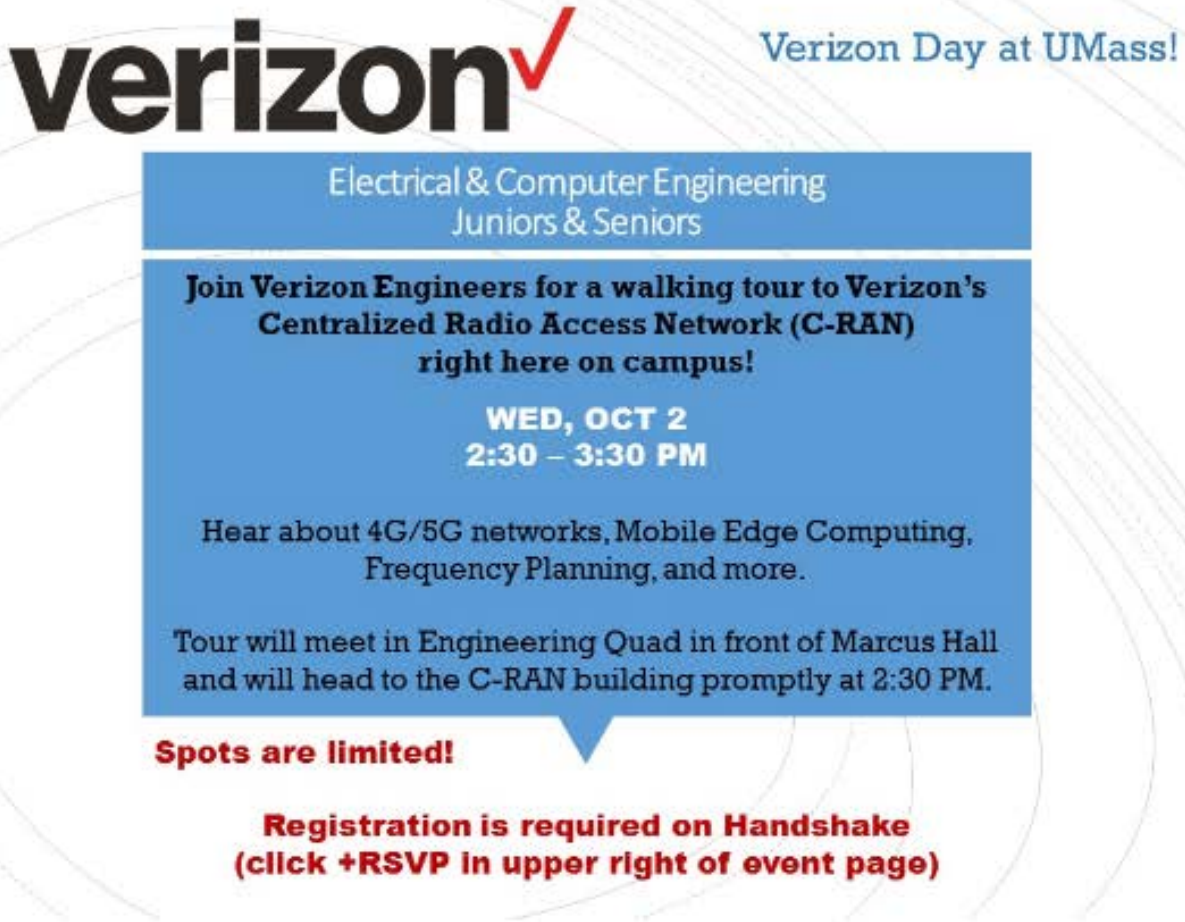
Verizon: C-RAN Site Tour

Hosted by University of Massachusetts Amherst



THE 20TH SHIRLEY & TING-WEI TANG ENDOWED LECTURE

"UMass to Tesla: 35 Years of Computer Design"

Peter J. Bannon '84

ELECTRICAL AND COMPUTER ENGINEERING

VP, Low Voltage and Silicon Engineering | **Tesla Motors, Inc.**

湯

Thursday, October 3, 2019

4:00 PM ◆ Great Hall, Old Chapel

presented by the UMass Amherst College of Engineering • free & open to the public • for information, call (413) 545-0282

PDR is Here!

	Benchsides (15min/team) 5.30-7.45pm seven nominations for evaluators due		Benchsides (15min/team) 5.30-7.45pm		Benchsides (15min/team) 5.30-7.45pm	

October 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	30 Lecture 3 PDR	1	2	3	4	5
6	7 PDR	8 PDR	9 PDR	10 PDR	11 PDR	12
13	14 Holiday	15 Lecture 4 Analyzing experiments Prof. Goeckel	16	17	18	19
20	21 Lecture 5 Teaming Dr. Peter Reinhart	22	23	24	25	26
27	28 Benchsides (10min/team) 4-5.30pm	29	30 Benchsides (10min/team) 4-5.30pm	31	1 Benchsides (10min/team) 4-5.30pm	2

November 2019

SDP20

PDR Prep

Department of Electrical and Computer Engineering
Lecture 3

Design Process

“Place and Paste” SDP12

Design Process: Set Intermediate Goals

assess needs

analyze requirements

design system

Problem Statement

System Specifications

Block Diagram

detailed block level design and test

Functioning subsystems

system integration and test

Covering the Fundamentals of PDR

- We will examine a previous PDR presentation
  - Covers all major points
  - Well executed presentation for a useful project
  - Place N Paste – Senior Design Project 2012 - Salvatore Cacciatore, Kenny Neyhart, Benjamin Oven, Tony Saloio
- You need to describe what you have done so far and what you will do in the future
  - Ask *yourself* the tough questions first before evaluators do
- Stress teamwork and moving forward together

PDR Preparations

- Your presentation must include
  - Assess needs (Problem Statement)
  - Analyze requirements (System Specifications)
  - System Design (Design Alternatives & Solution: Block Diagram)
  - Team roles (technical and administrative)
  - MDR Prototype
    - Very specific
    - What will your prototype be able to do?
  - Significant Hardware Component
  - Budget
- Handouts (1 per reviewer)
  - Problem statement/System Specifications/Block diagram
  - Copy of slides (~4 slides/page printout)

PDR Rules

- 20 Minutes of Presentation
- Evaluators May Not Interrupt Presentation
- Evenly Divided Among Team Members
- Advisor Present but Silent
- 20 Minutes of Questions & Answers by evaluators
- Invited guests may also be present
- Evaluators will forward evaluation to your SDP adviser.

The PDR Ether

Is your project impressive?

- Significant?
- Societal Impact?

Do your reviewers have advice?

What will you deliver for MDR?

Practice, Practice, Practice

Four speakers is 20 minutes is a lot of handoffs. Practice at least 2 times in front of advisor.

Assess Needs (Problem Statement)– Place n Paste

- Assess Needs
  1. Students cannot properly squeeze toothpaste
  2. Unable to apply appropriate amount of toothpaste
  3. Teachers must assist students every time they need to brush
  4. Students must be independent in maintaining *their* daily hygiene

- Problem Statement
  1. Difficult for disabled people to brush their teeth without assistance
  2. Automated system that doesn't make a mess. Easy to use
  3. Functioning system that can easily be used by a disabled person without external assistance

Analyze Requirements (System Specifications)

1. Dispense pea-sized toothpaste onto brush
2. Will hold toothbrush such that the machine and toothbrush will stay sanitary
3. Toothbrush will be placed in a way such that users lacking fine motor skills can insert toothbrush
4. Product will take no longer than 20 seconds from when toothbrush is correctly inserted to return loaded toothbrush
5. Product size will not obstruct normal use of school's single occupancy bathroom
6. Product will be designed such that it will guide toothbrush motion once it is placed into holder

Design Alternatives (Existing Products)

This product will not meet:

Specification 3: Toothbrush will be placed in a way such that users lacking fine motor skills can insert toothbrush

Specification 6: Product will be designed such that it will guide toothbrush motion once it is placed into holder

