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SSOE Research Symposium Dean's Awards

Title

Syroto Bioprinter

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Publication Date

2018-03-15

Supplemental Material

<https://escholarship.org/uc/item/2bt1x2j1#supplemental>

Peer reviewed

Motivation

Over the past fifty years the pharmaceutical industry's productivity in releasing new molecular entities (NME) has remained relatively constant, despite an annual compounding financial investment at approximately 13%¹. Reviews across major pharmaceutical companies attribute an NME's failure to reach commercialization primarily on lack of efficacy (approximately 30%), and safety (approximately 30%)². One approach to validating NMEs is by testing on physiologically relevant in vitro tissues, an intermediate between the current standard of cultured cells and the ideal in vivo organ. Creating a way to streamline research using high sample arrays could accelerate discovery of NME's and repurpose existing ones. Commercialized bioprinters such as Allevi³, 3D-Bioplotter⁴, and Cellink Bio X⁵ feature the pneumatic syringe dispenser but are unable to perform other methods of dispensing such as micro dispensing inkjets, thermoplastic extrusion and mechanical dispensing of whole cell spheroids. Bioprinters with multi-printheads allowing diverse material dispensing are yet to be seen.

Objectives

- Modify the cell dispensing print-head for optimal cell viability and precision.
- Build a novel prototype for fast and reliable printing of biological constructs in a multi-array format (i.e. 96 well array).

References

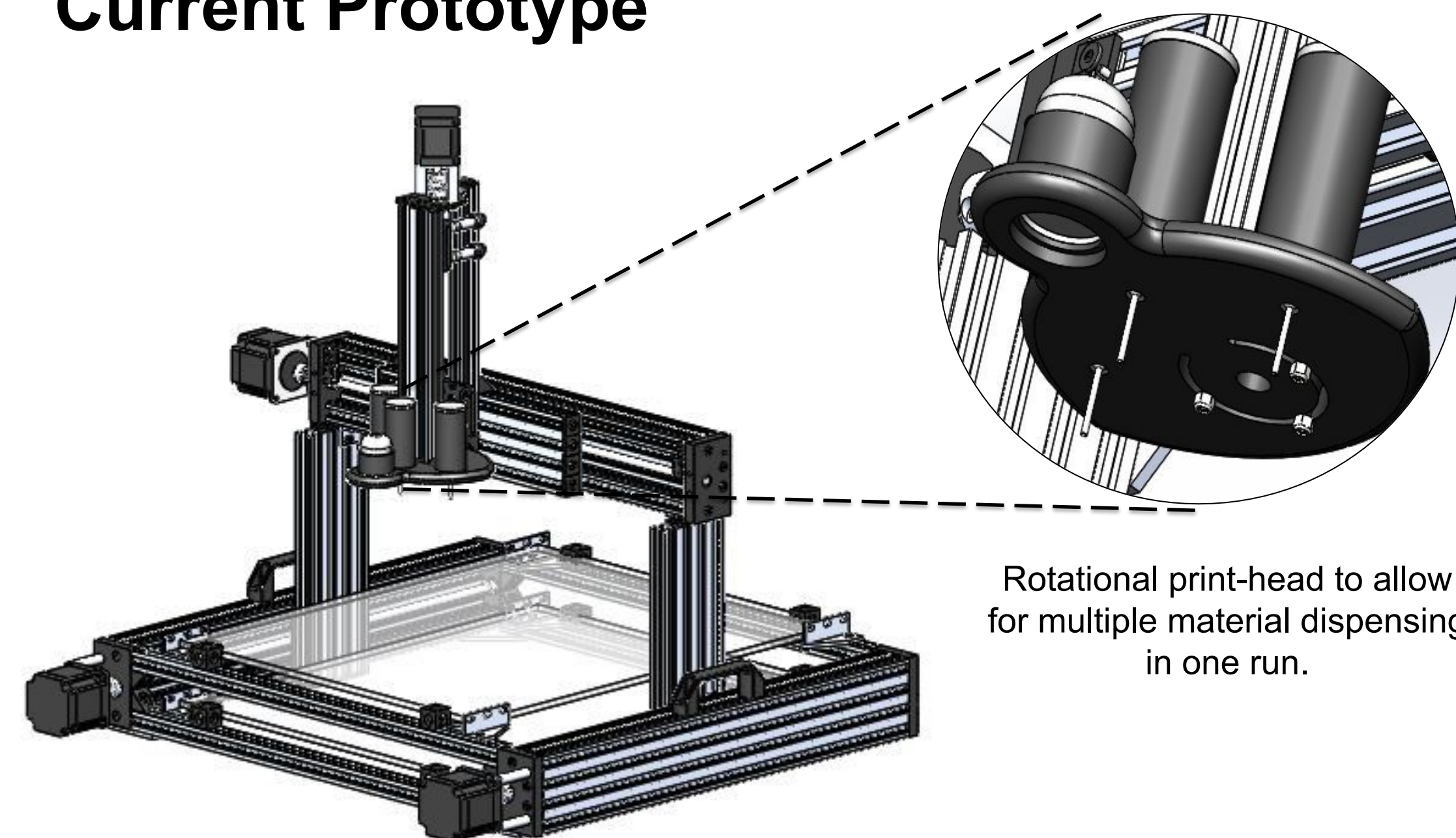
1. Munos, B. Lessons from 60 years of pharmaceutical innovation. Nature reviews. Drug discovery⁸, 959-968.
2. Kola, I. & Landis, J. Can the pharmaceutical industry reduce attrition rates? Nature reviews. Drug discovery³, 711-715.
3. Allevi, Allevi formerly Biobots. Retrieved from <https://biobots.io/> (2017).
4. EnvisionTec, There's Only One 3D-Bioplotter. Retrieved from <https://envisiontec.com/3d-printers/3d-bioplotter/> (2017).
5. Cellink, Cellink Bio X. Retrieved from <https://cellink.com/product/cellink-bio-x-bioprinter/> (2017).

