Sound Tech Inc.

Multifunction Intelligent Headphone System

ENSC 305/440 Final Project Presentation
Simon Fraser University

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Agenda

- Introduction
- System Overview
- Hardware
- Software
- Business & Marketing
- Project Specific
- Conclusion
- Future Work
- Question

INTRODUCTION

- Sound Tech Inc.
- Team Members
- Motivation
- Sound Tech Solution

Introduction

- **Sound Tech Inc.**
  - work on products related to music and sound
  - products are based on market research and analysis

- **Team Members**
  - 5 senior engineering students with varying backgrounds in software, hardware, mechanical systems, and project management

    - **Leo Jiang** – CEO, System Major
    - **Simranjit Sidu** – CTO, Biomedical Major
    - **Ray He** – COO, Electronics Major
    - **Afrin Chowdhury** – CFO, Electronics Major
    - **Frank Zhu** – CIO, System Major

Motivation

- **The New Trend**
  - Enjoy music where ever they go
  - Long lives music!
- **Safety is a Concern!**
  - You are blinded by the headphone
  - What is around you?
- **Pardon Me!**
  - SCREAMMMM!!!
  - Couldn't hear *ya!*

Motivation

Podestrians (that's pedestrians with iPods) trigger rise in road accidents by failing to hear cars

By RAY MASSEY

Last updated at 1:59 AM on 8th October 2008

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Beware. There is a new danger on the streets. And you might not spot it until it's too late.

Pedestrians with iPod or MP3 music player headphones glued to their ears have a habit of stepping out into busy roads oblivious to the traffic.

Accidents involving 'podestrians', as they have been called, now account for nearly one in ten minor accidents involving sudden braking and shunts, according to figures from an insurance company.

Well over half of the culprits are described as young people, teenagers or children.

'In many accounts of minor accidents on insurance claim forms, we have seen a significant increase in drivers citing such individuals as having been a factor in the incident,' a spokesman for the company said.

The most common scenario involves a 'podestrian' stepping into the road without looking properly and failing to hear an oncoming vehicle.

This can force the approaching driver to brake suddenly, subsequently being hit by the car behind.

Risk: iPod listeners account for one in 10 of minor accidents involving sudden breaking and shunts

Headphone-Wearing Pedestrians Causing More Traffic Accidents

by **Lee Bains** on October 9, 2008 at 07:06 AM

FILED UNDER:

An unnamed insurance company recently stated that one in ten minor accidents are caused by headphone-wearing pedestrians, the Daily Mail reports.

Since headphones and earbuds have become louder and increasingly capable of blocking out external noise (especially those new-fangled in-ear buds), the folks who don them on the streets are frequently unable to hear traffic noise. This can result in a listener stepping into a crosswalk, oblivious to the oncoming truck forced to slam on its brakes. Not surprisingly, collisions are on the rise.

Although we haven't heard any such reports yet, we're confident that sometime soon, some iPod-listening jaywalker is going to be taken to the bank. [From: Daily Mail]

Solution

Provide you great music quality!

Controls your headphone with your voice command!

Warns you there is danger around you!

Warns you if there Fire Engine is nearby!

Cancels out unwanted ambient noises!

Notify you when someone is calling your name or talking to you!