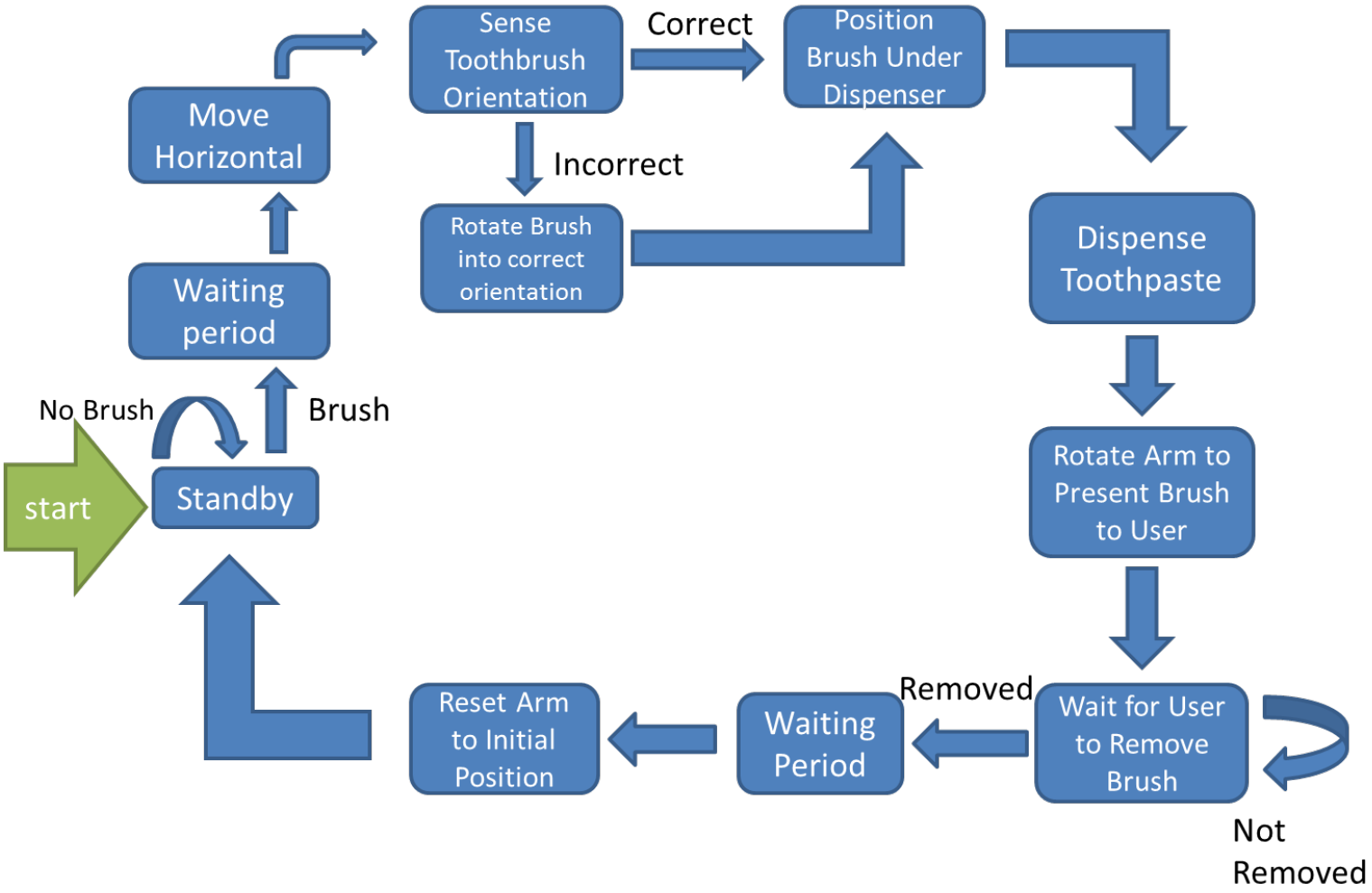
Design Alternatives (Existing Products)

This product will not meet:

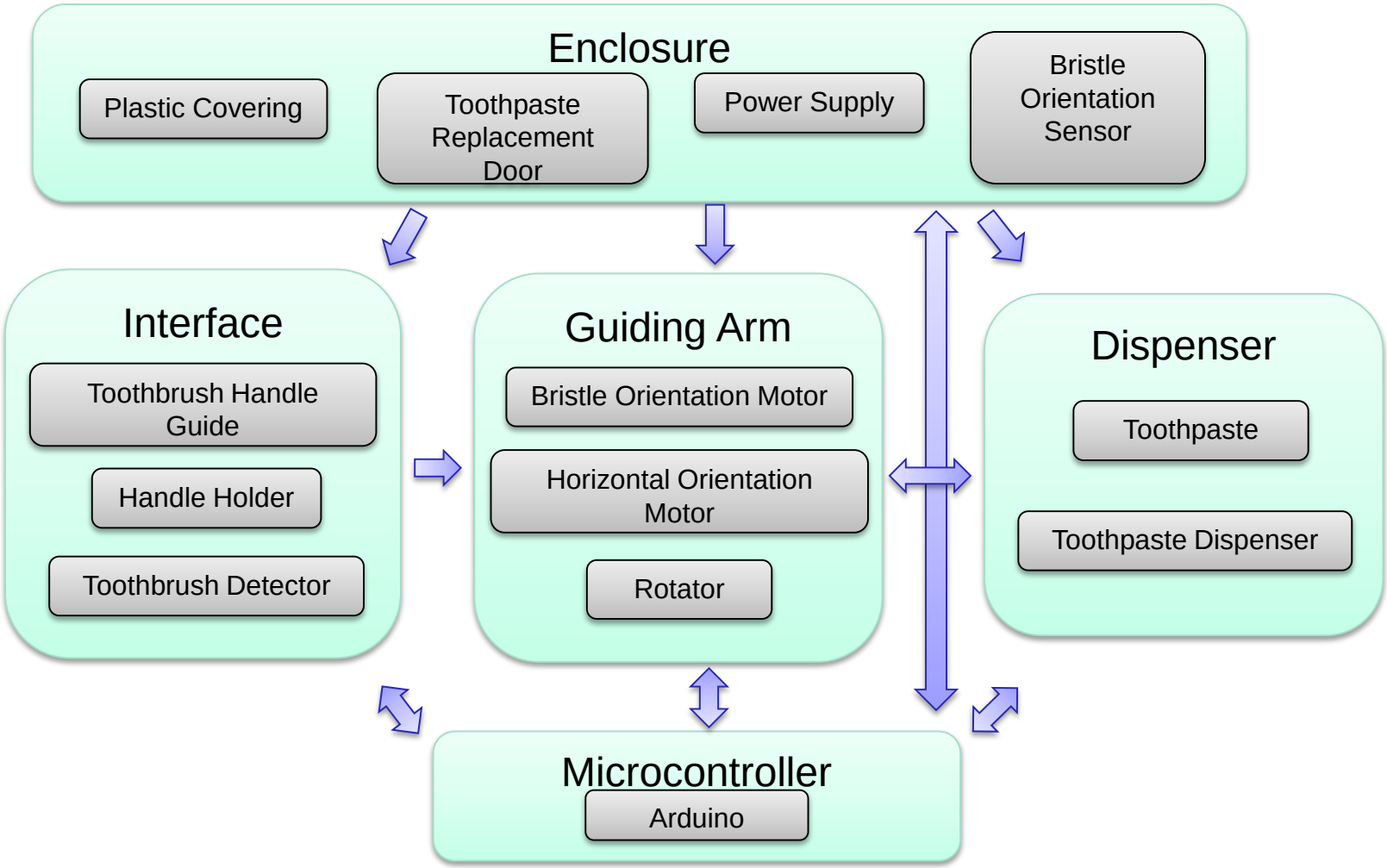
Specification 2: Will hold toothbrush such that the machine and toothbrush will stay sanitary

Specification 3: Toothbrush will be placed in a way such that users lacking fine motor skills can insert toothbrush

Solution: State Machine

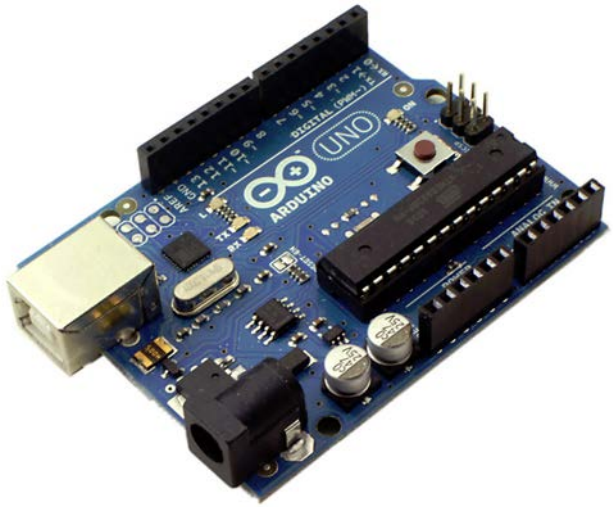


Solution: Block Diagram



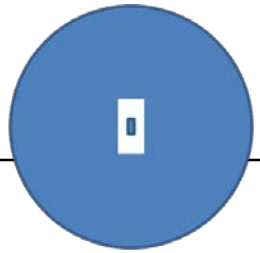
Subsystem: Microcontroller

- Satisfies requirement 4
- Arduino Uno
- Controls all motors and sensors
- Controls timing of operations
- Easily programmable
- Digital and analog inputs and outputs
- Contains onboard clock