Acknowledgements

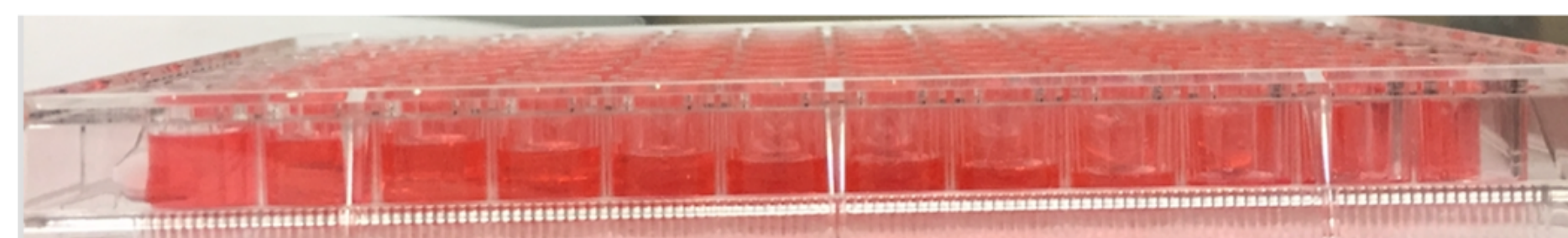
Rachel Hatano, Edwin Shen
Graduate Program in Bioengineering and Small Scale Technologies, UC Merced