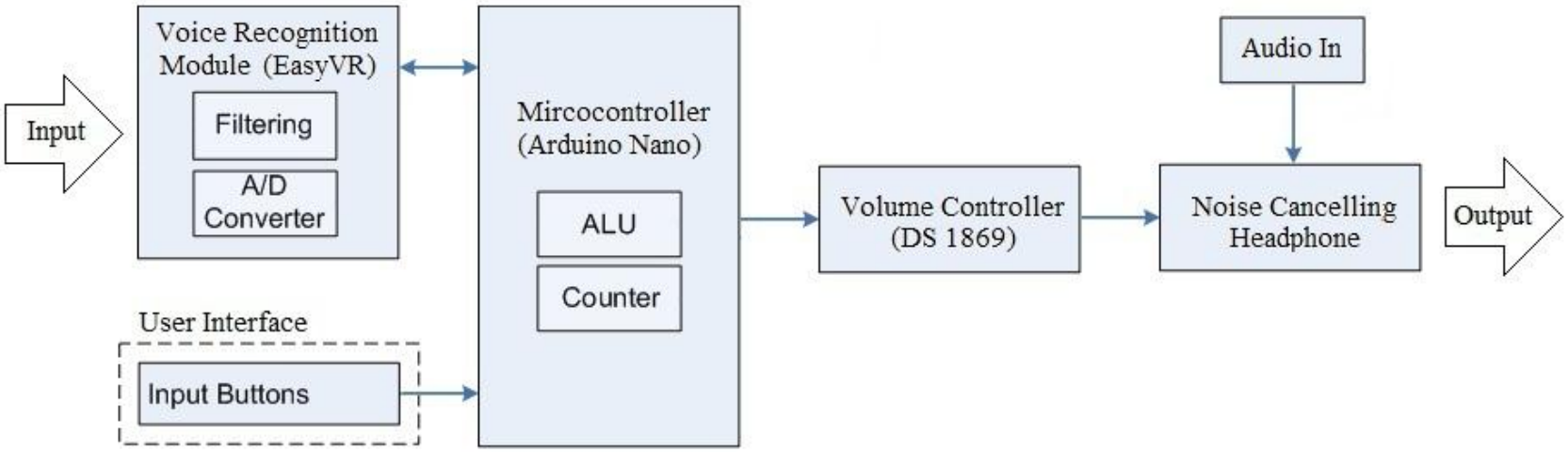
Solution

- **Word Recognition**
  - Detects keywords and perform actions
  - “VOUME UP”, “VOLUME DOWN”, “MUTE VOLUME”, “MAX VOLUME”
- **Sound Recognition**
  - Warn the user when danger is lurking
  - “AMBLUANCE”, “POLICE”, “FIRE ENGINE”
- **Voice Recognition**
  - Inform the user who is calling their name

System Overview

- System Block Diagram
- High Level Hardware
- Prototype Design

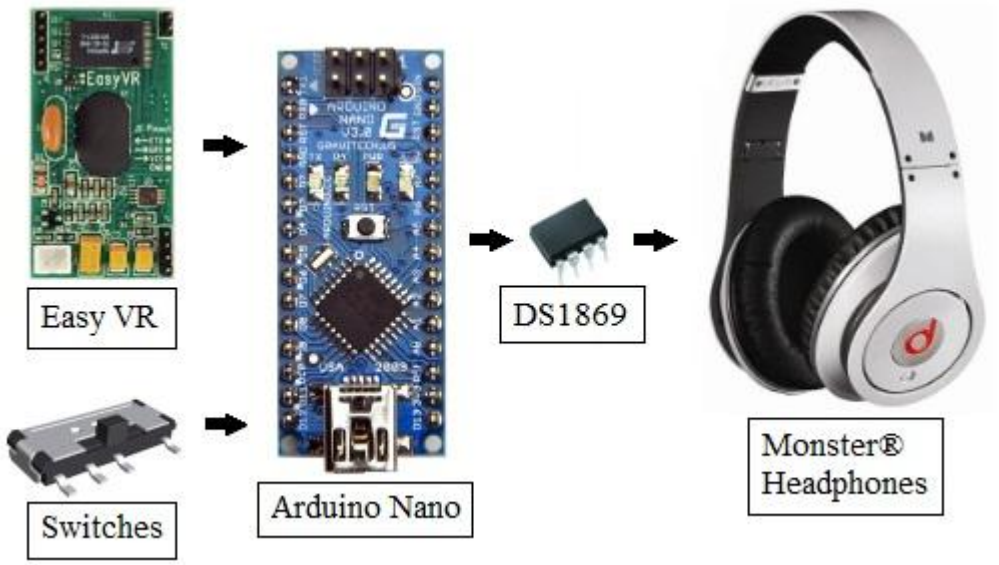
System Block Diagram



(High Level Block Diagram of MIHS)

