MSD P13038 Hearing Aid Design

System Design Review
January 11, 2012

Team Members 1.11.13

Alissa Anderson **Team Manager**

Conor Murphy **System Integration Engineer**

Ronald Dries **Lead Electrical**

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Nanxi Yu **EDGE Master**

Paula Garcia **Secretary**

Eric Lew **Budget Master**

Marbella Vidals **Customer Relations**

Sarah Brownell **Guide**

Agenda 1.11.13

Project Overview (5 minutes)

- Background
- Motivation
- Major customer needs, specs, and functions

Mechanical Design (10 minutes)

- Enclosure renderings
- Mechanical architecture
- Hot Topic: User-centered design

Electrical Design (20 minutes)

- Electrical architecture
- Hot Topic: micro-processor selection and power distribution

Software Design (15 minutes)

- Software architecture
- Hot Topic: System simulation and filtering methods

Project Plan (10 minutes)

- Critical Path
- Major risk summary
- Budget review

Background & Motivation 1.11.13

Expected Project Benefits:

(1) De-stigmatize hearing aids as medical devices by creating an audio accessory that is socially accepted and used by both hearing and hard of hearing individuals.

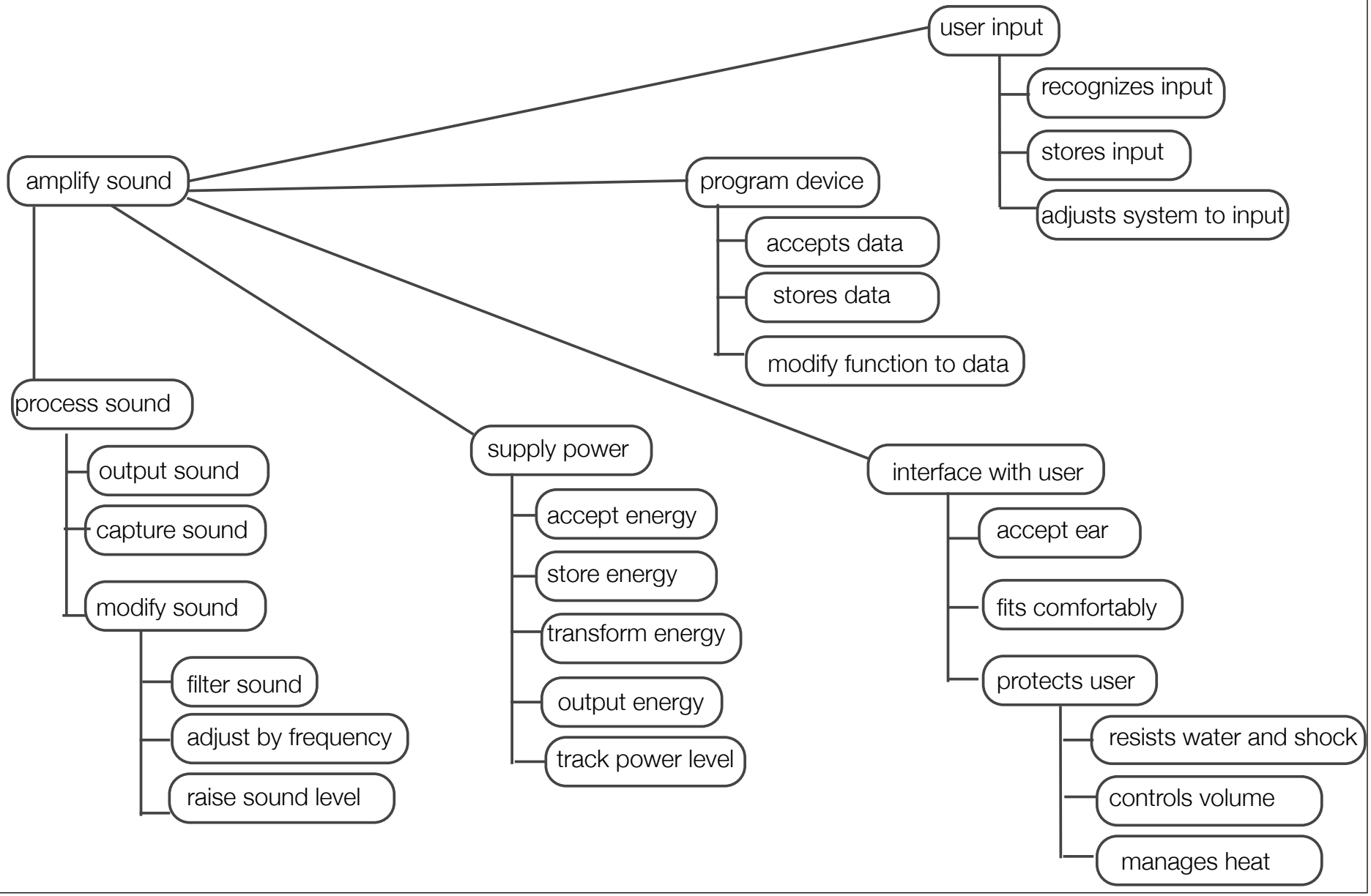
(2) Provide hard-of-hearing market with an alternative hearing aid device that offers similar features contained within a new physical form