Design Process

Current Prototype

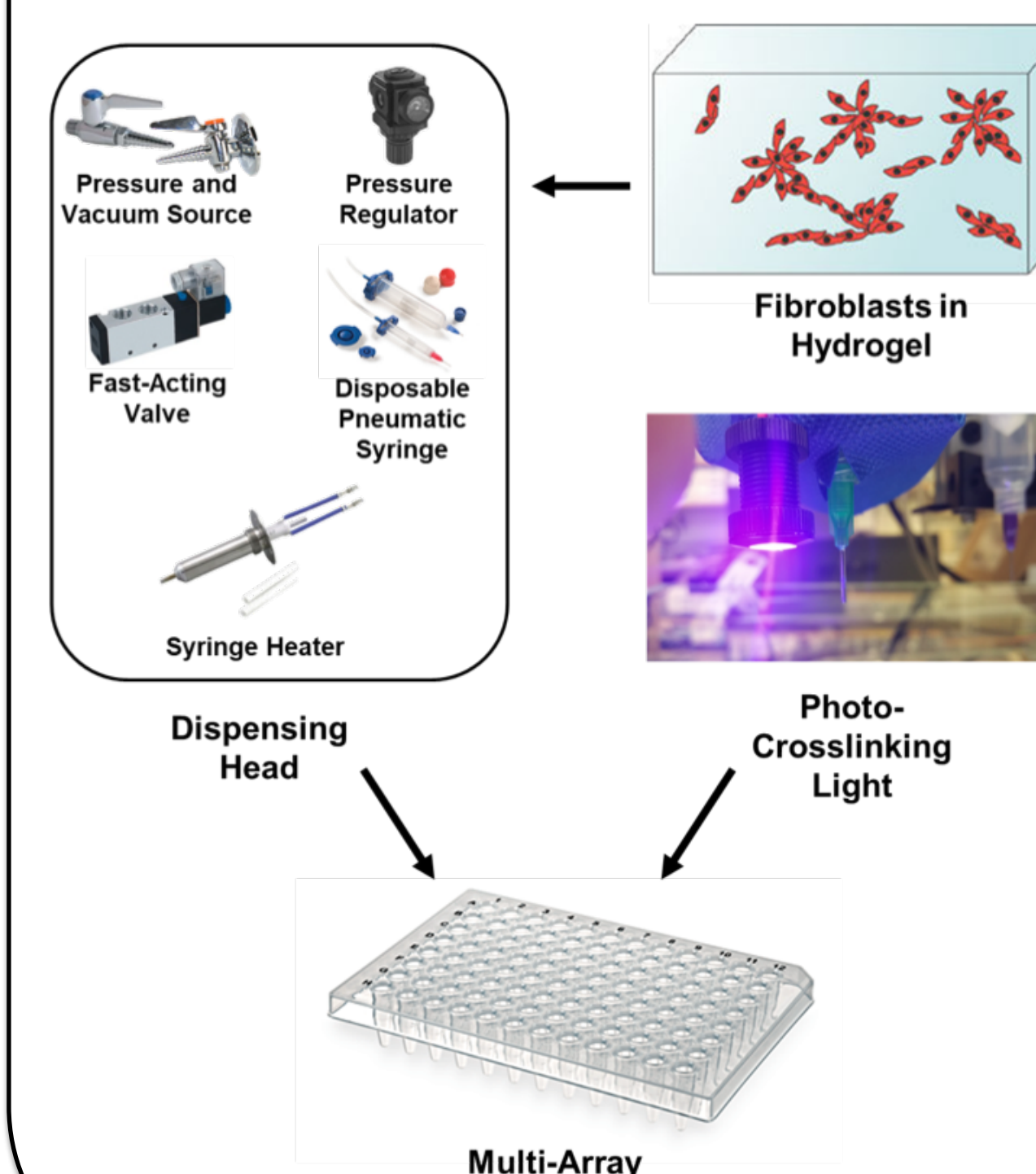


Rotational print-head to allow for multiple material dispensing in one run.

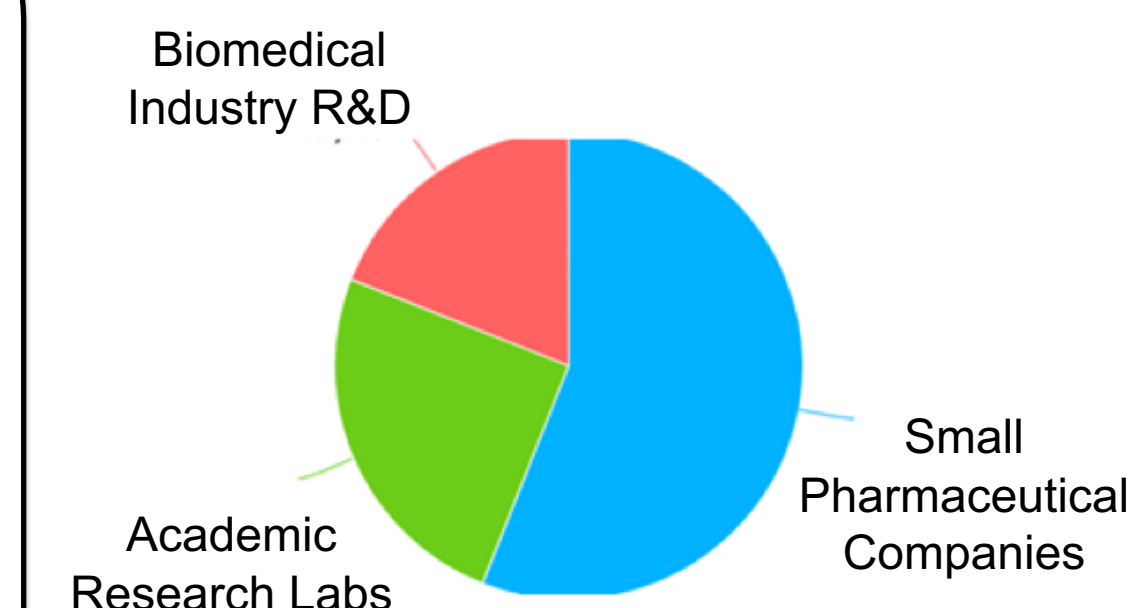


Gradient test dispensing decreasing volumes along a row of 96 well plate.