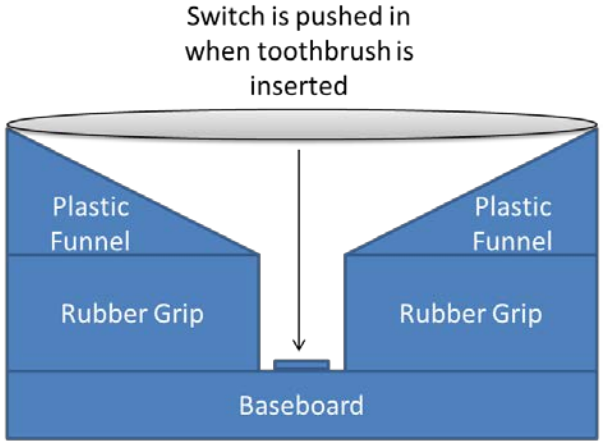


Subsystem: Interface

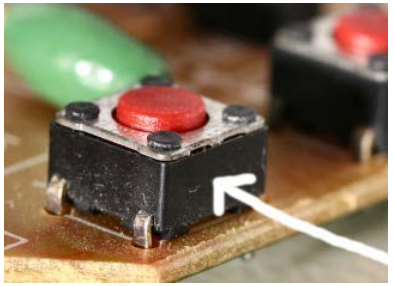
- Satisfies requirement 3
  - Plastic funnel allows for guided entry into grip
- Helps satisfy requirement 2
  - Direct contact only with handle of brush
- Rubber grip holds toothbrush in place while allowing easy entry and exit
- Micro switch indicates toothbrush detection



Top View

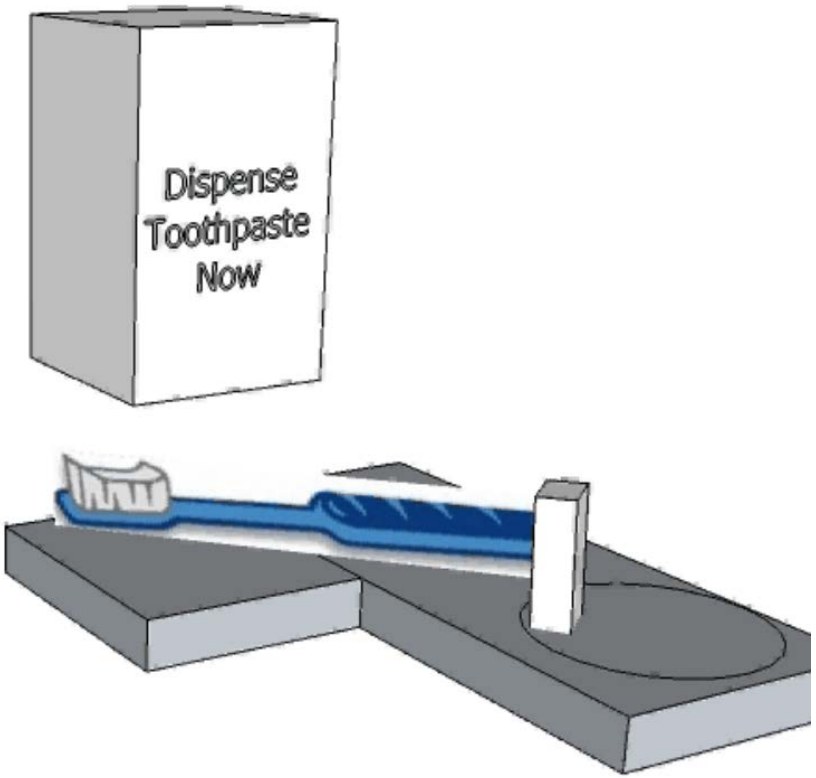


Side View



Subsystem: Guiding Arm

- Satisfies requirement 6
  - Once activated toothbrush is fully guided through motion
  - Limits user involvement to initial insertion and final removal
- Uses servo motors to control motion
  - Compact
  - Easy to Use
- Helps satisfy requirement 2
  - Controls motion for minimum surface contact



Subsystem: Dispensing

- Satisfies requirement 1
  - COTS dispensing product designed to dispense proper amount of toothpaste
- Helps satisfy requirement 2
  - Toothbrush does not come into contact with dispenser
- Uses Servo Motor to control Dispensing
- Will dispense toothpaste only when toothbrush is in correct position

Subsystem: Enclosure

- Need enclosure to house all products
- Plugged into wall for power
- Helps with requirement 2
  - Limits access to dispensing mechanism
- Allows for easy replacement of empty toothpaste tube
- Keeps electronics, motors, and other components out of direct contact
- Helps satisfy requirement 3
  - Allows for easy toothbrush insertion and removal
- Satisfies requirement 5
  - Compact enough to fit into confined space in bathroom

Subsystem: Additional Features

- Time Permitting:
  - Sound indicators for proper toothbrush insertion and removal
  - LED indicator to show low toothpaste supply
  - Programmable timer to help encourage proper brushing for students
    - Light and Music integration
  - Network interface to notify teacher of low toothpaste
  - Work for a wider range of toothbrush sizes

Products: Budget

- COTS Toothpaste Dispenser: $25.00
- Toothpaste: $5.00
- Arduino Microcontroller $35.00
- Interface Product: $50.00
  - Funnel
  - Rubber Holder
  - Microswitch
- Motor/Servo
  - 4x $40.00 = $160.00
- Proximity Sensor: $70.00
- Enclosure: $150.00

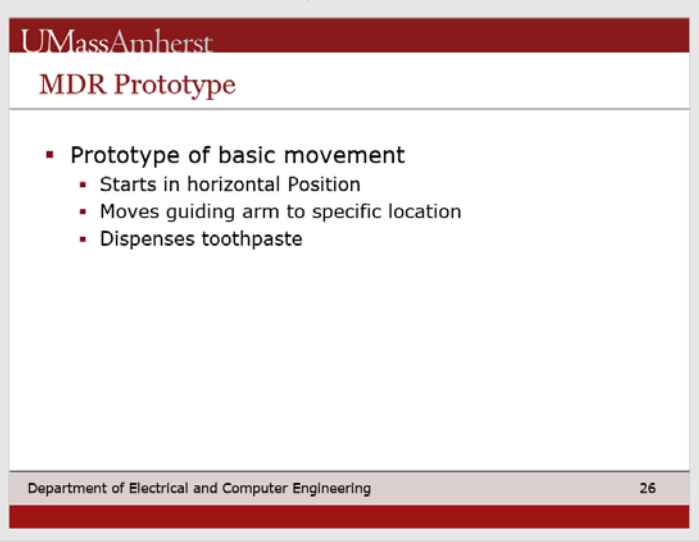
TOTAL: $495.00

Subsystems: Risks

- Hardware
  - Custom Designed Enclosure
  - Third Party COTS Dispenser
  - Many moving parts
- Software
  - Arduino working with chosen sensors
  - Proper timing of motors crucial to success

MDR Prototype

- Prototype of basic movement
  - Starts in horizontal position
  - Moves guiding arm to specific location
  - Dispenses toothpaste



Warning

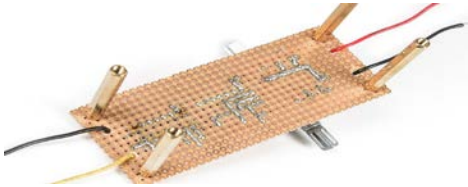
This slide was not sufficient, it should:

- include figures
- provide details on what will be specifically prototyped

Significant HW Component (1/3)

- Significant custom analog and/or digital electronic circuit demonstrated on a solderless breadboard at MDR and as a PCBA at CDR, FPR and demo days.

- Identify the individual who is taking primary responsibility for the PCBA.
- If your design call for one or more circuit boards, they can be either PCBs or hand-soldered protoboards.



- Solderless breadboards are not allowed at CDR, FPR and demo days.

Significant HW Component (2/3)

- Prototype rapidly for MDR.
- Use development boards/breakout boards for MDR.
- Development boards not allowed at CDR, FPR and demo days.
  - including Arduino, mbed and no-operating-system 8-bit and 32-bit dev boards.
  - instead, migrate your MDR design onto your custom PCB and migrate your Arduino code to ANSI C code prior to CDR.

