MDR
&MDR Report
MDR Format

- Team Presentation (30 min)
  - ppt presentation
  - demos of MDR deliverables

- Evaluators Q&A (20 min)
<table>
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<th></th>
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Example MDR

Team RCA
SDP13
RCA (Real-Time Concussion Analyzer)

Timothy Coyle, EE
Impact Processing & Communication

Kenneth Van Tassell, EE
User Interface & Communication

Scott Rosa, CSE
Server & Data Analysis

Justin Kober, EE
Sensor Network & Power
Concussion Detection in High School Football

- Current concussion detection
  - Train coaches to recognize symptoms

- Players may hide or not experience symptoms right away

- RCA will monitor each player and alert the coach with the risk of concussion after each collision

- Customer feedback
  - College trainers and high school athletic director
Our Previous Solution: Block Diagram
Our Redesigned Solution: Block Diagram

- Bluetooth
- Android
- Server
Sensors

- ADXL 193 MEMS Accelerometer
  - Testing
  - Noise analysis

- PCB Design
  - ADXL 78
  - More sensitive
Battery Selection

- Energy Consumption
  - Worst Case: 25.0 kJ per game
  - Typical: 5.8 kJ per game
    - 100 ms per hit and 100 hits per game

- Coin Cell Batteries
  - Weight & Size
  - Series or Parallel
Measured System Energy Consumption

Helmet network connect but idle

Mean Voltage: 255.8 mV

Helmet network connect and transmitting

Mean Voltage: 305.6 mV
Application / User Interface and UI Communication

- **Requirements**
  - Easy to use
  - Displays Acceleration
  - User Adaptable
    - Coach vs. Trainer
  - Reliable

- **Challenges**
  - Unable to perform long processes on UI thread
  - Uncaught process errors
  - Working with Android Bluetooth protocol
Application / User Interface and UI Communication

- **Android AsyncTask**
  - Allows multi-threading in Android applications
  - Performs tasks asynchronously in the background

- **Android Debugging**
  - Used to catch unseen errors
  - Found and fixed multiple runtime errors

- **Android Bluetooth**
  - Using Android Bluetooth package
  - Measured response time of transfer to be 16.8 ms
Data Processing and Storage

- **Requirements**
  - Calculates rotational acceleration
  - Determines probability of concussion
  - Output within 500 ms
  - Store all impact data efficiently

- **Accomplished**
  - Calculates rotational acceleration and probability of concussion in average of 411.6 ms
  - Computational analysis
  - Set up server with database to store data
  - Tested and graphed data
Test Results

Rotational Acceleration (rad/s²)

90% Risk
75% Risk
50% Risk
25% Risk
10% Risk

Probability of Injury

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

C₁ = -12.531
C₂ = 0.0020

risk = \frac{1}{1 + e^{-(c₁+c₂)}}

Our Risk Algorithm
Steven Rowson’s Injury Risk Function

Department of Electrical and Computer Engineering
Test Results

\[ \text{risk} = \frac{1}{1 + e^{-(c_1 + c_2 a)}} \]

- \( c_1 = -12.531 \)
- \( c_2 = 0.0020 \)

Rotational Acceleration (rad/s\(^2\))

Probability of Injury

- 90% Risk
- 75% Risk
- 50% Risk
- 25% Risk
- 10% Risk
Impact Processing & Communication

- **ATmega32U4 8-bit AVR Microcontroller**
  - 16MHz Clock
  - 10-bit ADC every 8us

- **Bluetooth: BlueSMiRF w/ RN-41**
  - Redesigned for scalability
  - 25m Effective range
    - Proof of concept vs. XBee redesign
Impact Processing & Communication Experiments

- Experiments
  - Compared sensor to datasheet
    - Noise in system
  - Sample rate
    - Noise stabilized and found sample rate problem
  - System output vs direct sensor output
    - Confirmed sampling rate problem
  - Revised sample rate settings
    - Improved sampling rate and confirmed stable output

- Statistical analysis
  - Mean, Variance, Histograms
    - Confidence intervals of final system
Proposed MDR Deliverables

- Demonstration of Impact Data Collection
  - Accelerometer interfaced with processor
  - Helmet processor transmission

- Demonstration of Base Station/UI Interaction
  - Using test data
    - Receive from helmet
    - Run algorithm
  - UI able to receive and display test results
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Proposed CDR Deliverables

- **Demonstration of Complete System Functionality**
  - Show implementation of battery powered system
  - Impact the helmet with a known force
  - Transmit impact data with required sample rate from the sensor array to Android device
  - Display risk of concussion with confidence interval on Android device
  - Display player impact history on Android device upon user request
Thank You

