A precise handheld injection device for cardiac interventions

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Overview

- Motivation and Background
- Client Requirements
- Existing Devices
- Pneumatic Design
- Electrical Design
- Mechanical Design
- Design Matrix
- Future Work
- References
- Questions

Motivation and Background

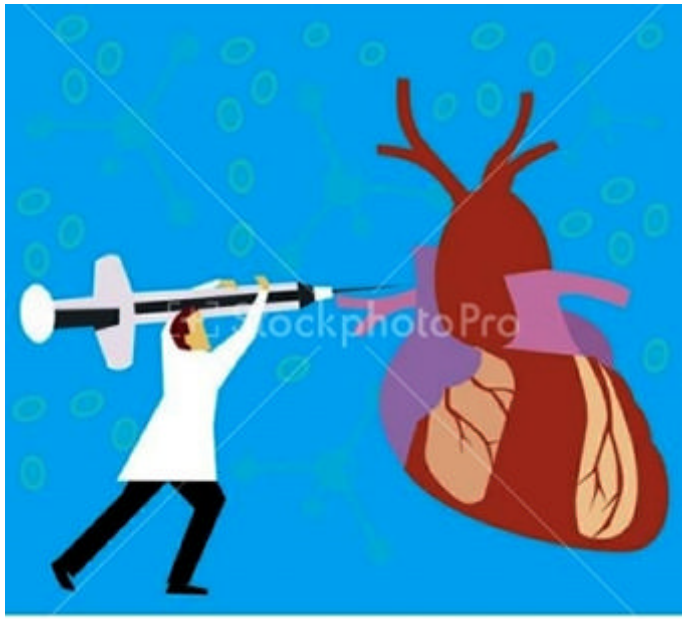
- Dr. Raval researches how stem cells can restore cardiac function to the heart

- Currently uses manual injection method
  - Leads to inconsistent results for testing due to human variability
  - 100 - 200uL over 15-30 seconds
  - Manual injection produces variable shear stress

http://commons.wikimedia.org/wiki/File:Injection_Syringe_01.jpg

Client Requirements

- Small handheld device
- Disposable
- Simple operation
- Portable/Cordless
- Low cost to manufacture
- Injects at constant, preset rate and pressure
- Alert if exceeds pressure threshold

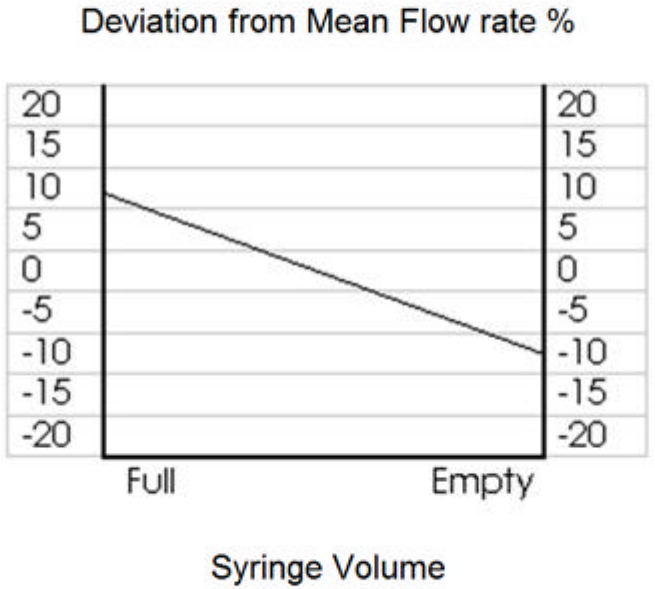


http://www.stockphotopro.com/photo-thumbs-2/stockphotopro_377745PEL_no_title.jpg

Existing Devices: Mechanical - SpringFusor

- Spring-driven
- 10mL, 30mL-short and 30mL-long syringes
- Different diameter microbore tubing determines flow rate
- Long duration infusions (hours)
- $45 - $65 from Allied Medical
- Patent #5,954,695

http://www.alliedmedical.com.au/springfusor/?cID=3



http://www.gomedical.com.au/products/springfusor_data_sheet.htm

Existing Devices: Electrical

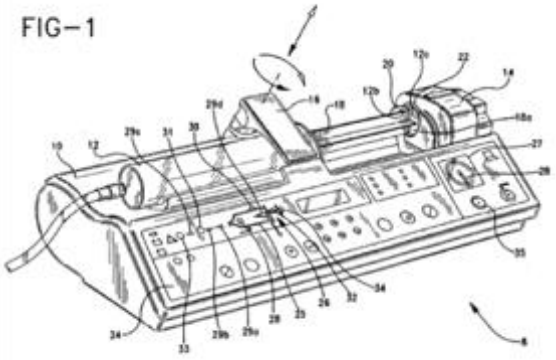
NE-300 "Just Infusion" Syringe Pump

- Barely meets flow rate requirements
- +/- 1% accuracy
- $275 from New Era Pump Systems Inc.
- 1.63kg
- 12 page manual

