.775"	97 x115 mm
<b>Cost</b>	\$343	\$189	<b>\$309</b>	?	\$413	\$484	\$120 (Dev Kit)	\$475	\$219
<b>Your Name</b>	S. Kim	J. Park	<b>J. Park</b>	S. Kim	J. Park	J. Park	J. Park	G. Shieh	S. Kim
<b>Additional Items needed</b>	CF card, RAM	CF Card	<b>**Includes: 12V/2A Pwr adapter, ethernet cable, usb cable, mounting kit.</b>	Comp. Flash Card with Socket	Comp. Flash Card with Socket	Need to add CM-X255, CF socket	CF card,	Need EPM-VID-3 for video ouput. Comp. Flash Card	Comp. Flash Card

? : Not enough Data

Links

- Versallogic <http://www.versallogic.com/private/lynxsupport.asp>
- Technologic Systems <http://www.embeddedARM.com>
- Emac <http://EmacINC.com>
- Arcom [www.arcom.com](http://www.arcom.com)
- Advanced Digital Log [www.adlogic.com](http://www.adlogic.com)
- CompuLab <http://www.compulab.co.il>
- Embedian [www.embedian.com](http://www.embedian.com)
- NorhTec [www.norhtec.com](http://www.norhtec.com)

### Maxim DC-DC Converters

Part Number	Description	V <sub>in</sub> (min) (V)	V <sub>in</sub> (max) (V)	Preset V <sub>out</sub> (V)	V <sub>out</sub> (min) (V)	V <sub>out</sub> (max) (V)	I <sub>cc</sub> (max) (mA)
MAX1621	Digitally Adjustable LCD Bias Supply with SMBus Serial Interface	1.8	20	-	-20	20	0.25
MAX1620	Digitally Adjustable LCD Bias Supply	1.8	20	-	-20	20	0.25
MAX1771	12V or Adjustable, High-Efficiency, Low IQ, Step-Up DC-DC Controller	2	16.5	12	2	16.5	0.11
MAX618	5V or Adjustable, Step-Up DC-DC Converter	3	28	12	-	28	0.5
MAX734	12V, 120mA Flash Memory Programming Supply	3	12	12	-	-	2.5
MAX642	12V/Adjustable, 10W, CMOS, Step-Up, Switching Regulator Controller	1.5	16.5	12	1.5	16.5	2
MAX632	12V/Adjustable, CMOS, Step-Up Switching Regulator	2	16.5	12	2	16.5	2
MAX773	5V/12V/15V/Adjustable, High-Voltage, High-Efficiency, Low IQ	3	16.5	12	1.5	16.5	0.11
MAX771	12V/Adjustable, High-Efficiency, Low IQ, Step-Up DC-DC Controller	2	16.5	12	1.5	16.5	0.11
MAX761	12V/Adjustable, High-Efficiency, Low IQ, Step-Up DC-DC Converter	1.7	16.5	12	5	16.5	0.15
MAX732	12V, Step-Up, Current-Mode, PWM DC-DC Converter	4	9.3	12	-	-	0.3

### Lithium Ion Batteries

Company	Model	Type	Avg Voltage (V)	Nom. Capacity (Ah)	Quantity	Total	Total Weight (grams)
"Benchmark"	"DynaVox DV4"	Cylindrical	3.7	2.2	12	7.4V @ 13.2Ah	
Ultralife	UBP103459/PCM	Prismatic	3.7	1.7	12	7.4V @ 10.2Ah	492
Ultralife	UBBL07	3 Cylindrical Pack	3.7	6.1	4	7.4V @ 12.2Ah	640
Ultralife	UBBL04	Block	7.2	6.5	2	7.2V @ 13.0Ah	700
Panasonic	CGR18650	Cylindrical	7.2	2.55	12	7.2V @ 15.3Ah	558

### Power Transformer (Charger)

Benchmark: AC 100-240 V 1.0 A 50/60 HZ DC 12 V 3A □

+5V regulator to power Embedian APC-7115

## Thermal Analysis

### Parts:

#### **IBM 15" LCD Monitor**

55A 15.0-inch TFT LCD Color Monitor (9513) – Overview [1" bigger than ours]

