Preliminary Presentation

Specialized Pads for Dual Sequential Defibrillation

Team Members:

Rebecca Poor, Hunter Belting, Daisy Lang, Nick Johnson, Jack Sperling, Maribel Glodowski

Client: Dr. Michael Lohmeier

Advisor: Dr. John Puccinelli, Tyler Ross

Presentation Overview

- Problem Statement
- Background Information
- Product Design Specifications
- Design Ideas
- Design Matrix
- Future Work
- References and Acknowledgements

Problem Statement

Client: Dr. Lohmeier, Method for Dual Sequential Defibrillation (DSD) Implementation

Problem #1: DSD pad placement with out removal of LUCAS

Problem #2: DSD requires two defibrillation monitors

Goal:
Create a device to perform DSD from one monitor and adapt pads to be placed without removal of the LUCAS

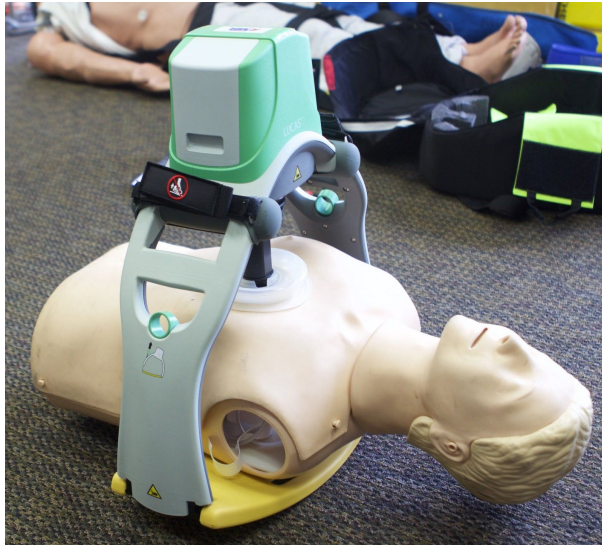


Figure 1: LUCAS Device [1]
https://www.mlive.com

Background Material

- Cardiac arrest is disruption in electrical rhythm of heart
- Defibrillation depolarizes myocardial cells [2]
- 1 per 200,000 individuals experience Refractory Ventricular Fibrillation [2]

DSD: <u>TWO</u> defibrillation shocks sent through the heart back to back

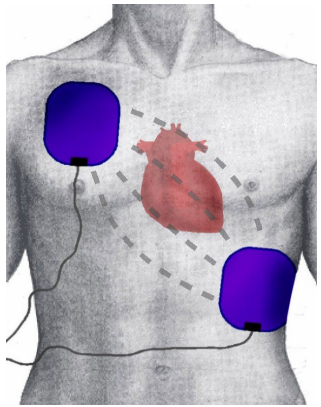


Figure 2:
Standard Defibrillator Placement [3]
https://www.firstaidforfree.com

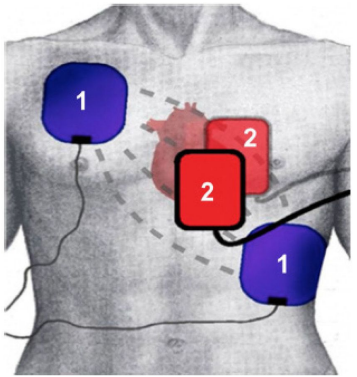


Figure 3:
DSD Placement [4]
https://www.researchgate.net

Competing Designs

- **Novel design**
  - 4 electrodes per patient
  - Anterior/anterior and anterior/posterior
- **Similar products**
  - Zoll CPR-D-padz [5]
  - Zoll CPR Stat-padz
  - Stryker/Physio-Control Cardiac Pads [6]

