PennState

Syringe Pump for Injecting/Refilling Fluid

GEOSC 597 Project

by

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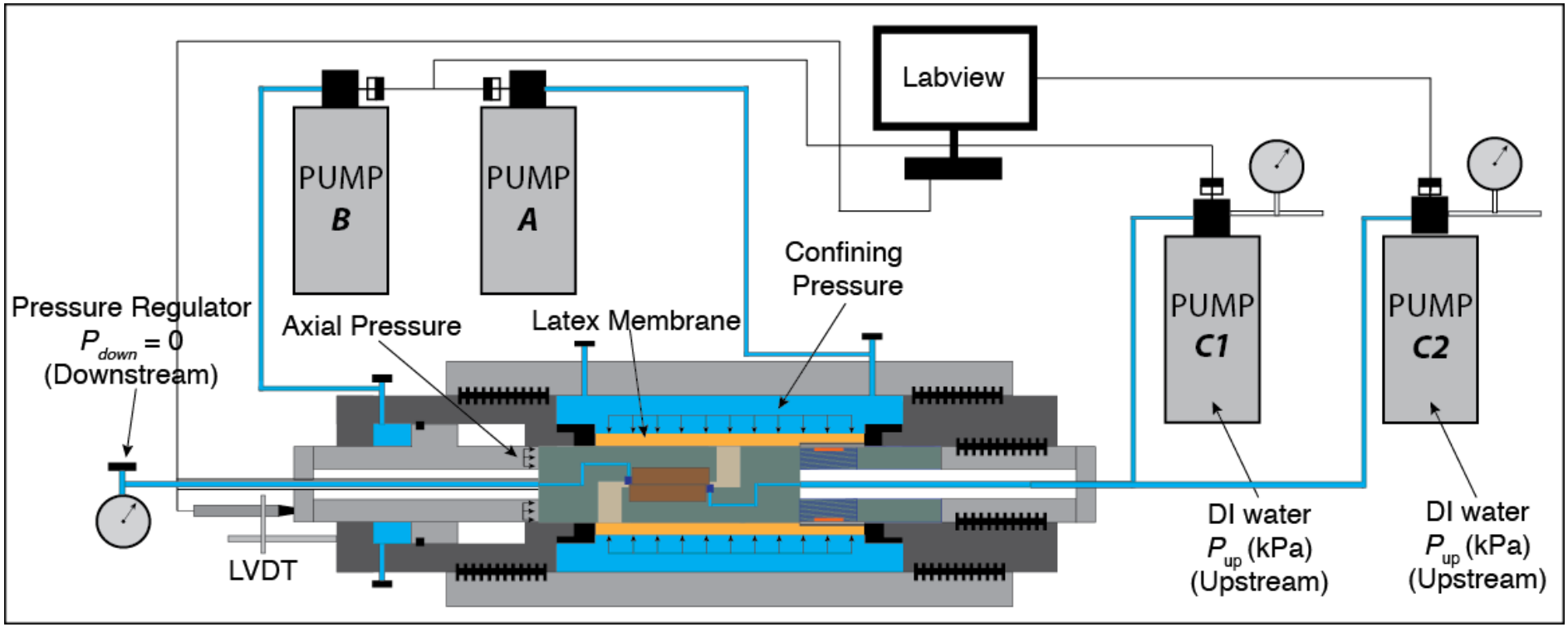
Project Goal