High Level Hardware

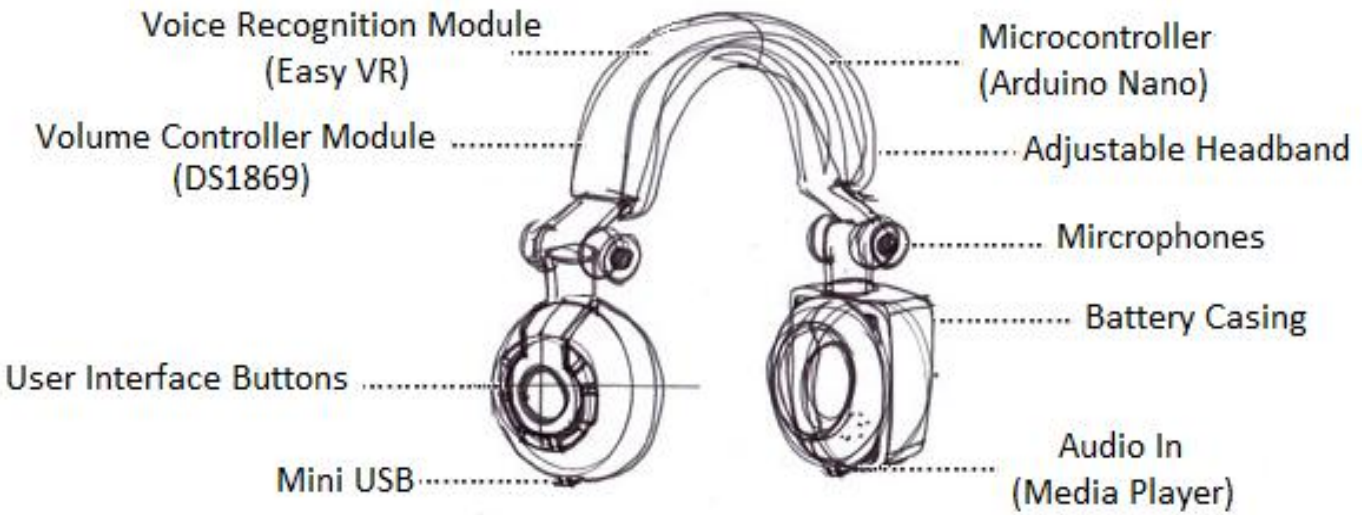
- High Level Hardware shows the interaction of the different components used for MIHS



(High Level Hardware)

Prototype Design

- The prototype design shows the placement of the hardware and user interactive features for MIHS



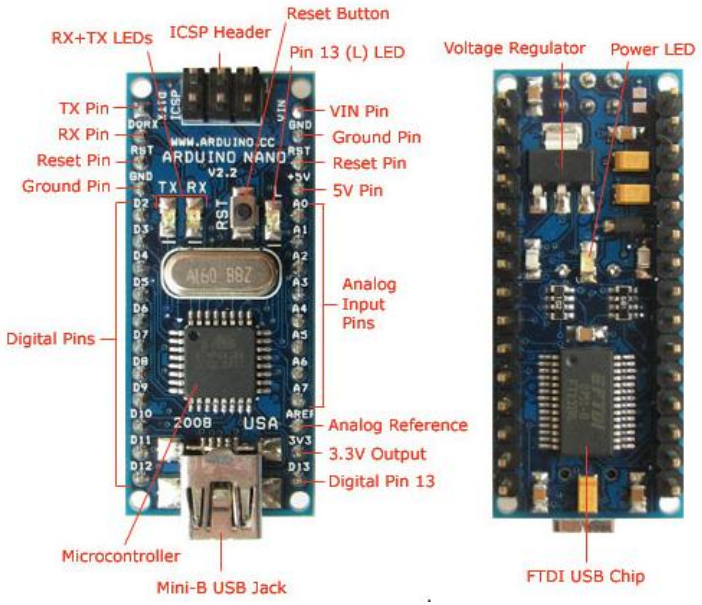
(Prototype Design)

Hardware

- Arduino Nano
- EasyVR
- Headphones
- DS 1869

Arduino Nano

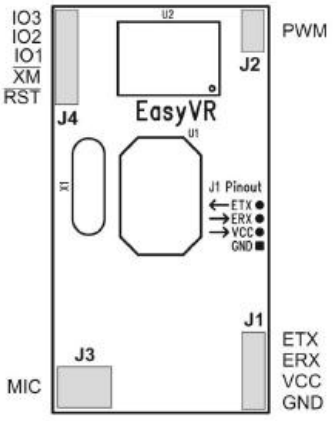
- Arduino Nano is a small, complete, and breadboard-friendly microcontroller board based on the ATmega328.
- **Why Arduino Nano?**
  - Checks the mode of operation
  - Main part of arithmetic operations
  - Controls the digital potentiometer
  - Flash memory 32KB
  - Cheap Price and smallest size



EasyVR

- EasyVR is a multi-purpose speech recognition module designed to add versatile, robust and cost effective speech and voice recognition capabilities.