Figure 4: Zoll Pads [5]
Zoll.com

Figure 5: Stryker Pads [6]
Stryker.com

Product Design Specifications

- **Make DSD results quantifiable & repeatable**
  - 360J split from 1 monitor
  - 0.5 - 2.0 seconds [9]
- **Quick, simple, effective**
  - Easily understandable
  - > 96% reliable [10]
  - Device must be reusable
- **Highly compatible**
  - 3 separate cardiac monitors
- **$500 budget**

Figure 6: Lifepak Monitor [7]
Stryker.com

Figure 7: Zoll Pads [5]
Zoll.com

Figure 8: Zoll Monitor [8]
Zoll.com

Jack

Design 1: Light Sensor Design

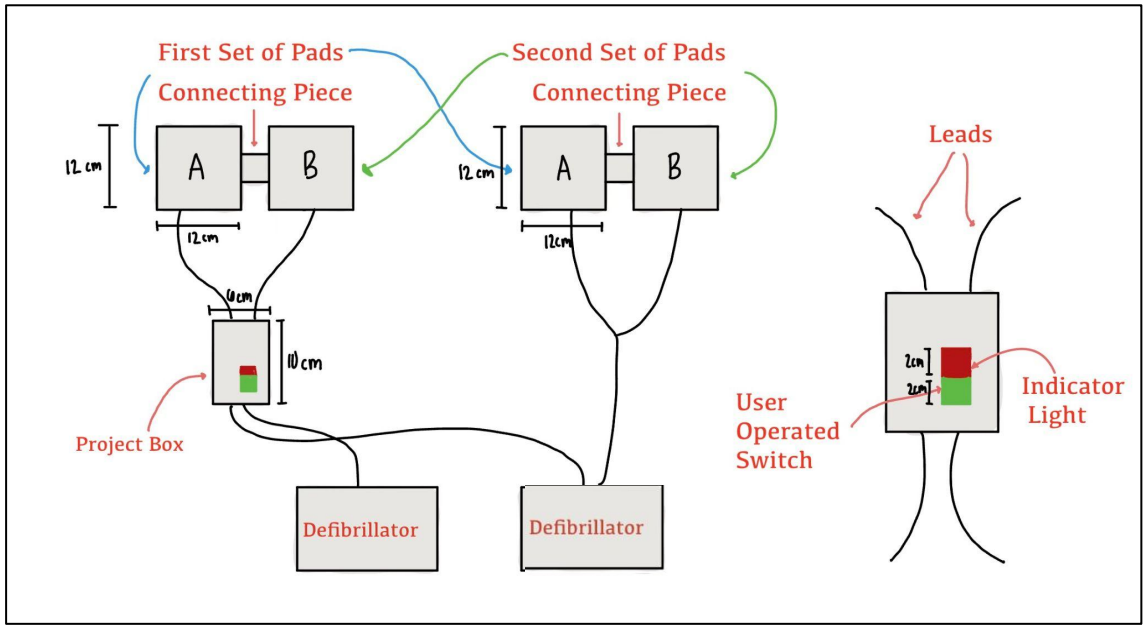


Figure 9:
Light Sensor Design

Advantages

- Connection to monitor
- Reads initial shock

Disadvantages