Significant HW Component (3/3)

- Raspberry Pi and the Beagleboards are allowed throughout the course unless it is determined that your justification for using a power-hungry and complex single-board Linux-based computer is found lacking. In those cases you'll be required to migrate your design down to an 8-bit or 32-bit microcontroller on your own PCB.

- Recommend:
  - Altium Design for PCB layout
  - Surface-mount technology as opposed to through-hole technology

Other Slides You Need

- Breakdown of activities for each student
  - Each student should discuss their responsibilities
  - Each student should be able to answer questions regarding their approach
- What will you present at FPR and at Demo Day
  - Be prepared to answer questions about this.
  - A drawing would be helpful
  - Be realistic

Other Suggestions

1. Have a friends review your slides.
2. Practice by asking each other questions.
3. Wear nice clothes. Easier to be taken seriously.
4. Have fun! Think of it as a performance rather than a presentation.

UMass SDP20 PDR – Evaluation Sheet

Team Members:

Evaluators:

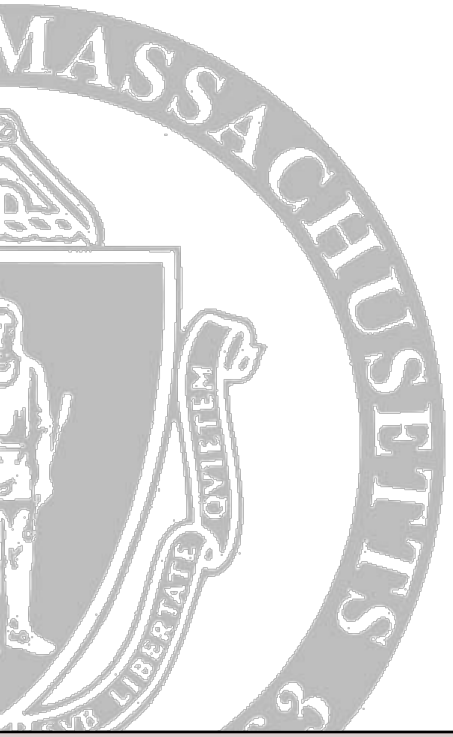
Team Number/Name

Presentation (15%)	❑ (4.0) A professional presentation that demonstrates knowledge and practice. ❑ (3.5) The presentation should have been practiced more. ❑ (3.0) The presentation was confusing at a few points. ❑ (2.5) The presentation was confusing at more than a few points. ❑ (2.0)The presentation was poorly organized or presented.
Project Plan (10%) • Prob Statement • Requirements/ Specifications	❑ (4.0) Project's background, design and deliverables described in straightforward and non-technical terms. Requirements are clear, complete, quantitative and appropriate. ❑ (3.5) A few necessary characteristics of the problem statement and/or a few necessary requirements are missing. ❑ (3.0) More than a few characteristics and/or more than a few requirements are missing. ❑ (2.5) Problem statement and specifications given, but are either inappropriate or very incomplete ❑ (2.0) Minimal emphasis was placed on the problem statement and/or the requirements
Design (35%) • Design Alternatives • Block Diagram	❑ (4.0) Technical and non-technical alternatives were described and compared well. A clear block diagram, well defined interfaces, and feasible plan to implement. ❑ (3.3) A single key alternative or comparison criteria was omitted and/or one or two blocks is poorly defined or feasibility is unknown. ❑ (2.7) Comparisons were not made well or multiple key alternatives were omitted, and/or more than two blocks are missing interface or feasibility. ❑ (2.0) Minimal emphasis was placed on alternatives and/or the block diagram needs major work.
MDR Prototype (20%)	❑ (4.0) MDR prototype is sufficiently described and addresses the most essential, technically challenging portion of project. Individual responsibilities addressed. ❑ (3.3) Either the most essential portion of the project or individual responsibilities were not fully addressed. ❑ (2.7) Both the most essential portion of the project and individual responsibilities were not fully addressed. ❑ (2.0) Both the most essential portion of the project and individual responsibilities were not addressed.
HW Component (5%)	❑ (4.0) The proposed significant hardware component was well-described and sufficient. ❑ (3.3) Either the proposed significant hardware component was not well-described or not sufficient. ❑ (2.7) Both the proposed significant hardware component was not well-described and not sufficient. ❑ (2.0) The proposed significant hardware component was not addressed.
Budget (5%)	❑ (4.0) The budget was well-described and complete. ❑ (3.3) Either the budget was not well-described or incomplete. ❑ (2.7) Both the budget was not well-described and incomplete. ❑ (2.0) The budget was not addressed.

UMass SDP20 PDR – Evaluation (Written Comments) **Team Members:** **Evaluators:**	**Team Number/Name**
Presentation	
Project Plan	
Design	
MDR Prototype	
HW component	
Budget	
Other Comments:	

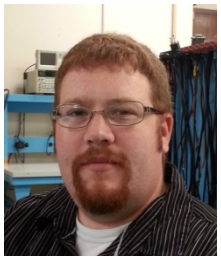
Scheduling a PDR

Preliminary Design Review



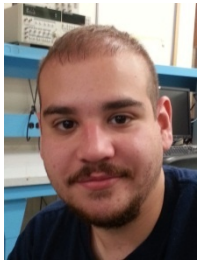
Team RCA
October 15, 2012

RCA (Real-Time Concussion Analyzer)

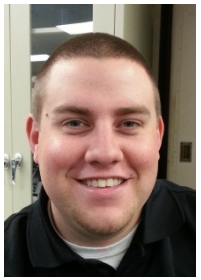


Timothy Coyle
EE

Kenneth Van Tassell
EE



Scott Rosa
CSE



Justin Kober
EE

Concussion Detection in High School Football

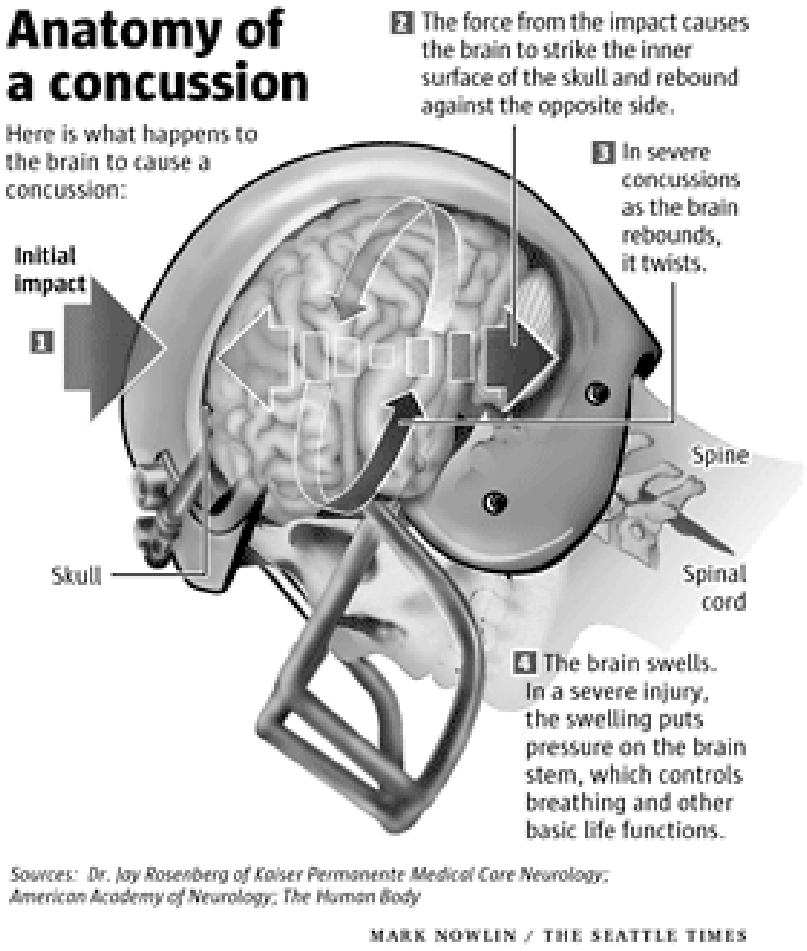
- Current concussion detection
  - Train coaches to recognize symptoms
- Players may hide or not experience symptoms right away

How significant is the problem?