- **Why EasyVR?**
  - Captures sounds, performs noise filtering
  - convert the analog signal to digital signal
  - Communicate with Arduino Nano
  - Simple graphical user interface
  - Appropriate size
  - Excellent Price



Headphones

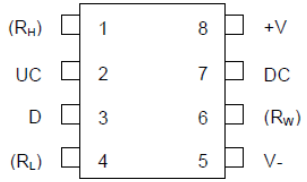
- **Why normal headphone in prototype?**
  - Cheap price
  - Easy to perform adjustment and lower risk to take
  - Feedback from the market survey show that most people do not want to spend more than $ 100 on a headphone

- **Why noise cancelling headphone in proposal?**
  - Great quality of audio output
  - Avoid the interfere from external noise
  - High powered digital amplifier for decreasing distortion

DS1869

- The DS1869 is a digital rheostat or potentiometer, this device provides 64 possible uniform tap points over the entire resistive range.
- **Why DS1869?**
  - Read pulse signal from Arduino Nano and adjust the resistance of potentiometer
  - Controls the volume of headphone
  - Replaces mechanical variable resistors
  - Integrated digital circuit and higher precision
  - Save space, reduces heat

DALLAS SEMICONDUCTOR



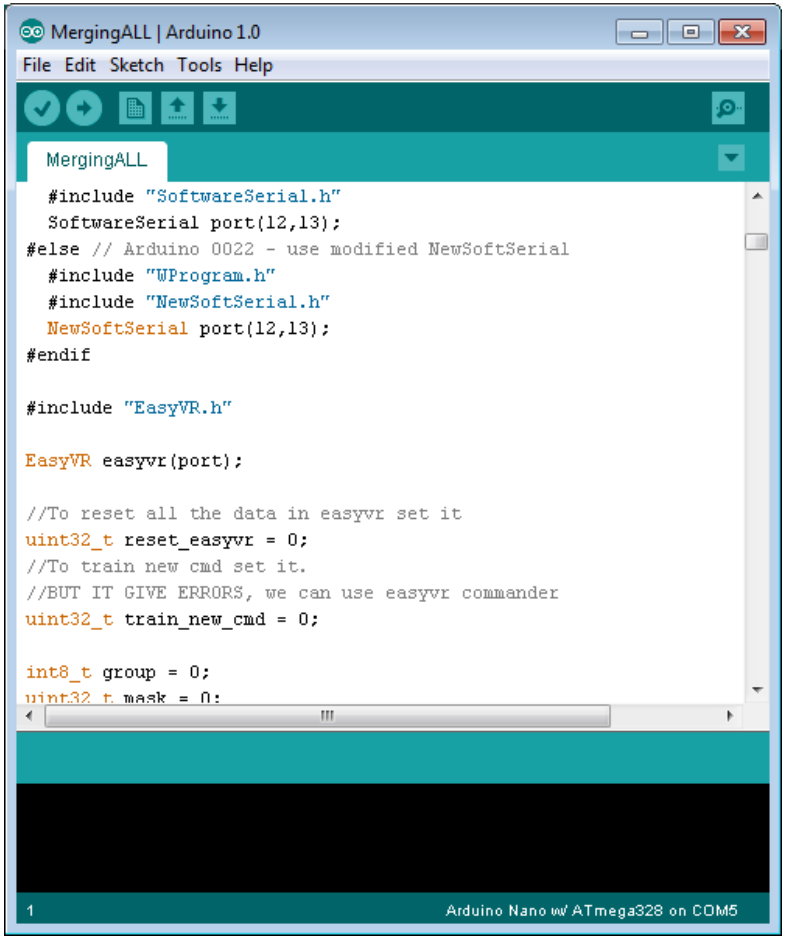
Software

- Software Design
- Arduino Software
- EasyVR Commander

Software Design

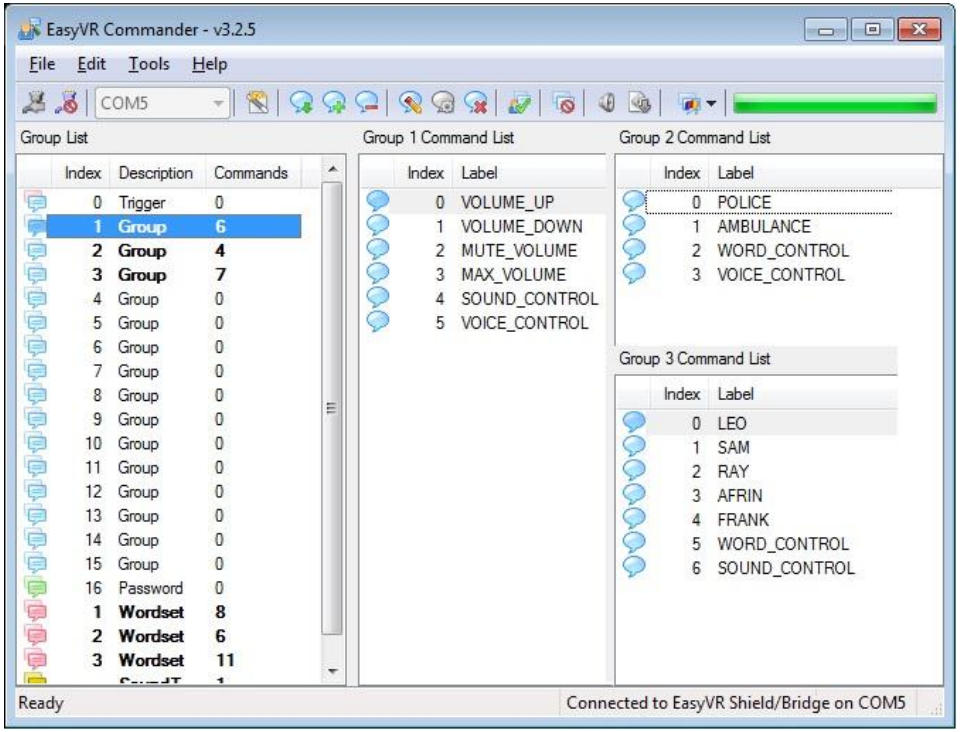
- There are two software modules for MIHS
  - **For Developer:**
    - the central software, it is the control software of MIHS.
  - **For Users:**
    - for the user is for training words, sounds, or voice for MHIS.

Arduino Software



- **Arduino software**
  - Central control
  - Sets up communication channels
- **Setup()**
  - Bridge mode communication channel
  - Pulse mode communication channel
  - Serial mode communication channel
- **Loop()**
  - Continuous check status of EasyVR
  - Control Volume

EasyVR Commander



- **EasyVR commander**
  - Front End
  - Train new commands

User Interface

- **Hardware Interface:** hardware interface includes any component of the MIHS where they come in contact with the user
  - Power switch
