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Microfluidic Cell Lysis Device for Point of Care Diagnostics

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Microfluidic Cell Lysis Device for Point of Care Diagnostics

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UCI Samueli School of Engineering

OMNICA CORPORATION PRODUCT DEVELOPMENT

Background

- Point-of-care (POC) diagnostics provide quick results for patients in remote areas with limited access to laboratory equipment.
- Concurrently in-vitro diagnostic device market is a valued at $24 billion dollar and its expected to be valued at over $70 billion by 2020
- These diagnostics require access to intracellular components, such as DNA, which can be accessed by bursting open the cell, a process called cell lysis.
- Microfluidic technology allows for an entire laboratory procedure to miniaturized onto a small, portable platform, allowing for a quicker diagnostics and results.

Goals

- Lyse 75% of cells by stressing the cell membrane using thermal and or standing electric field generation technology.
- Optimize design of device and develop circuit board.
- Develop a power and a control system for the heaters and electric field generators powered solely off batteries.
- Confine the dimension of the platform to that of a standard iPhone®6.

Timeline

	Winter Quarter	
Objectives and Tasks	Wk 9	Wk 10
2. Building Phase		
Class Presentation		
Winter Design Review		

Legend
Quarter
Milestone
Weekly

	Spring Quarter									
Objectives and Tasks	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
3. Testing Phase										
Develop Software for Device										
Assemble Device and Test/Improve Device										
May UROP Symposium										
Assemble Final Version of Device										
Final Design Review and Symposuim										

Prototypes

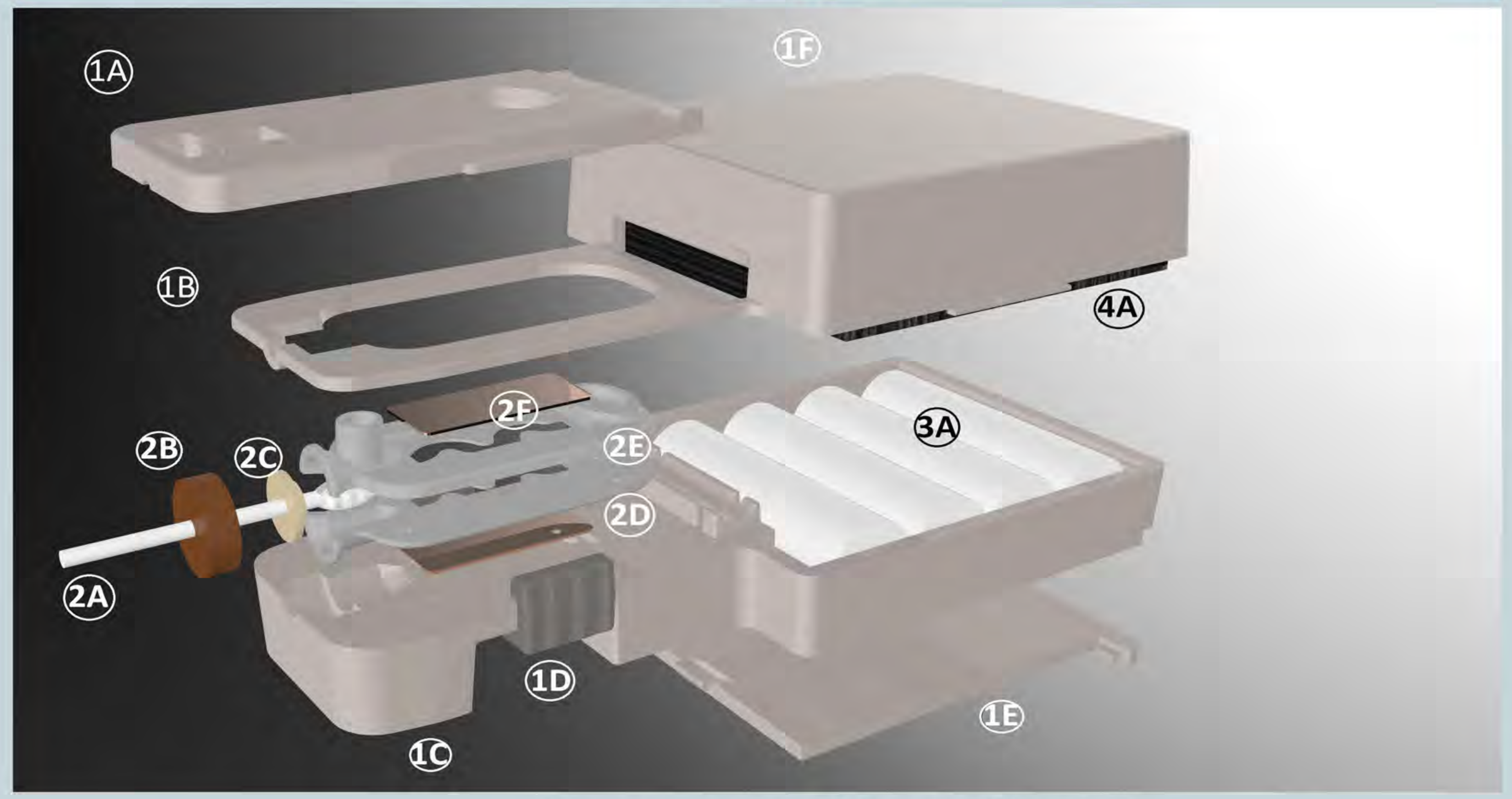

Figure 1: Cell Lysis Device

Figure 1 (Exploded View): (1A,B,C,F) represent the exterior of the device. (1D) is the safety latching mechanism that secures the disposable lysing chamber to the heaters mounted on (1A,C). (1E) is where the user can replace the batteries. (4A) represents the placement of the circuit board. Parts (2A-F) compromise the design of the dispoable componet.