http://www.syringepump.com/NE-300.htm

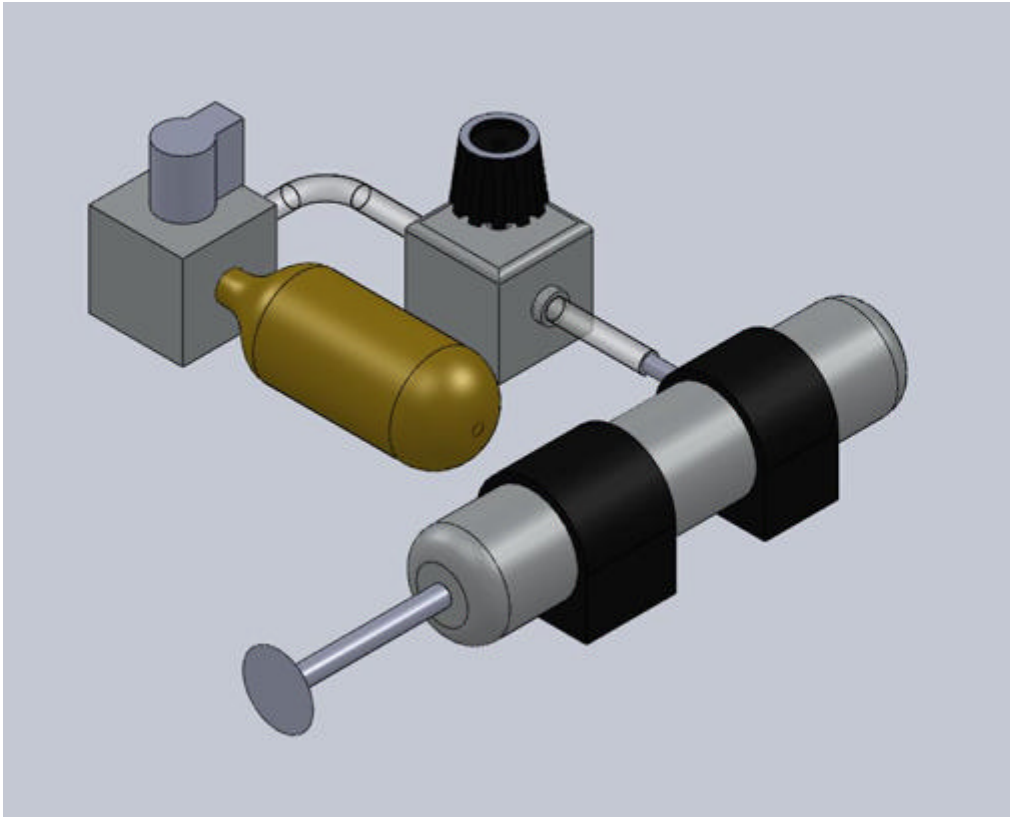
Syringe pump having continuous pressure monitoring and display

- Uses load cell
  - Monitor force exerted on plunger
  - Therefore pressure within syringe
- Rate is controlled and monitored by user
- Patent # 5,295,967



http://www.freepatentsonline.com/5295967.pdf

Pneumatic Design



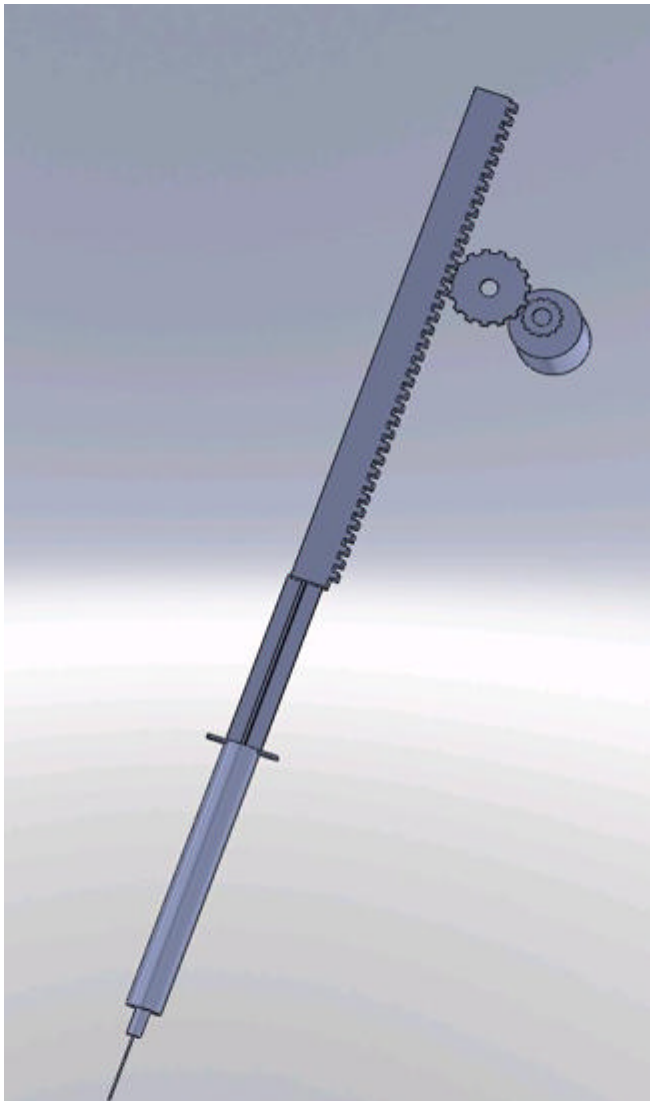
Pros:

- Easy to control pressure
- Easy assembly

Cons:

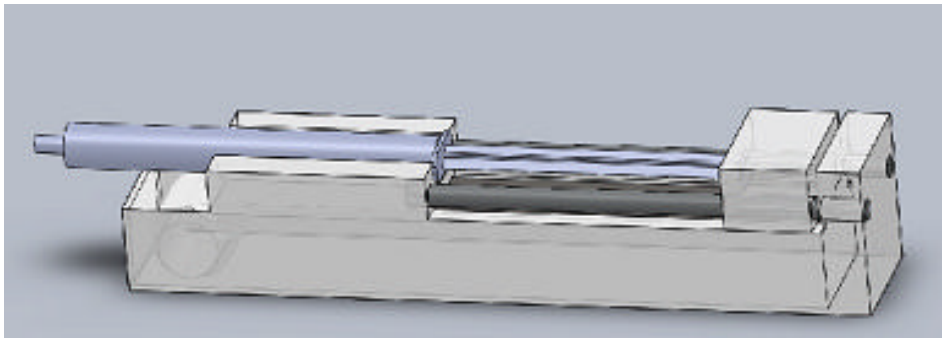
- High pressure system
- Size
- Weight

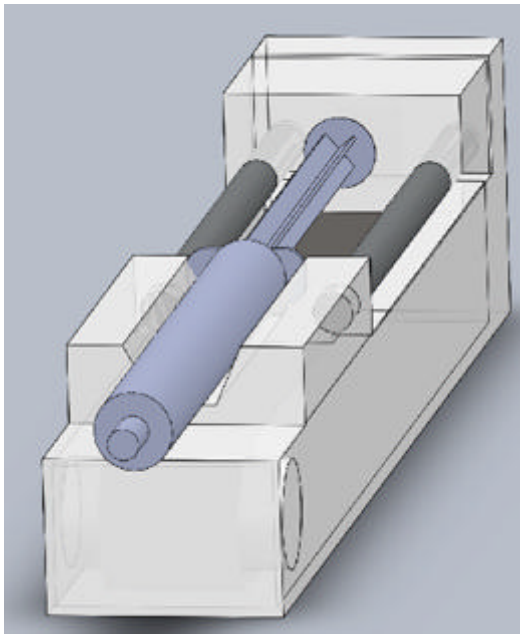
Electrical Design



- **Pros:**
  - Constant pressure
  - Automated system
- **Cons:**
  - Heavier and bulkier with motor
  - Harder assembly
  - Power driven

Mechanical Design





- **Pros:**
  - Compact design
  - Low cost
  - Easy to use

- **Cons:**
  - Pressure depends on spring

Design Matrix

Design Characteristics	Pneumatic	Mechanical	Electrical
Ease of Use (15)	10	12	15
Cost (20)	13	20	10
Precision (30)	30	23	29
Size (25)	19	25	21
Manufacturability (10)	7	10	3
TOTAL	79	90	78

Future Work

- Find suitable spring
- Reverse engineering
- Get materials
- Build design
- Testing

References

- http://www.kdscientific.com/products/pumps/kds410.asp
- http://www.gomedical.com.au/products/springfusor.php
- http://www.made-in-china.com/showroom/margieyada/product-detailqExJNGmUtQrp/China-Disposable-Pain-Killer-Pump-A-01-.html
- http://www.syringepump.com/NE-300.htm
- http://www.freepatentsonline.com/5295967.html
- http://www.freepatentsonline.com/4544369.html
- http://www.freepatentsonline.com/5244461.html

Questions?