  - Reset switch
- **Voice Interface:** voice interface does not have physical contact with the user, it only requires sound
  - Commands
- **Visual Interface:** visual interface does not have physical contact with the user, it's main purpose indicate to the user the different modes
  - Red & Green LEDs

Business & Marketing

- Market Research
- Headphone Price Analysis
- MIHS Cost
- Unit Cost vs. Mass Production
- MIHS Survey

Market Research

- **According to The NPD Group**
  - the Sales of headphones over $100 are growing
  - Headphones cost $100 or more went from around 2 percent of the headphone market in 2009 to 3.5 percent of the market in 2010
  - Average consumers buy a new pair of headphones every 14 months, but teenagers buying new ones even more frequently

Features	Premium ($100+) Headphone Purchasers
Brand	84%
Sound quality	76%
Noise cancelling	47%
Length of cord	27%
Water/sweat resistant	22%
Playback/volume controls	21%
Cordless	15%
Microphone	10%
Color	8%

Noise Cancelling Headphone Price Analysis

Noise Cancelling Headphone	Price	Comfort
Able Planet Clear Harmony	$350	Good
Audio-Technical ATH-ANC7	$220	Excellent
Bose Quiet Comfort 2	$299	Excellent
Bose Quiet Comfort 3	$349	Excellent
Jabra C820s	$199	Good
Logitech NCH	$150	Excellent
Outside The Box Solitude	$250	Fair
Panasonic RP-HC500	$200	Good
Sennheiser PXC 450	$450	Good

MIHS Cost

Stage	Cost
Projected Cost (includes NCH)	$650
Actual Cost (without NC)	$572
Actual Prototype Cost (1unit) (without NC)	$232

- For the prototype cost, noise cancelling headphone is not included

Product Unit Cost vs. Mass Production

Component	MIHS Unit		MIHS Mass Production	
	Cost	Retail Price	Cost	Retail Price
Micro-controller	$50		$15	
Voice Recognition Module	$50		$15	
Noise Cancelling Headphone	$150		$50	
Debugging Chip	$15		$2	
Miscellaneous Electrical Components	$20		$2	
Power Supply and Batteries	$5		$1	
Total Product Cost	**$290**		**$85**	
Labour (1 Junior engineer)	$875*		$50**	
Total Cost	**$1,165**	**$1,700**	**$135**	**$250**