- 1.6 – 3.8 million sports-related concussions in the United states every year
  - Have reached “epidemic level”

- Not only professionals
  - Young people ages 15 – 24 years
    - Second leading cause of TBI (Traumatic Brain Injury)

Context: Effect on Individuals



- Post Concussion Syndrome
  - Problems concentrating, irritability, sensitivity to light…
- If gone undiagnosed
  - One hit away from traumatic brain injury
  - Multiple impacts add up

Context: Effect on Groups

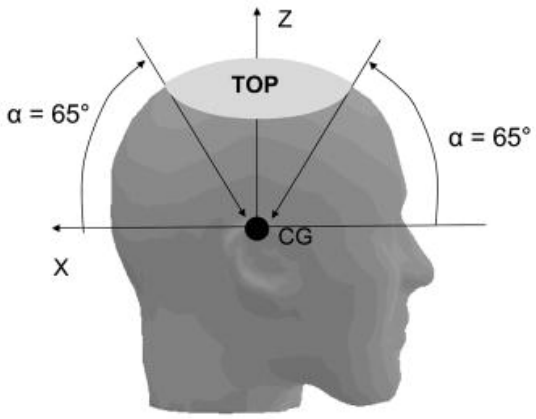
- Affects team sports and the way they're played
- "Tough guy attitude"
  - Creates a culture
- Subjective decision making

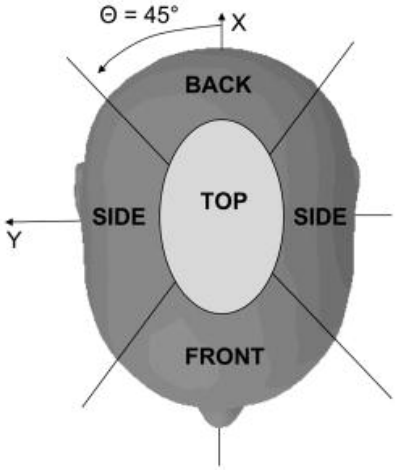
Requirements Analysis: Specifications

- Real-Time continuous impact measurements
- Player specific adaptability
- Equipment weight increase less than 5%
- Effective range 150 m
- Responds in under two seconds
- Robust
  - Interference
  - Durable

Design Alternatives

- HITS – Head Impact Telemetry System †
  - Six accelerometers
  - Frequency, location, and magnitude
  - Sideline response system
  - Linear acceleration

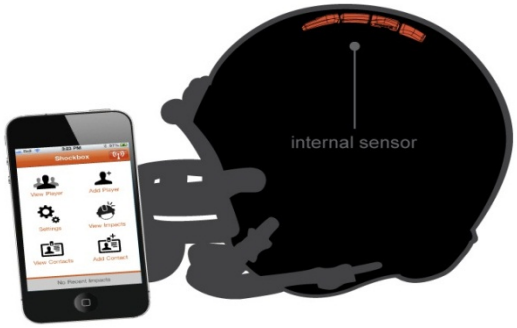




†Measuring Head Kinematics in Football: Correlation Between the Head Impact Telemetry System and Hybrid III Headform. Beckwith, Jonathan, Jeffrey Chu, and Richard Greenwald. October 13th 2011

Design Alternatives

- ShockBox
  - *Impakt Protective*
  - Commercial use for football/hockey
  - Secured with high adhesive bonding tape
  - Wireless transmission
  - Threshold of 50 g set by app



- HEADS
  - *BAE Systems*
  - Military use
  - Suspended beneath the crown of the helmet
  - Wireless/USB transmission
  - Processing done by computer at base

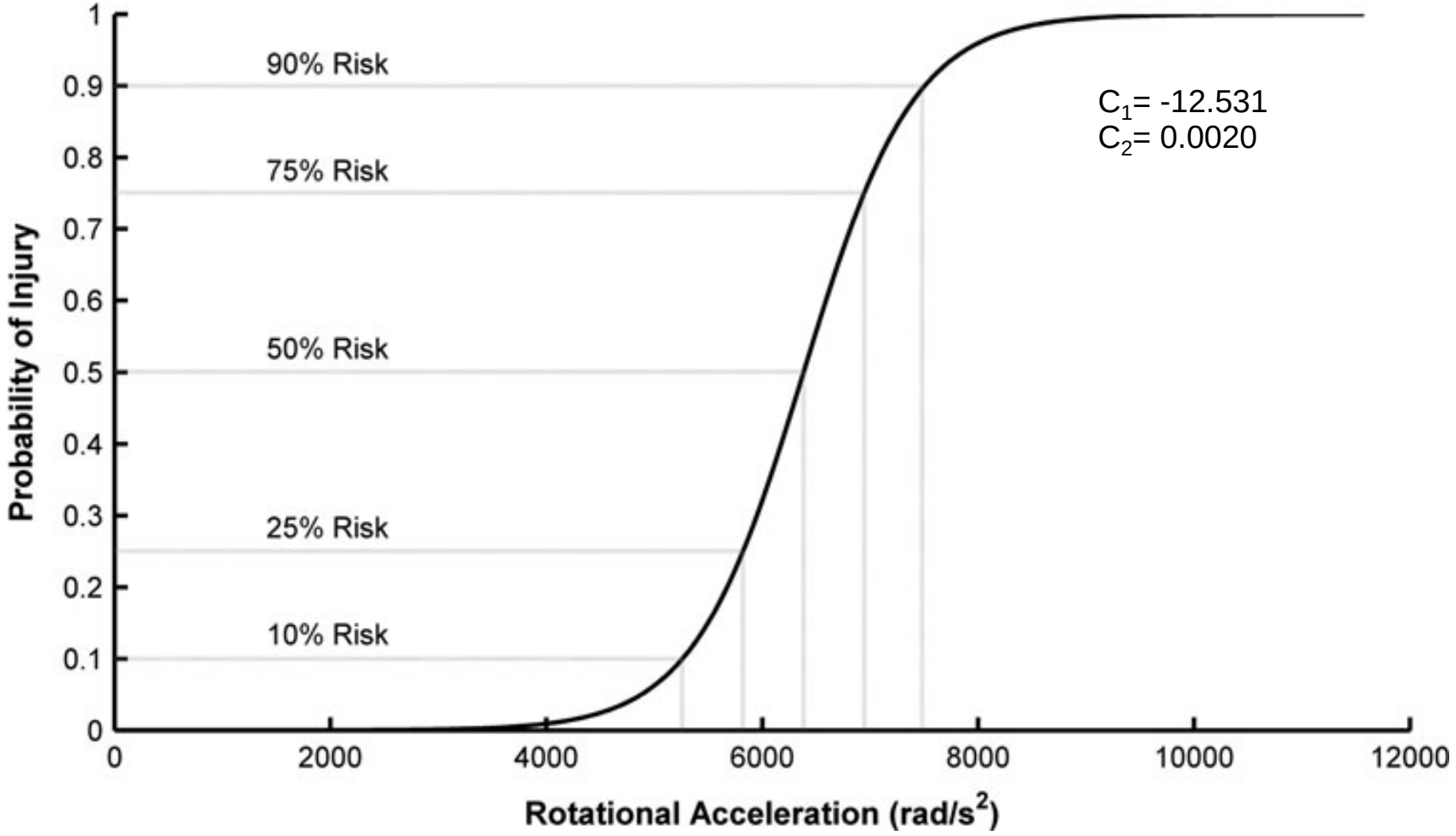
From Impact to Probability

- "Rotational Head Kinematics in Football Impacts: An Injury Risk Function for Concussion"
  - S. Rowson *et al. Annals of Biomedical Engineering, Vol. 40, No. 1, January 2012*