(3) Project is to serve as an initial proof of concept for future MSD projects to focus on improvements in device adjustability and functionality

Target Audience: hearing and hard-of-hearing, young hearing aid users

Oticon, Agile

Functional Decomposition 1.11.13



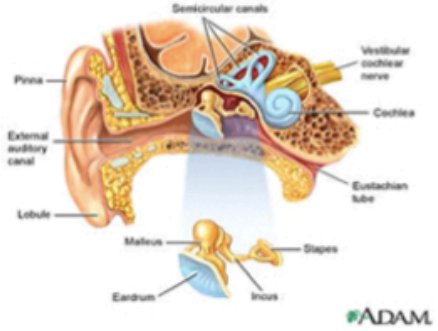
Design Constraints (ME/ID) 1.11.13

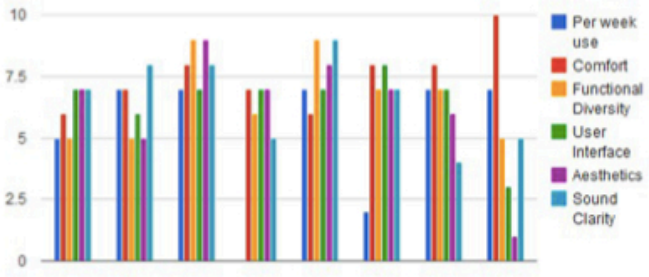
Customer Need	Rank	Description
CN2	9	The device fits most adult ears ages 15-25years
CN3	9	The device does not draw attention to the user as a hard of hearing individual
CN4	9	The device supports an active lifestyle (stays on the ear during everyday activities and light activities)
CN7	9	The device is rechargeable by computer USB port

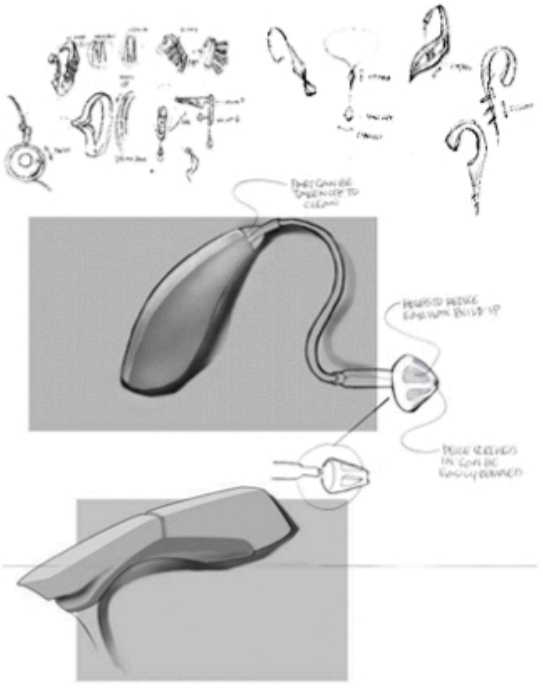
Spec	Source	Specification	Direction	Units of measure	Marginal	Ideal
S9	CN2, CN4, CN11	Range of adult ear size accommodated	max	percentile	25th to 75th	10th to 90th
S10	CN4, CN6, CN10, CN11	Weight of earpiece	min	g	<15	<12
S14	CN3	Percent of serveyed people who identify a picture of the device as something other than a hearing aid.	max	percent	>60	>80
S15	CN3	Percent of surveyed hard of hearing people who prefer the form of the new device to standard behind the ear hearing aids	max	percent	>50	>75
S17	CN11	Percent of surveyed people who feel the device is comfortable to wear	max	percent	>60	>80

Benchmarking 1.11.13

"Sensory neuron loss meaning the inner ear and the hair cells are not functioning properly, which is usually caused by some random genetic "mistakes" is basically the most common reason for hearing loss. Most frequent reason of hearing loss is aging. There is a segment of the market is directing to the student. The aged hearing loss started from the high frequency and spread toward the middle frequencies."