- Increased cost with AED ($2,000) [11]
- Possibility for user error

Maribel

Design 2: Layered Electrode Design

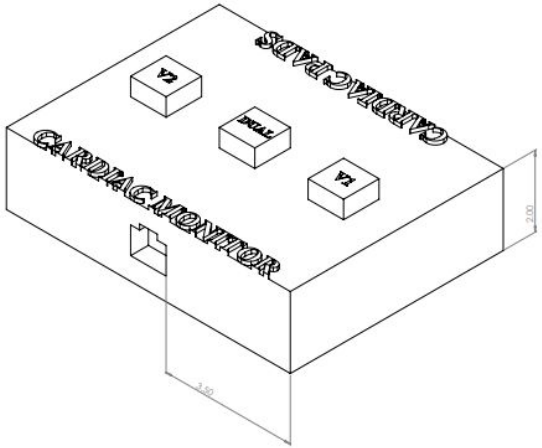


Figure 10:
Layered Electrode Box Design

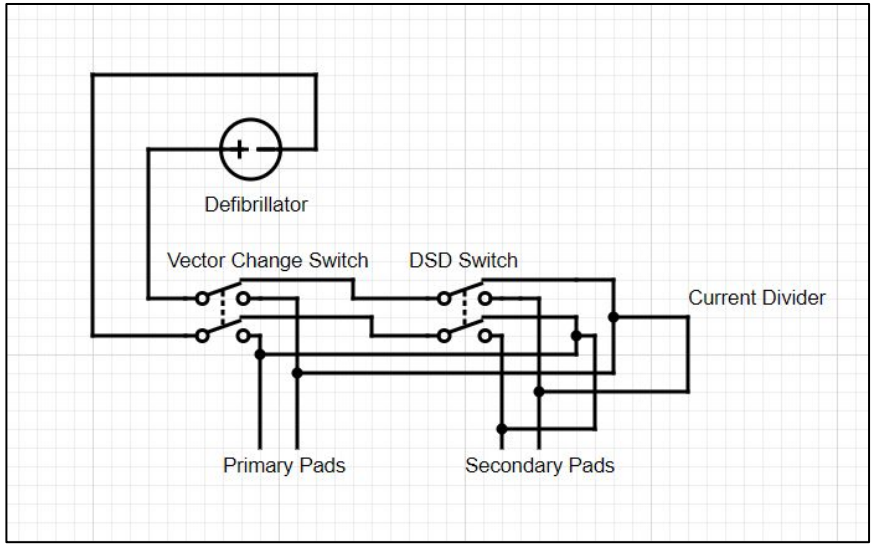


Figure 11:
Layered Electrode Preliminary Circuit

Design 2: Advantages & Disadvantages

Advantages

- The buttons easily switch defibrillation needs
  - Vector changes
  - Dual sequential defibrillation
- Only one monitor is required for dual sequential defibrillation
- Internal time delay

Disadvantages

- Compatible only with LifePak
- 180 J delivered for DSD
- Possibility to bump buttons during use

Design 3: Modular Shock Pack (Exterior)