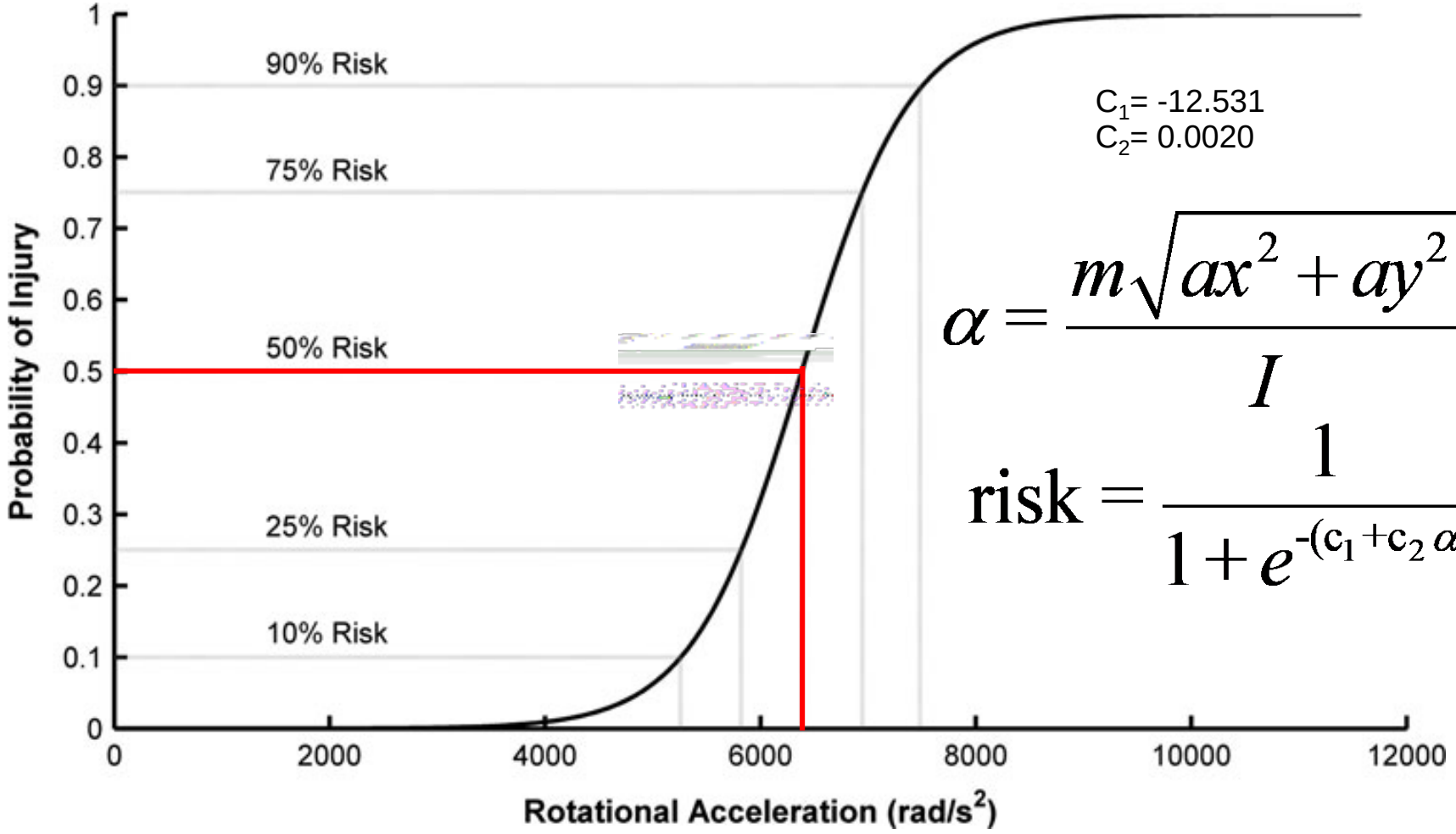
- Rotational acceleration is important

$$\text{risk} = \frac{1}{1 + e^{-(c_1 + c_2 \alpha)}}$$

Risk Function



Risk Function



C_1= -12.531
C_2= 0.0020

$$\alpha = \frac{m\sqrt{ax^2 + ay^2}}{I} d$$

$$risk = \frac{1}{1 + e^{-(c_1 + c_2 \alpha)}}$$

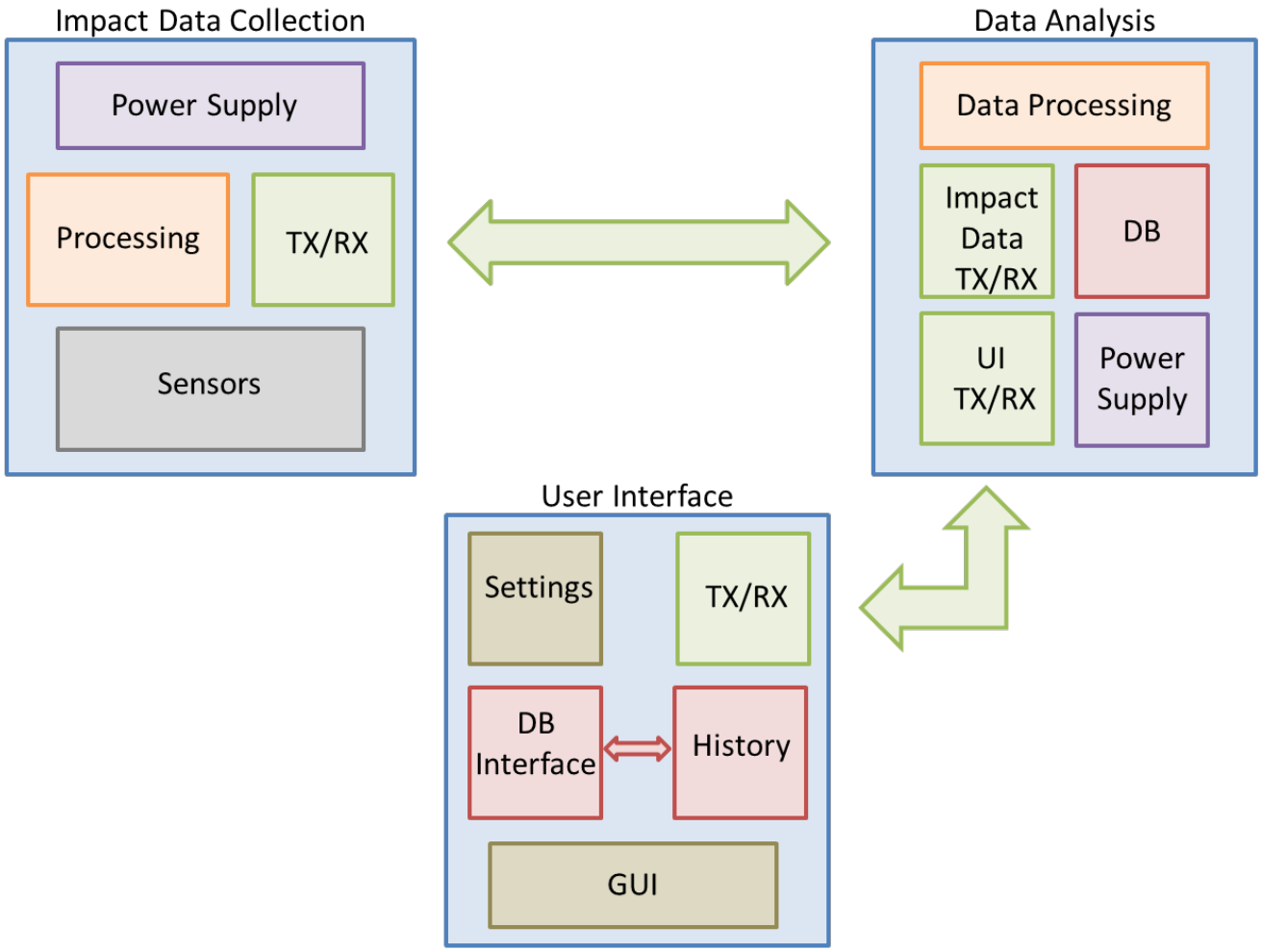
Our Solution: RCA

- Array of sensors in helmet padding
  - Continuous measurements
  - Variable impact thresholds
  - Wireless transmit on threshold trigger
- Base station
  - Database: Impact data & medical history
  - Concussion algorithm
  - Wireless transmit to UI & triggered helmet
- UI
  - Android device
  - Easy to interpret results within two seconds of impact