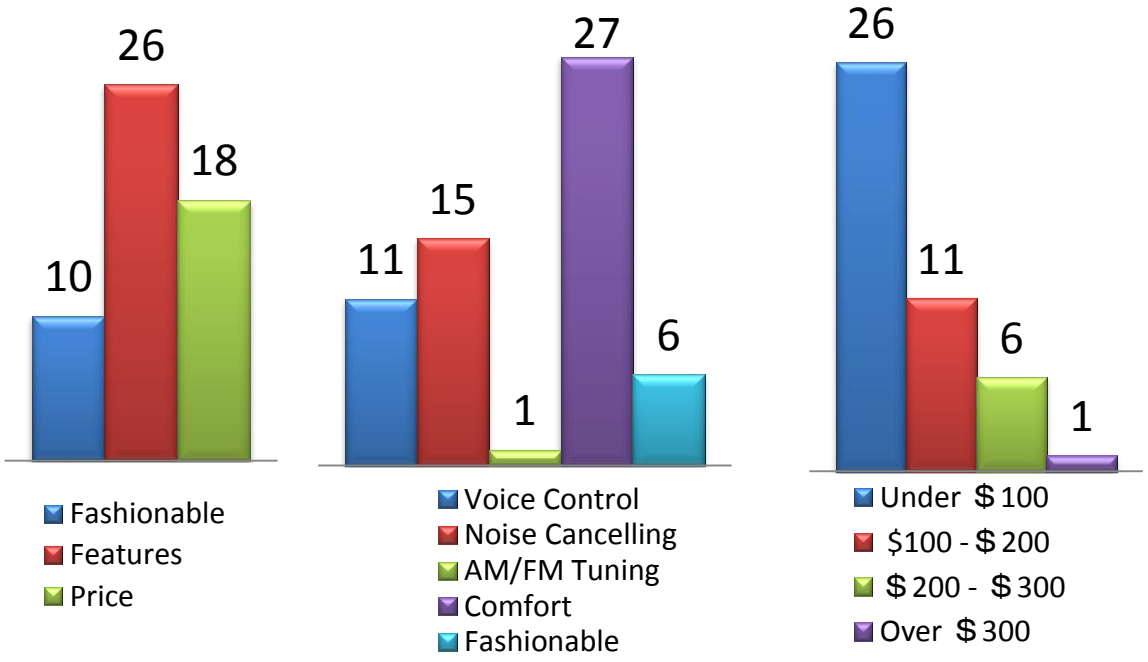
One Junior Engineer:

* Labour for an unit: 35hours/week X $25/Hour = **$875**

** Labour for Mass Production: 2 hours/week X $25/Hour = **$50**

MIHS Survey

- **Purpose:** to understand what consumer wants and how much they are willing to spend for a Headphone?
- **Number of people participated in this survey:** ~ 50



Project Specific

- Budget
- Safety & Sustainability
- Documentation Timeline
- Development Timeline
- Lesson Learned

Budget

COMPONENT	PROPOSED PRICE	ACTUAL PRICE	DEVIATION	PROTO-TYPE	MODULE	TESTING / EXTRA
Micro-controller	$150	$97	$53	$49	$48	$1
Voice Recognition Module	$150	$218	-$68	$49	$67	$102
Headphone	$150	$100	$50	$100	$0	$0
Debugging Chip	$100	$103	-$3	$13	$14	$77
Miscellaneous Electrical Components	$50	$51	-$1	$19	$15	$19
Power Supply and Batteries	$50	$3	$47	$3	$0	$0
Total	**$650**	**$572**	**$78**	**$233**	**$144**	**$199**