Cell Dispensing Design



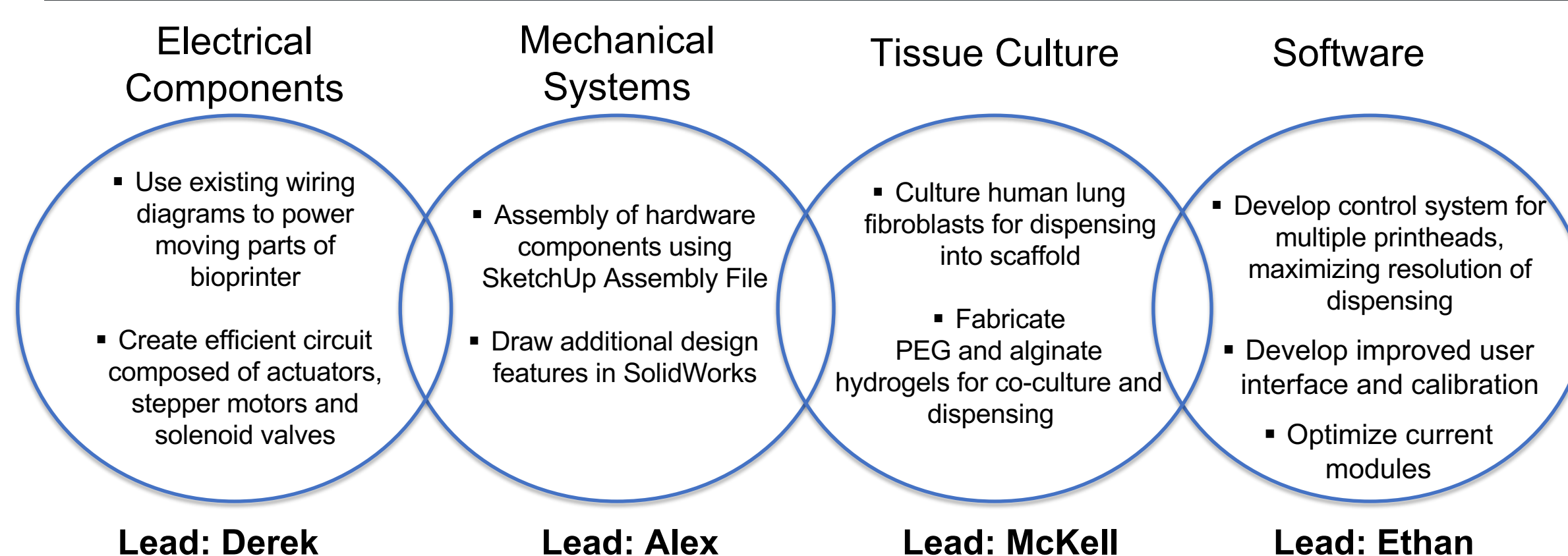
Market Analysis



Spring Design Additions

- Thermoregulation capabilities
- LEDs for photo crosslinking of hydrogels
- User Friendly interface
- Design of replaceable, removable cartridges to increase sales potential

Team Organization



Market Research, Lead: Sydney Interviews will be conducted throughout the design process to receive feedback from leading industry representatives to further aid in developing our design.

All team members will contribute to each aspect of the project under direction from respective leads.

Timeline

Fall	Winter	Spring
<ul style="list-style-type: none"> ○ Assemble printer hardware, wiring and circuitry and test with actuated control programming. ○ Use a laser in place of dispensing syringe to determine needs for resolution requirements and adjustment to target into 96 or more well plate. 	<ul style="list-style-type: none"> ○ Achieve fully optimized resolution and dispensing of different colored gelatin to test dispensing with a similar material but with a slow polymerization time. ○ When testing is sufficiently optimized, we will print target hydrogels in a 96 well tissue culture plate. 	<ul style="list-style-type: none"> ○ Print 3D matrices composed of both hydrogels and cell cultures, using fibroblasts and PEG or alginate, keeping cells alive for at least 3 days in multi-well plates. ○ Assign known drugs to each well and observe distinguishable effects, ○ Finalize project presentation and attend industry night in the spring.