Enclosure Proposal 1.11.13

Key Features:

Processes and amplifies sound based on custom user hearing profiles

Rechargeable power source

Reprogrammable software for changes in user application

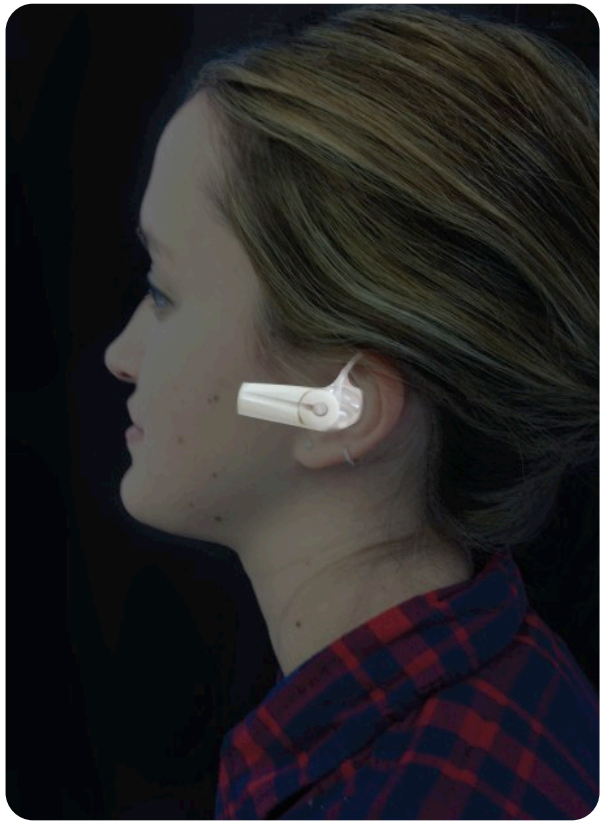
Interfaces with USB 2.0

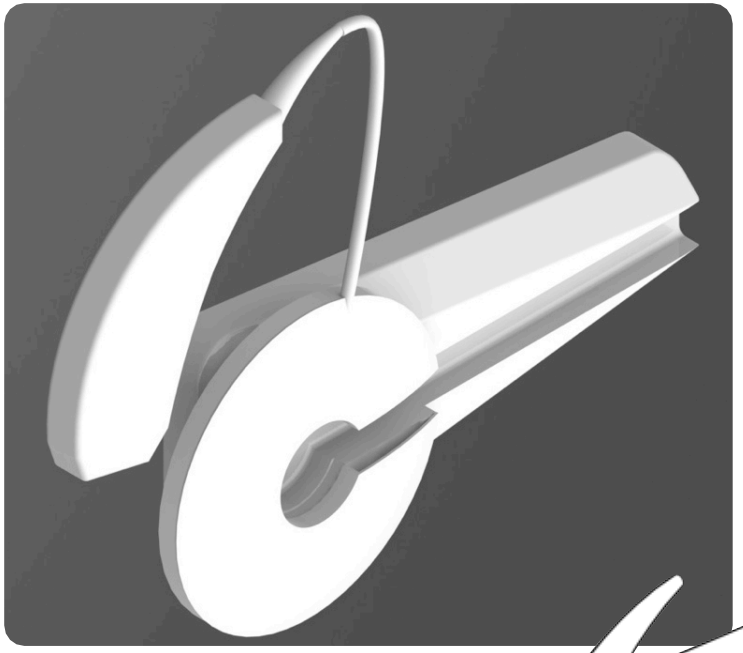
User control of volume, power, and profile setting

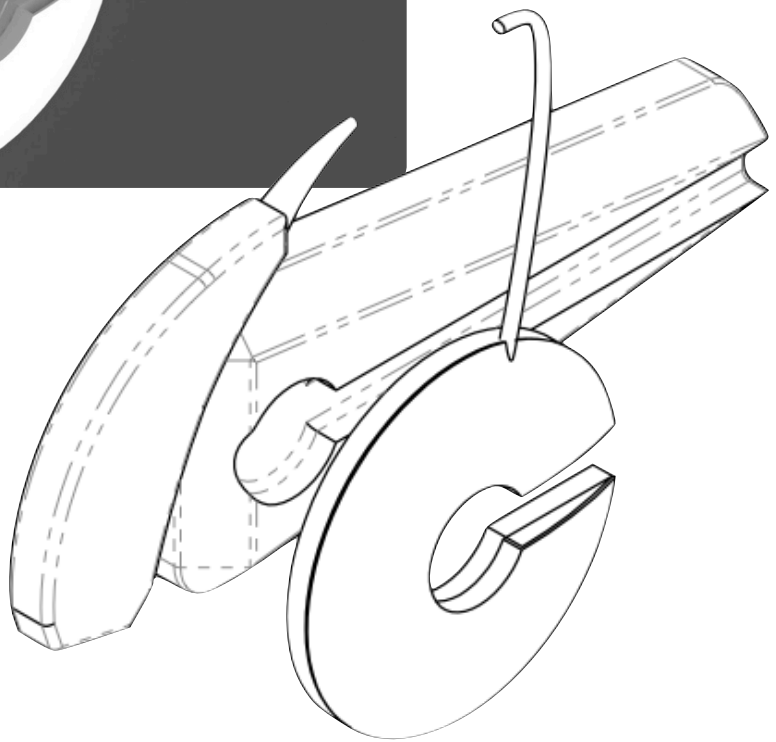
Interfaces with standard ear tube and ear mold styles (custom fit, dome, etc.)