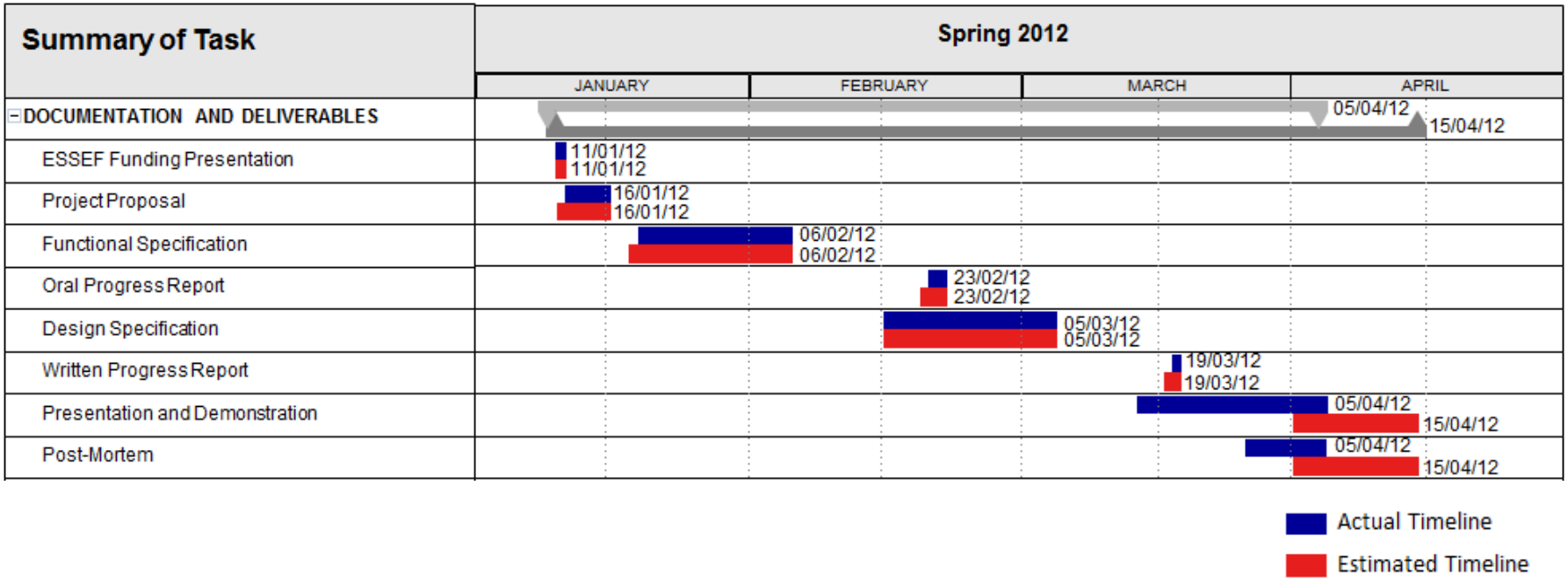
- We received **$500** fund from ESSEF for MIHS

Safety & Sustainability

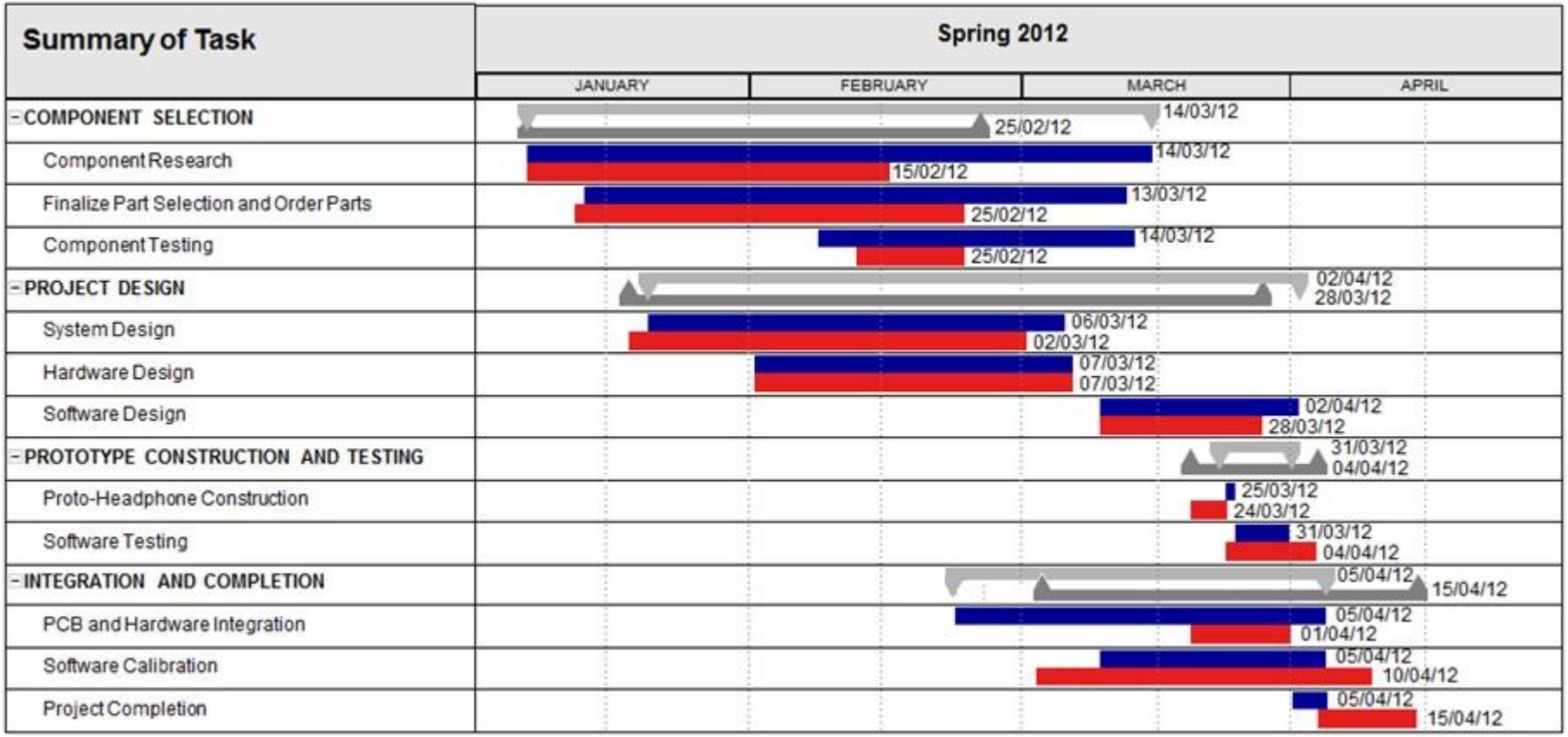
- **Safety**
  - All electrical components enclosed inside the MIHS
  - Electrical components should not cause any harmful interference