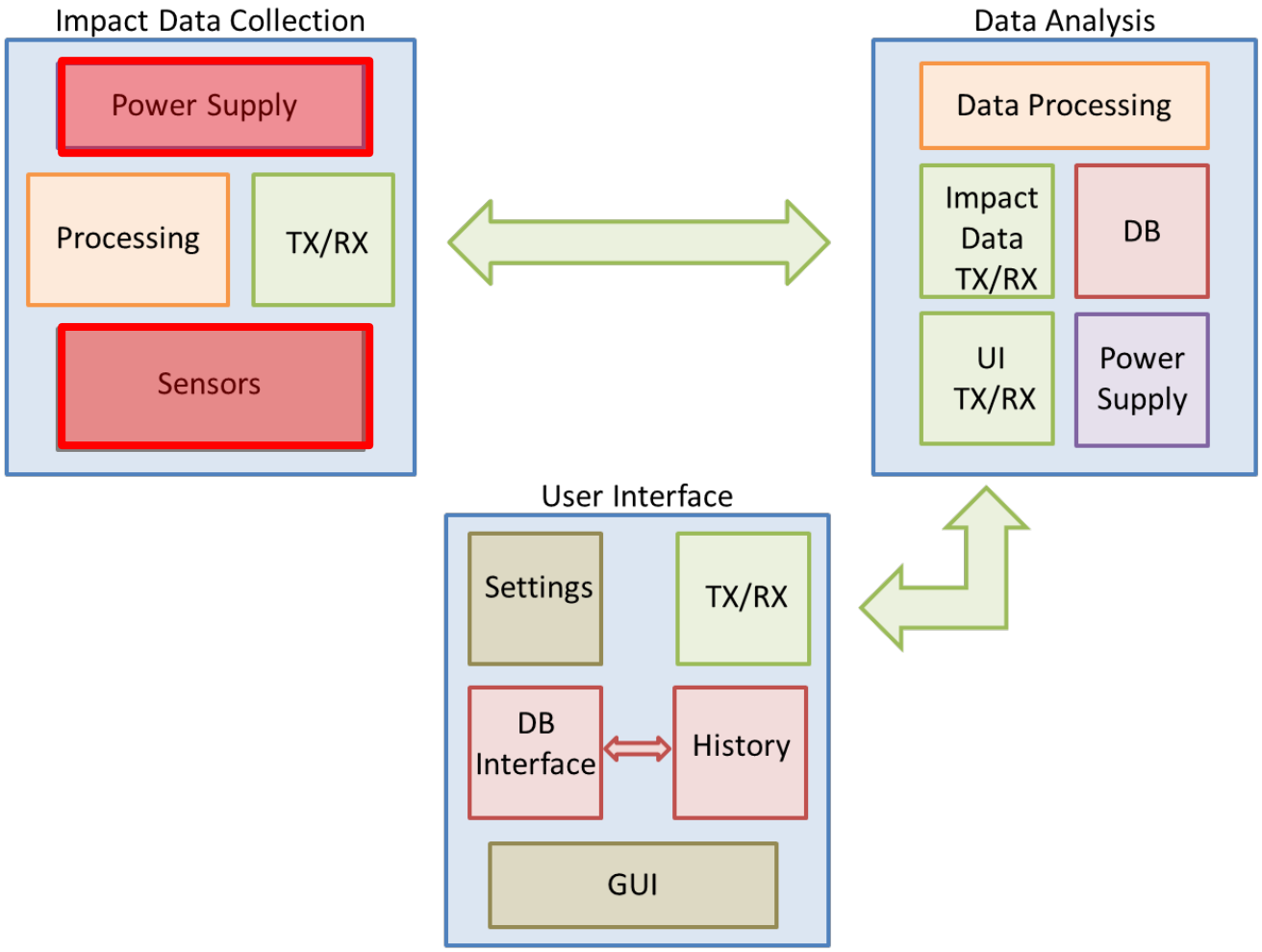
Our Solution: RCA

- Array of **sensors** in helmet padding
  - Continuous measurements
  - **Variable impact thresholds**
  - Wireless transmit on threshold trigger
- Base station
  - **Database: Impact data & medical history**
  - Concussion algorithm
  - Wireless transmit to UI & triggered helmet
- UI
  - Android device
  - Easy to interpret results within two seconds of impact

Our Solution: Block Diagram

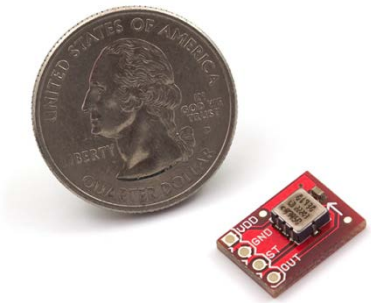


Sensor Network



Sensors

- Requirements
  - Accurate
  - Response time under 100 ms
  - Low power
  - Lightweight and secured safely
    - Players should not notice sensors



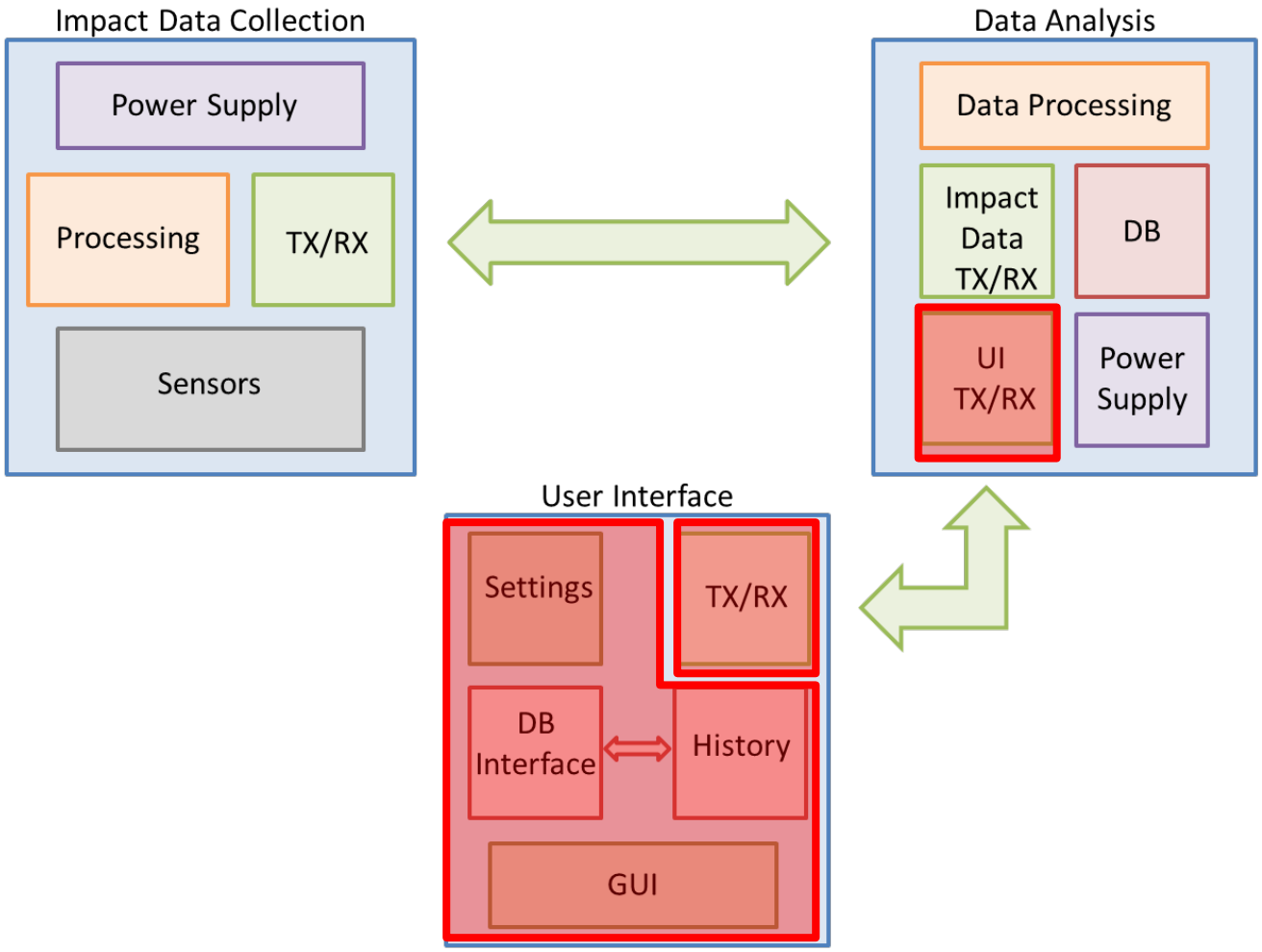
- Implementation
  - Accelerometers, Gyroscope
  - Successful Senior Design Projects
    - Motion Analyzer for Physical Therapy (2010) for Accelerometers
    - Personal Head-Up Display (2009) for Gyroscope

Power

- Requirements
  - 3.5 – 6 V in helmet
  - Safe, reliable and lightweight
  - Up to five hour run time

- Experience
  - Power supplies
    - Design experience in previous coursework
    - Theater design project

