Research Experiences for Teachers and Young Scholars in Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)

A Micro Wearable Device that Increases Accessibility to Healthcare

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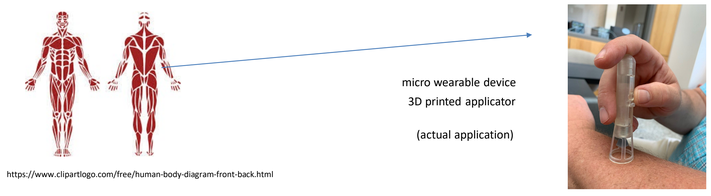
BioInterfaceLab

Motivational Objective

This research aims to develop a micro wearable device which increases accessibility of healthcare by expanding the point-of-care by allowing for sample collection outside the clinical setting. Serving those unable or reluctant to come to a clinical setting also.

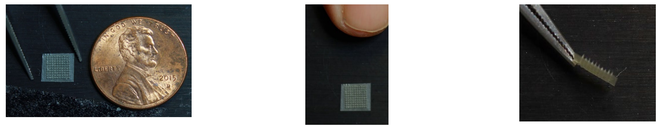
Methods

The powerless device will gather interstitial biofluids from around the cells, for analysis of human health. This will assist in monitoring hemostasis of the body, and providing a greater reach and frequency of care. Testing for such markers as pH, sodium, potassium, calcium, glucose, oxygen, and carbon dioxide levels.

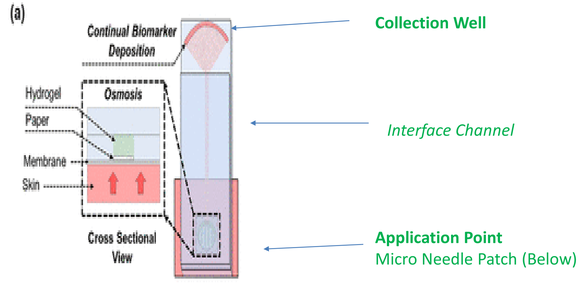


https://www.clipartlogo.com/free/human-body-diagram-front-back.html

Engineering (indirect team work) bio fluids are collected by means of 100 micro needles on a 1cm square patch.



Engineering (direct team work) The micro patch is attached to a uniquely engineered paper pump design for collection. The microfluidics of these paper pumps is the center of our research and design.



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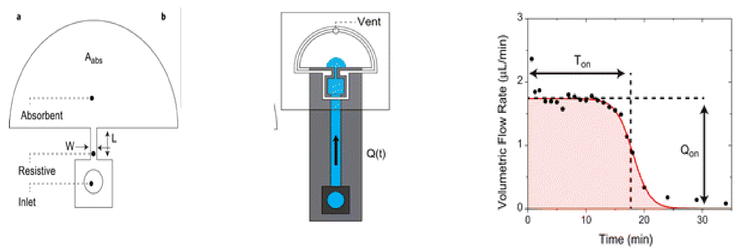
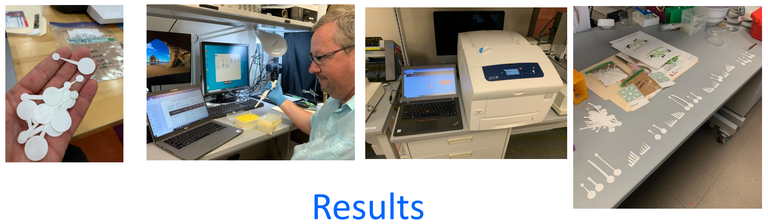
Microfluidics - Powerless Paper Pump Designs



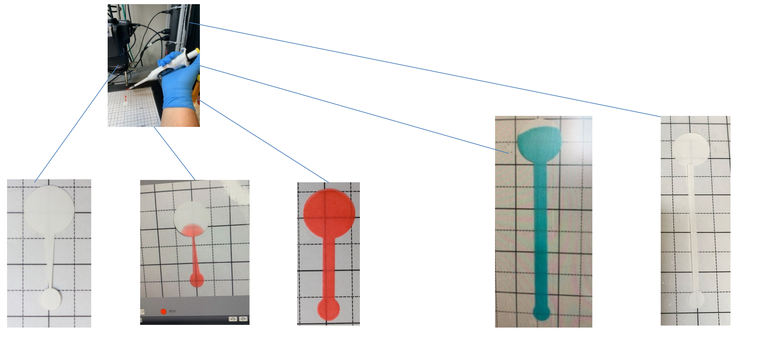
Variables

- Porosity of the filter paper by GE
- Microfluidics Rate of Flow
- Paper pump design
- Shape-size-length-width of pump channel
- Inset venturi like taper (inset and outset)



Results

Laser cut paper pump designs was tested. Also, the GE filter paper material grade 1 and 4 (porosity/fibers) were tested. Pump channel length, width and an inset taper of channel designs tested for the microfluidic rate. Though more testing is required to be conclusive, the outcome favored the 0.25 cm wide 9cm long pump. The 5cm long taper out design tested close to the microfluidic rate of the straight one.

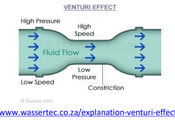


Paper Pump # Timing Microfluidics of paper pump designs	Design	Paper Porosity Grade	Time Test 1	Time Test 2	Time Test 3	Avg Time
Pump 1 (drops each 20sec) 100 ul pipet & tip	Straight 5cm	4	2-42s	2-46s	2-53s	2m-47s
Pump 2(drops each 20sec) 100 ul pipet & tip	Taper In 5cm	4	3-53s	3-38s	3-48s	3m-46s
Pump 3 (drops each 20sec) 100 ul pipet & tip	Taper Out 5cm	4	3-05s	3-15s	2-38s	2m-58s
Pump 1 (paper weight chg)	Grade	1	2-38s	2-28s	2-41s	2-36s
Pump 2 (paper weight chg)	Grade	1	3-42s	3-37s	3-35	3-38s
Pump 3 (paper weight chg)	Grade	1	3-01s	3-42s	2-49s	3-11s
Pump 4 (drops @20sec)	Straight 9cm Width 0.5cm	4	5-15s	6-20s	6-30s	6-02s
Pump 5 (drops @20sec)	Straight 9cm Width 0.25cm	4	5-12s	5-08s	5-44s	5-21s
Pump 6 (drops @20sec)	Straight 9cm Width 0.5cm	1	6-29s	6-38s	6-39s	6-35s
Pump 7 (drops @20sec)	Straight 9cm Width 0.25cm	1	6-15s	6-46s	6-33s	6-31s

Timed testing of the microfluidic rate of each variable

Future Research

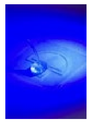
Continued research and engineering design is needed to solve the microfluidic challenge. The collection of the interstitial fluid from the micro needle patch and the flow to the collection area. Such research may include pump designs, inclusion of micro venturi within the channel, the width/length of pump channel, and porosity grade of the filter paper. The importance and future success of this project (device) is a paradigm shift in medical care.



https://www.wassertec.co.za/explanation-venturi-effect-applications/

FILTER PAPER Fisher Scientific

McKenna's Pump Design



Fluorescent (UV) Fluid Flow

Acknowledgement

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Joint Department of BIOMEDICAL ENGINEERING

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