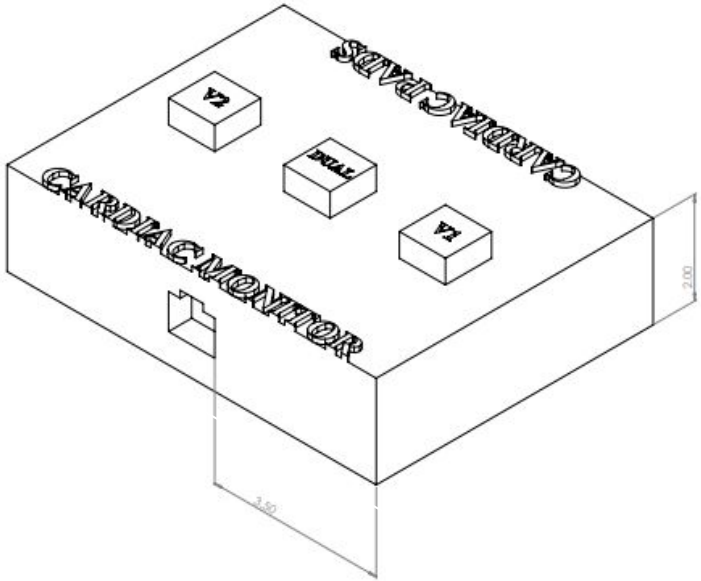


Figure 12:
Modular Shock Pack Exterior Design

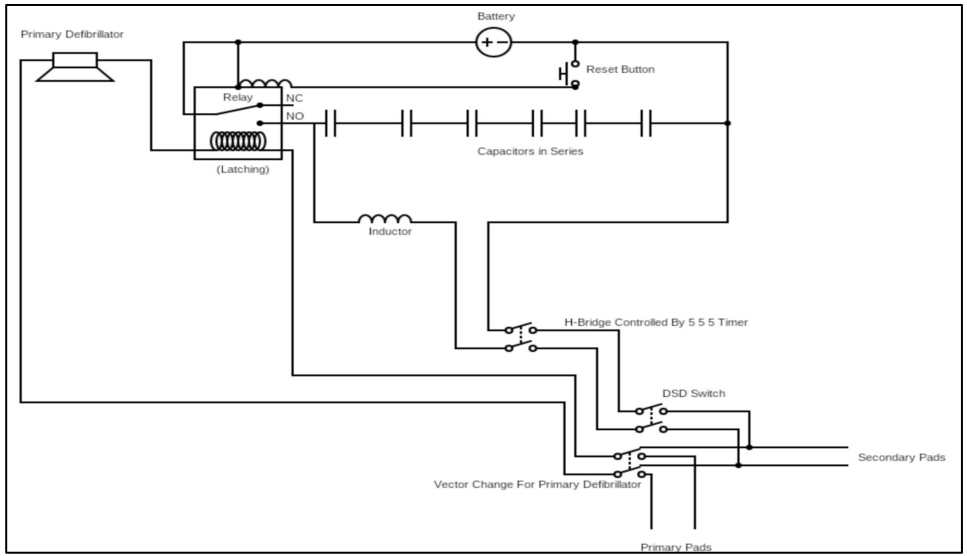


Figure 13:
Modular Shock Pack Circuit Design

Nick

Design 3: Advantages & Disadvantages

Advantages

- Flexibility to deliver as many joules as wanted to each set of pads
- Modular to different defibrillator brands
  - (Zoll, LifePak, Philips)
- Allows for vector change
- Automated Time Delay

Disadvantages

- Does not calculate impedance
- Preset voltages
- Significantly more complex circuit
- Requires large power source
- Reliability and effectiveness

Nick

Design Matrix

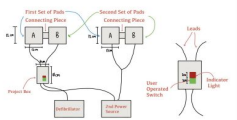
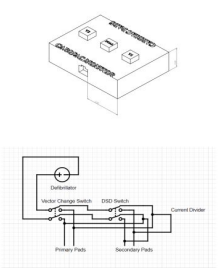
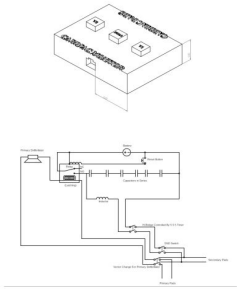
Design Criteria	Light Sensor Design		Layered Electrode Design		Modular Shock Pack Design	
						
Feasibility (25)	**5/5**	25	**4/5**	20	**2/5**	10
Efficiency (20)	**2/5**	8	**4/5**	16	**2/5**	8
Reliability (20)	**3/5**	12	**4/5**	16	**2/5**	8
Ease of Use (15)	**2/5**	6	**4/5**	12	**5/5**	15
Safety of Operator (10)	**5/5**	10	**4/5**	8	**2/5**	4
Cost (10)	**1/5**	2	**5/5**	10	**1/5**	2
Total (100)	**63/100**		**82/100**		**47/100**	

Figure 14:
Design Matrix

Becca

Future Work

- Development
- Testing
  - ~ 180 Joules being sent to each vector in DSD
  - Perform at UW Emergency Education Center
    - Efficiency between DSD and vector change
    - Time delay within specified range (0.5-2 seconds) [9]

Figure 15:
Practice Manikin and Ambulance at Education Center [12]

https://www.uwhealth.org

Acknowledgements

- BME Department
- Dr. Michael Lohmeier
- Dr. John Puccinelli
- Tyler Ross
- Dr. Amit Nimunkar

References

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Thank You! Questions?