User Interface and Communication



UI

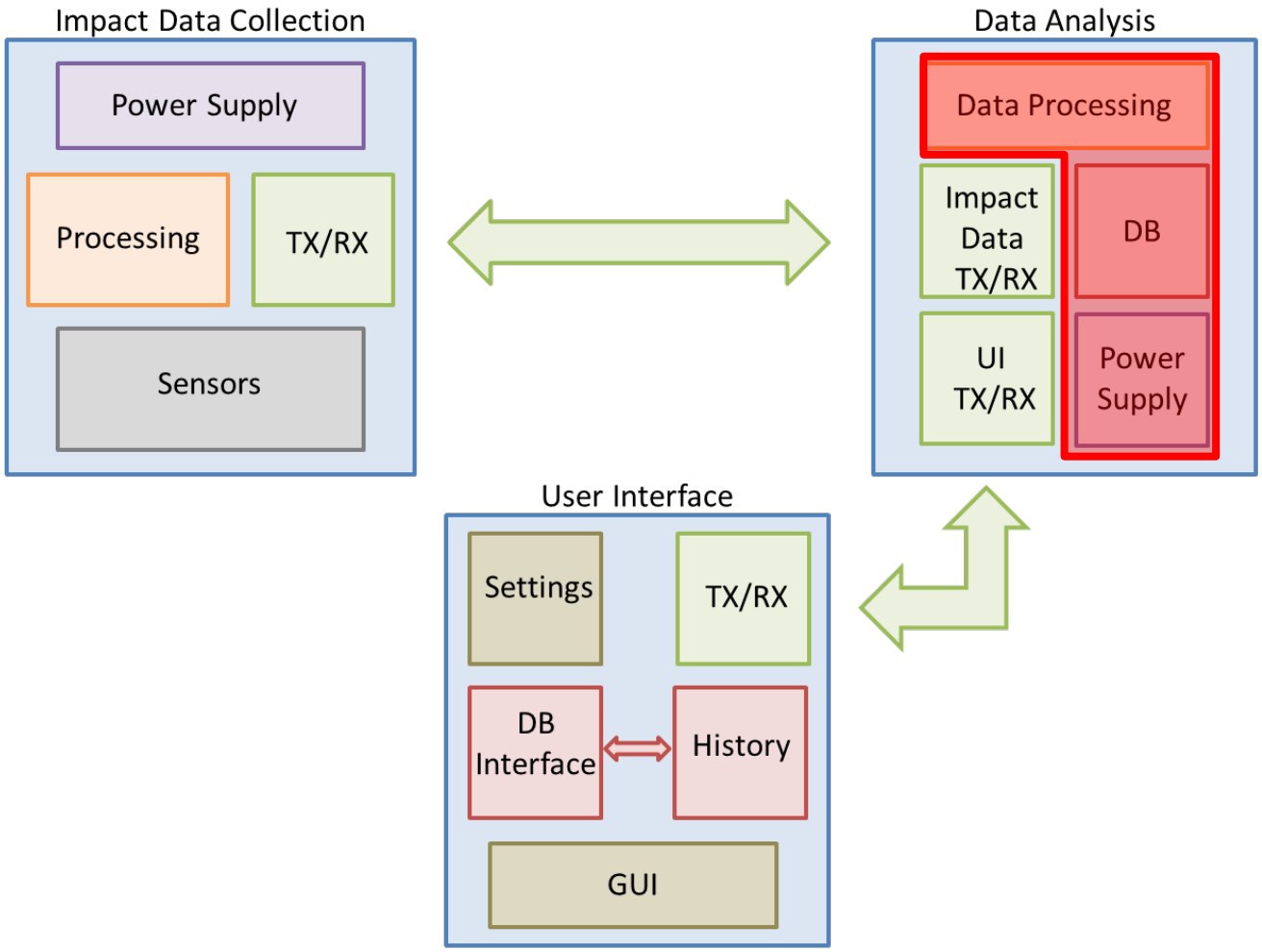
- Requirements
  - Easy to use
  - Deliver meaningful results
    - Medical staff
    - Coaching staff
- Implementation
  - Android Development

Tx/Rx for UI

- Requirements
  - Reliable
  - Response time under 500 ms
  - Easy to implement

- Implementation
  - Android WiFi/ Bluetooth Integration
  - Successful Senior Design Projects
    - BlueTag (2010) for Bluetooth
    - UMass Campus View (2010) for WiFi

Data Processing and Storage

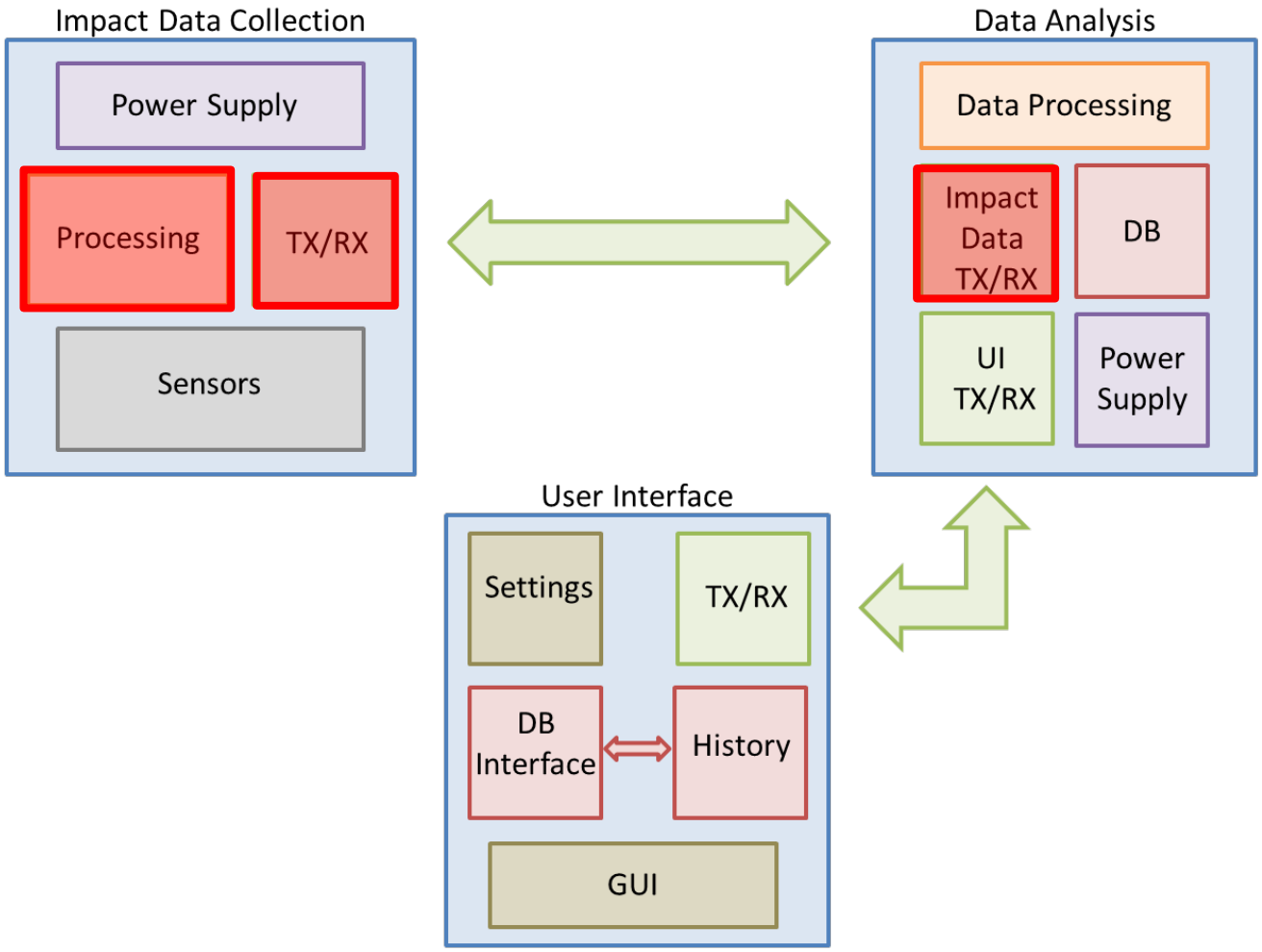


Data Processing and Storage

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

- Experience
  - Software development for Bose
  - Data organization and analysis algorithm development for ECM

Impact Processing and Communication



Impact Processing

- Requirements
  - Low power and lightweight
  - Inputs for at least 7 sensors
  - Tx/Rx Capable
  - Flash memory
- Experience
  - ATMega Microcontroller
    - Used in ECE 353
    - LED Cube

Impact Data Tx/Rx

- Requirements
  - Low power and lightweight
  - Effective range up to 150 m
  - Efficient data transfer rates
  - Secure

- Implementation
  - XBee
  - Successful Senior Design Projects
    - SAFE-T (2012) for XBee

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