Build A Syringe Pump
that Can Perform Long-Term Injection

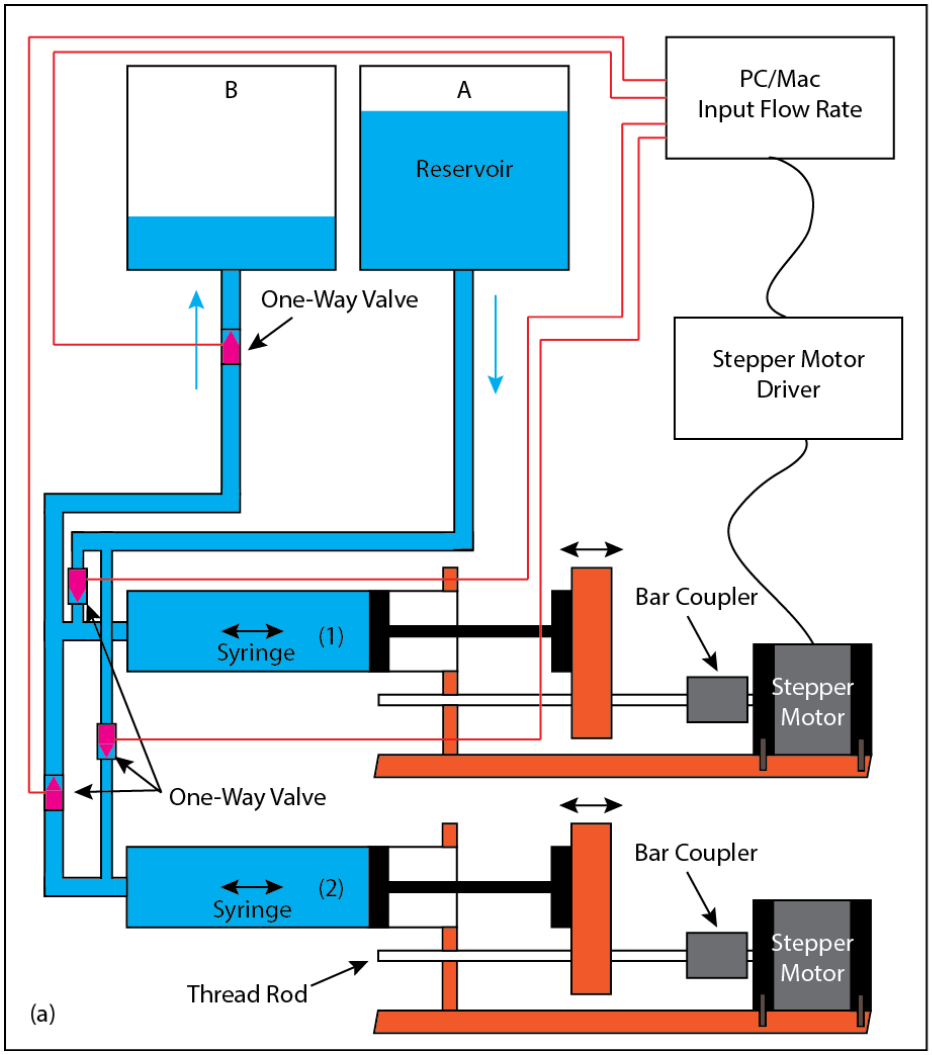
❖ What's the realistic problem?