- **Sustainability**
  - Use of recycled materials
    - Computer parts (jumpers, sockets, connectors, LED and switches)
    - Audio Jacks
    - Reused Electronic components

Timeline for the Documentation



Timeline for Designing & Development



Lessons Learned

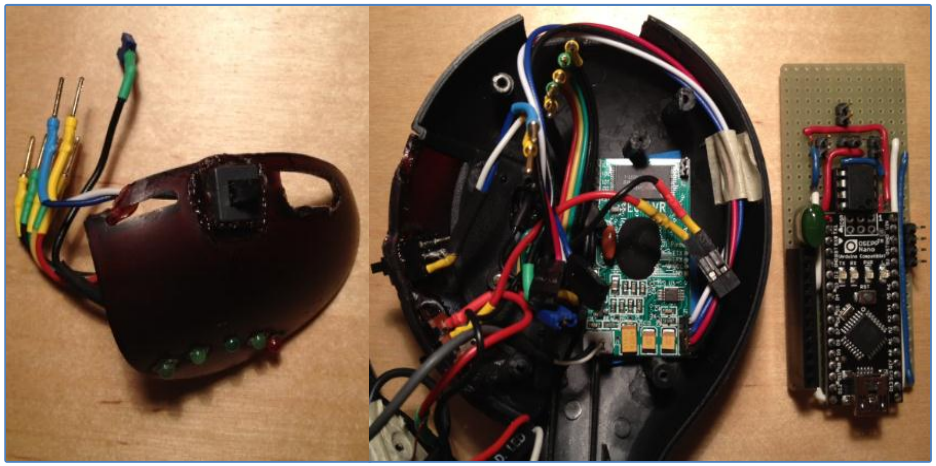
- **Team Dynamics**
  - Scheduling conflict need to be resolved
  - Well defined roles and responsibilities are important
  - Efficient teamwork is critical
  - Communication is crucial

- **Project Development**
  - Order parts early, purchase in bulk and extra
  - Create test plan, run tests that are likely to create errors first
  - Test individual parts before putting all together
  - Test entire system integration first, even if subsystems are not in their final versions.

Conclusion

- Prototype built on time and within the specified budget
- Future works needed to make it more robust
- Fully functioning prototype has designed and built
  - Word Recognition Mode
  - Sound Recognition Mode
  - Voice Recognition Mode
- Future works needed to make it more robust
- Great experience for all team members!

Conclusion



Future Work

- **Hardware**
  - Microphones – noise cancelling
  - Audio Amplification - match all headphones
  - Digital Potentiometer - more precise control
  - Power Supply – rechargeable, power indicator

- **Software**
  - Combine software, train commands using Arduino
  - Voice Independent Commands

Thank You! =]

Questions