*Power requirements:*

- Heat dissipation (Maximum): 136 Btu/hr (39.86W)
- Temperature: 10-35°C

Source: <http://www-307.ibm.com/pc/support/site.wss/document.do?sitestyle=lenovo&Indocid=VLAR-3WUK4Y>

#### **Embedian ARM9 APC-7115 PCB**

*Power requirements:*

- Consumes 3W → Max dissipation = 3W
- Acceptable running temperature: 0-70°C

Source: Email from Eric Lee, Embedian Inc.

#### **Batteries**

Negligible heating (source of power, not a resistance to it)

**A BASIC THERMAL ANALYSIS WILL BE DONE HERE IN TIME FOR THE MEETING ON FRIDAY**

### 07001 Prelim Budget/BOM

	Worst Case	Likely Case	Awesome Case
Battery	200	100	100
LCD/Touchscreen	400	300	0
Casing	400	300	200
PC104	350	350	350
<b>TOTAL</b>	<b>1350</b>	<b>1050</b>	<b>650</b>

Ouch!

Phew!

Yay!

ID	Task Name	Duration	Gantt Chart (Days)																											
1	Start of Fall Quarter	0 days	9/4																											
2	Project Selection	3 days	DPM																											
3	<b>Workshop 1: Know the Customer &amp; Your Team</b>	<b>0.97 days</b>	Team																											
4	Course Logistics	45 mins	Faculty Lead																											
5	Ice Breaker	45 mins	Faculty Lead																											
6	Project Background	30 mins	DPM																											
7	Project Planning	1.25 hrs	DPM																											
8	Break	1.75 hrs	DPM																											
9	Needs Assessment Exercises/Tours	1.5 hrs	DPM																											
10	Needs Assessment mini-Workshop	1 hr	DPM																											
11	Create Day's Summary	30 mins	DPM																											
12	5-Minute Project Updates	30 mins	DPM																											
13	<b>Needs Development</b>	<b>3 days</b>	Jeff																											
14	Update Website	1 day	Ryan																											
15	Roles & Responsibilities Worksheet	1 day	Ryan																											
16	3-week Plan	1 day	Suesie																											
17	1-page Project Description (1st draft)	1 day	Travis																											
18	Benchmark Existing Products	1 day	George																											
19	Prep interview questions	1 day	Team																											
20	Visit ARC	1 day	Team																											
21	Meet with Prof. DeBartolo	1 day	Team																											
22	<b>Workshop 2: Translating Needs to Specifications</b>	<b>0.94 days</b>	Team																											
23	Workshop Overview	30 mins	Team																											
24	Translating Customer Needs to Specifications	1 hr	Team																											
25	Specification Development mini-Workshop	1.5 hrs	Team																											
26	Break	2 hrs	Team																											
27	Specification Development Project Work	1.5 hrs	Team,DPM																											
28	Create Day's Summary	30 mins	DPM																											
29	5-Min Project Updates	30 mins	Team,DPM																											
30	<b>Specification and Initial Concept Development</b>	<b>3 days</b>	Team																											
31	Revisit ARC	1 day	Travis																											
32	Create Benchmarking poster	1 day	Team																											
33	Brainstorm/Organize/Reconcile and Document Final Needs AS A TEAM!	1 day	Salim,Jeff																											
34	Update QFD & Needs Assessment from Fri based on new needs	0.5 days	Team,by assignment																											
35	Update & upload all Paperwork to date	1 day	Team																											
36	Develop Intitial Test Document (Know how you will Validate Your Design)	1 day	Team																											
37	Needs & Specs Complete, Meet with Prof. DeBartolo to review	0 days	9/21																											
38	<b>Workshop 3: Concep Generation and Development</b>	<b>1 day</b>	Team																											

Project: SD Sample 3wk Plan  
Date: Mon 10/16/06

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			