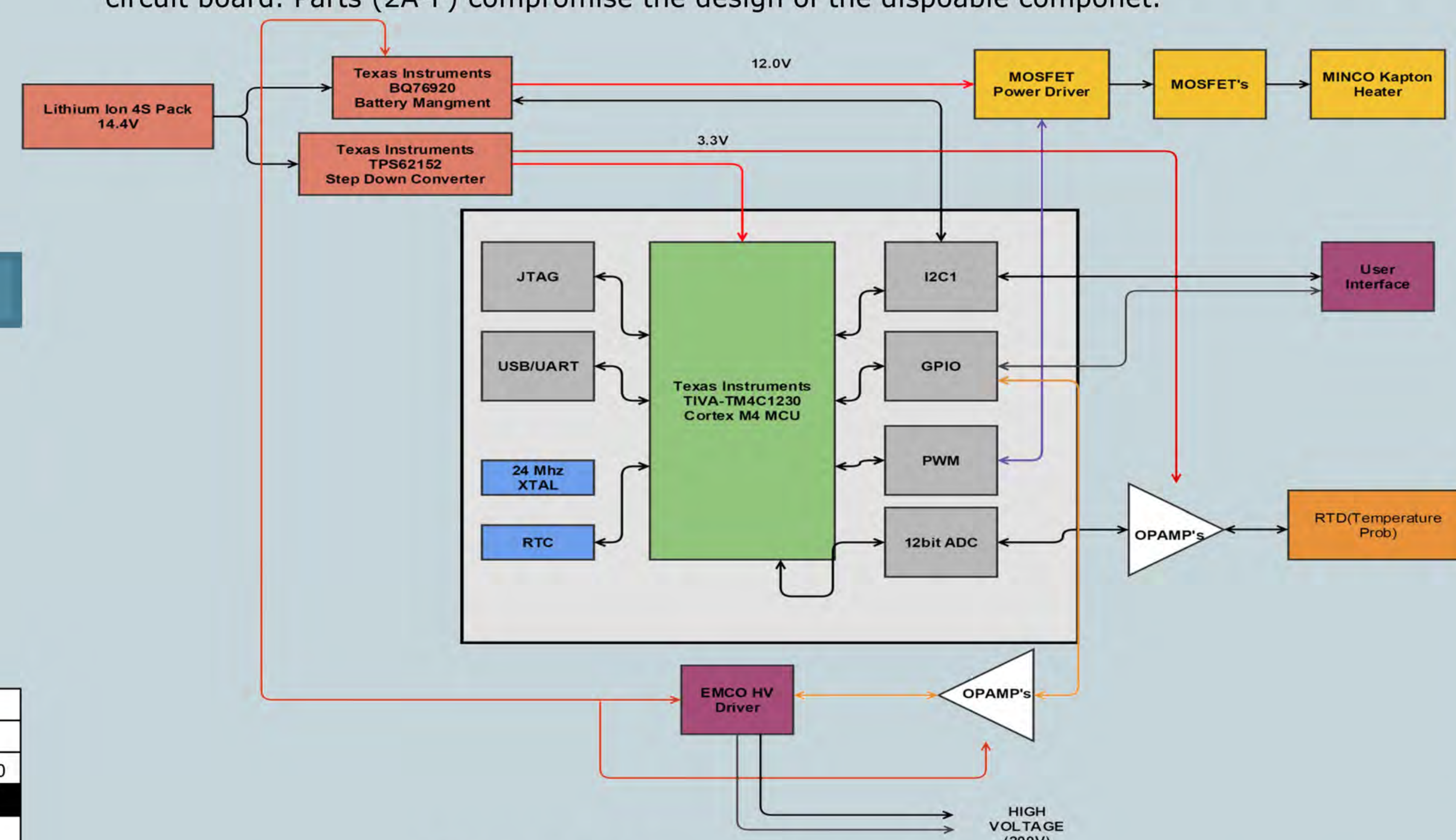

Figure 2: Design of Electronics

Figure 2: The design of the heater control unit consisting of a Texas Instruments TIVA ARM M4 at the core of the device, utilizing two Minco Kapton Heaters controlled through a Proportional Integral Loop. Two surface mounted thermistors on the heaters to consistently monitor the temperature of the heaters, this information is fed back to ADC's. Utilizing the EMCO high voltage converter, standing electric field can be generated across the lysis sample.

Progress

- Designed the reusable part of the device.
- Optimized geometry of the resuable component and disposable device.
- Conducted lab experiment using HEK cells to test the concept of thermal lysis.
- A run time of 60-120 seconds was required to lysis the HEK cells.
- Designed a custom circuit board for the device that included components to mointor power consumption and discharge of the battery pack and ciruict nesscary to measure RTD's.

Current Status

- Finalizing the design of the heater and electrostatic field generator controller and finalizing the layout of the circuit boards.
- Ordered the necessary micro heaters, thin copper sheets, and micro filters for the device.
- Started manufacturing of both reusable and disposable parts of the cell lysis device.

Team Members

Group Member	Responsibilities
Andrew Chavarin (BME/MAE)	Circuit Design and Electronics
Leovi Espitia (BME)	Concept Validation
Saffi Khan (BME)	Disposable Design
Marisa Lopez (BME)	Research and Report Validation
Frederique Norpetlian (BME)	Reusable Design
Abdullaah Tarif (MSE/AE)	Material Validation & Failure Analysis

Contact

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Team Lysis