Questions
# UMass SDP15 MDR – Evaluation Sheet

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MDR Report

draft due: 3rd Dec’14
final due: 15th Dec’14
MDR Report Rules

- IEEE Paper Format
- Cite all sources
- Grammar Counts
- Clear
- Content
  - 0. Abstract
  - I. Introduction
  - II. Design
  - III. Project Management
  - IV. Conclusion
Why

“We Have Met The Enemy and He is Powerpoint.”
--NY Times Article on Military Powerpoints 2010
Why

• “It is dangerous because it can create the illusion of understanding and the illusion of control.”
  --General McMaster
Preparation of Senior Design Project Report

First A. Author, EE, Second B. Author, CSE, Third C. Author, EE, and Fourth D. Author, CSE

Abstract—This is an editable template. You should follow the format of this template in writing your SDP Midyear report. Your abstract that goes here should be one paragraph based on the abstract you wrote earlier.

I. INTRODUCTION

Start with the statement of the problem. What is the problem that you are trying to solve? How big is this problem? Include citations that demonstrate that your problem is significant.

Put your problem in context. How have people solved your problem in the past? Has the problem changed with time? What are the impacts on societal impacts of your problem? How does your problem affect individuals?

Summarize the requirements analysis that you performed. How big can your solution be? How much power can it use? How will someone use your solution? List the specifications in a Table as shown in Table 1.

<table>
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<td>Weight</td>
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experiment you will perform to design or test this block. Explain how you will analyze the results of this test.

D. Block 3

Describe what this technical block will do. Explain what technology you will use to build this block. Detail which techniques from courses you will use to build this block. List what you need to learn in able to build this block. Explain an experiment you will perform to design or test this block. Explain how you will analyze the results of this test.

How do you know the format?

Different Organizations Use Different Style Guides.
Cite All Sources

- Course Coordinators will Weight This Heavily in Grade.
- You Can Site a Web Page
  - Don’t just type the URL
- Even if you didn’t have to look it up you should cite it.
- Describe what the cited work did and what you added to it.
- Formats can be found in style guide or sample document.
Grammar Counts

- Use complete sentences.
- Check your spelling.
- Avoid comma splices.
- Proofread, proofread, proofread.
Write Clearly

- Strunk and White said: “Write Tight”
- Start with an outline
- Start over
MDR Report Content

- Aside & Context (ABET)

- Content
  - I. Introduction
  - II. Design
  - III. Project Management
  - IV. Conclusion
ABET

- Accrediting Board for Engineering Degrees
- UMass EE and CSE programs evaluated every 6 years
ABET Student Outcomes (a-k)

- a) an ability to apply knowledge of mathematics, science, and engineering.
- b) an ability to design and conduct experiments, as well as to analyze and interpret data.
- c) an ability to design a system, component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- d) an ability to function on multidisciplinary teams.
ABET Student Outcomes

- e) an ability to identify, formulate, and solve engineering problems.
- f) an understanding of professional and ethical responsibility.
- g) an ability to communicate effectively.
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- i) a recognition of the need for, and an ability to engage in life-long learning.
ABET Student Outcomes

- j) a knowledge of contemporary issues.
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
MDR Report Content

- I. Introduction
- II. Design
- III. Project Management
- IV. Conclusion
Introduction

- State the problem (e)
- How big is the problem (needs citation)
- How have people solved this problem? (c)
- What impact(s) does your problem have on individuals, society, and the environment? (c) (f)(h) (j)
- System specifications table (e)
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<td>Response Time</td>
<td>&lt;2 s</td>
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<td>Battery Life</td>
<td>&gt;5 hours</td>
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<tr>
<td>Cost</td>
<td>&lt;$5000 for full team of 52 players</td>
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<tr>
<td>Power Consumption</td>
<td>&lt;2 W</td>
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<tr>
<td>Acceleration Range</td>
<td>+/- 70 g</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>Only measure actual collisions</td>
</tr>
<tr>
<td>Durable Packaging</td>
<td>Stable and waterproof</td>
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II. Design

- A. Overview (Block Diagram) (e)(f)
- B. Block 1
  - What will it do? (c)
  - What technology will you use to build it? (a) (i) (k)
  - How will you test it? (b)
III. Project Management

- Table of MDR Deliverables
  - What have you done
  - What is left to do
- What is each member’s expertise? (d)
- How do you help each other? (d)
- How does your team communicate? (d)(g)
IV. Conclusion

- What is the current state of the project?
- What are you working on now?
Sample MDR Report