Optimized number and location of microphones for sound capture

Enclosure Proposal 1.11.13







detachable “Transfer Module”

Design Constraints (EE) 1.11.13

Customer Need	Rank	Description
CN1	9	The device amplifies sound
CN7	9	The device is rechargeable by computer USB port

Spec #	Source	Specification	Direction	Units of measure	Marginal	Ideal
S1	CN1	Lowest level of sound detected	min	dB	<60	<30
S2	CN1	Frequencies amplified	max	Hz	N/A	85-8000
S3	CN1, CN6	Maximum amplification	target	dB	85-95	90
S5	CN7	Time to charge earpiece	min	minutes	<60	<30
S7	CN7	Connects to standard USB 2.0 computer port	target	yes/no	yes/no	yes
S12	CN8	Earpiece battery life at maximum amplification	max	hours	>16	>48

Proposed Budget 1.11.13

Item	Qty	Cost ea.	Total
Sound Processing Development Platform	7	$200	$1400
Microphones	2	$100	$200
Microprocessor	3	$150	$450
Amplifier components	1	$70	$70
Speaker	2	$50	$100
USB Interface	1	$20	$20
Rechargeable Battery	10	$15	$150
PCB	4	$50	$200
Acoustic Test Stand	1	$500	$500
3D Printing Costs	7	$75	$525
Miscellaneous	X	X	$1000
TOTAL			**$4615**

Timeline: Critical Dates 1.11.13

Date	Event	DRI
Jan 7	Enclosure sketches due (select 2 potential product options) Finalize scope, deliverables, needs	ID
Jan 11	System Design Review	ALL
Jan 17	Order Eval Boards	EE
February 7	PCB 1.0 Printed Enclosure Alpha Printed	EE
February 15	Detailed Design Review	ALL
March 29	Final PCB printed and on campus (for integration) Final enclosure printed (for integration)	ME
April 1	Start integration and debug	ALL
April 26	WORKING PROTOTYPE DUE	ALL
May 4	Imagine RIT	ALL
May 10	Final MSD Review (Week 10)	ALL

Risk Assessment 1.11.13

ID	Risk Item	Effect	Cause	Likelihood	Severity	Importance	Action to Minimize Risk	Owner
1	Project Scope too large	due to large scope, deliverable list is too large and project is not completed on time	team approves too many deliverables; poor resource planning; poor benchmarking and feasibility causes team to belive they have the resources to complete a task	3	3	9	Focus on main goals of project, discuss, research, and prove feasibility of optional functionality. Discuss goals of project with guide and experts to determine feasibility and likelihood of success. Drop dead date for deliverable list is at system design review (Friday Week 5)	Team Lead, Engineering Leads
5	Difficulty getting electronics small enough for hearing aid	Prototype is larger then originally intended	Components chosen too large, not enough space left for electronics in main hearing aid shell. System integration not thought of before mechanical and electrical systems are built	3	3	9	Keep small form factor in mind when choosing technologies and functionality	Lead Electrical Engineer / System Integration Engineer
10	No experience/ expertise with ON Semi chip DSP Hybrid chip	If chosen, could run out of time, not have a happy customer, potential product failure	Too difficult to implement, Run out of time trying to learn new product	3	3	9	Seek advice from experts at ON Semi, Plan for difficult implementation and put a large amount of scheduled time	Lead Electrical Engineer/ Systems Engineer
15	Team member feels overloaded with work from MSD	team loses support and quality of work from stressed team member. team member loses motivation to work for the team	team member volunteers for too many projects; unbalances work assignments; team member is under qualified for assigned tasks and does not seek necessary support (or vocalize need for support)	3	3	9	team manager should monitor work loads of team members to help facilitate an equal distribution of work; individual team members should speak up (to manager or team) if they feel over loaded or that the work is not equally divided among qualified members	team members (and team manager)

Backup