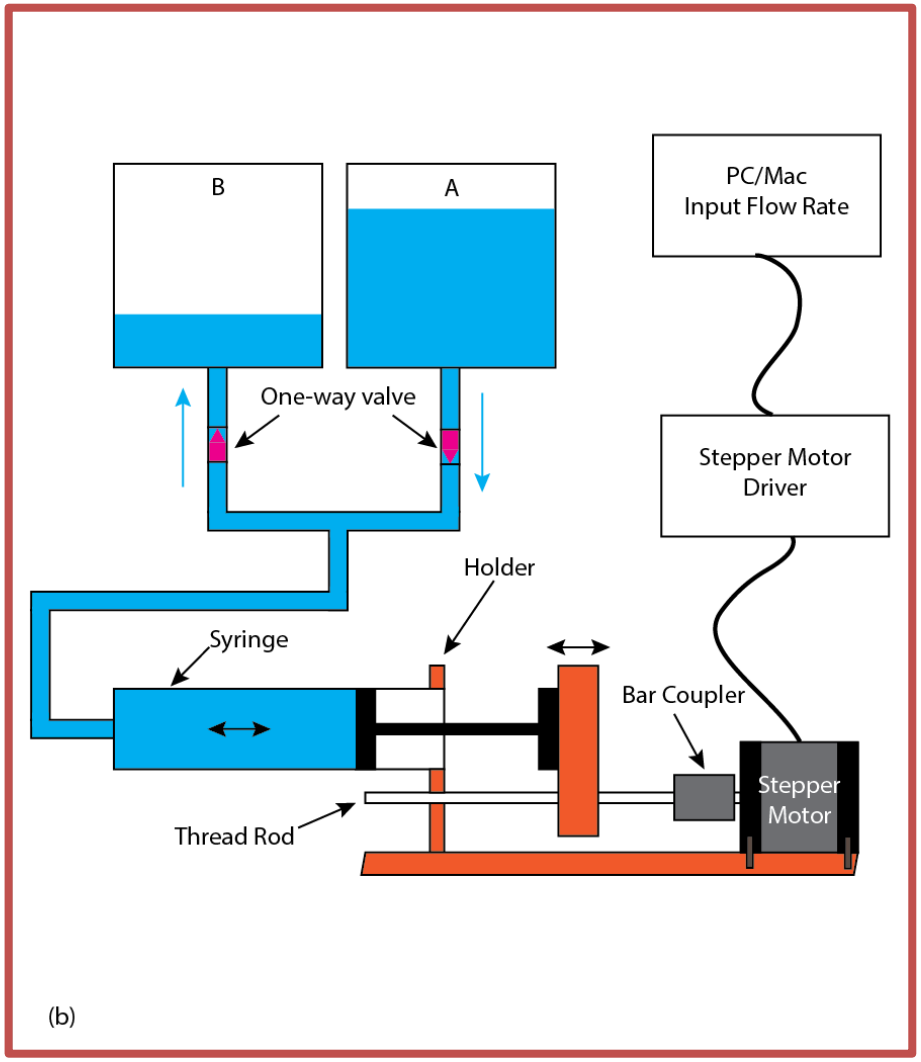
Static Hydro-Mechanical Experiment



- Long-term injection
- Large volume of fluid

Prototype and Simplification





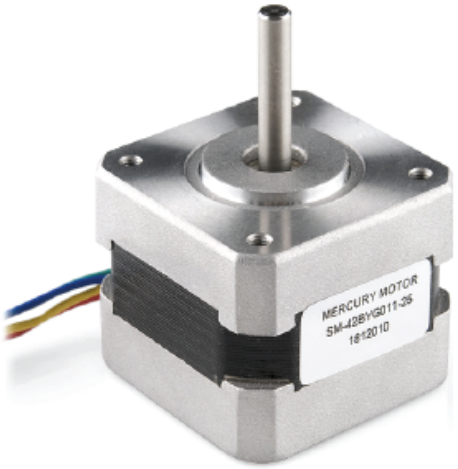
- Left: Prototype/Analogue Solution for Realistic Problem
- Large volume of fluid

❖ Three-Step Method

1. Collect necessary pumping hardware
2. Assemble the hardware system
3. Code the control system

❖ Syringe Pump Hardware Components

Stepper Motor

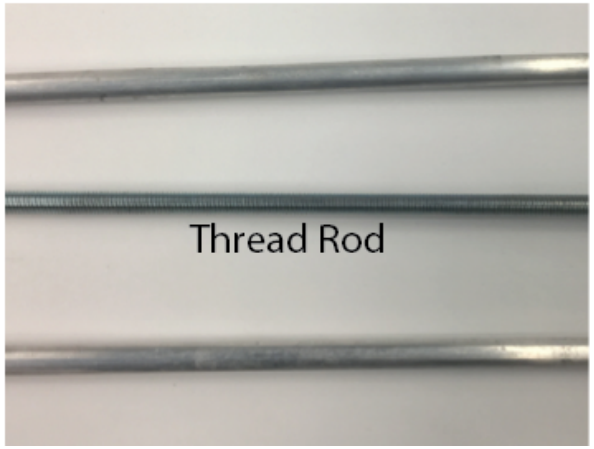


Syringe (50 ml)

One-way Valves

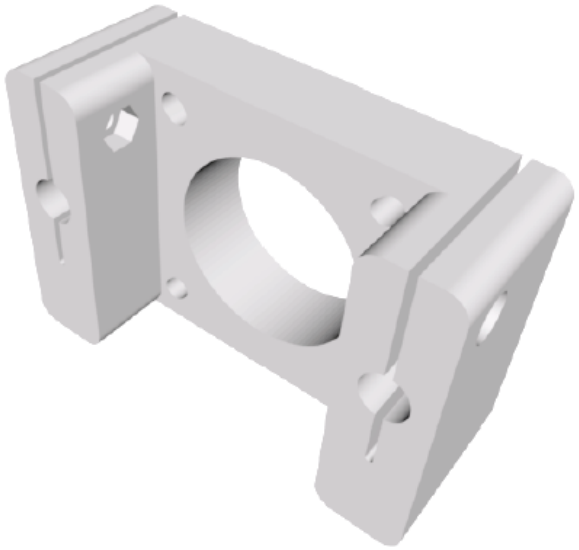
Flexible Clear Tube

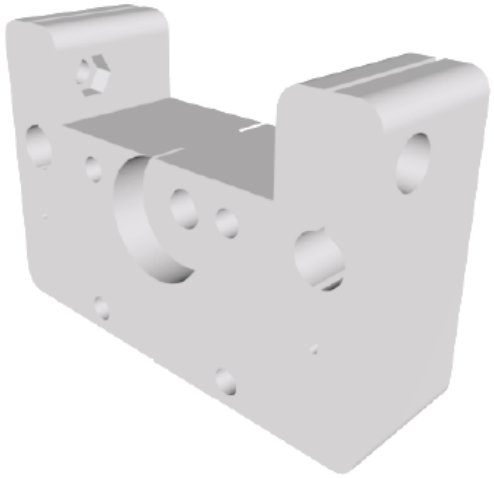
Rod

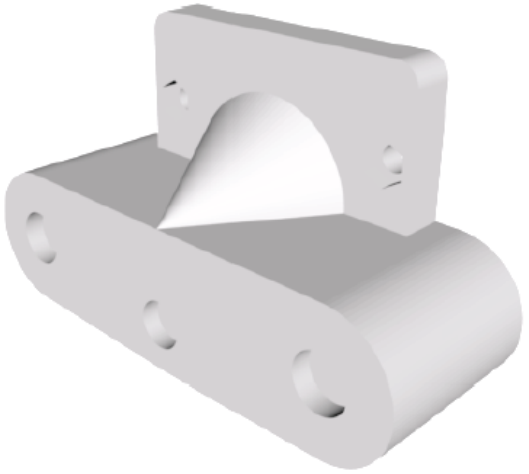


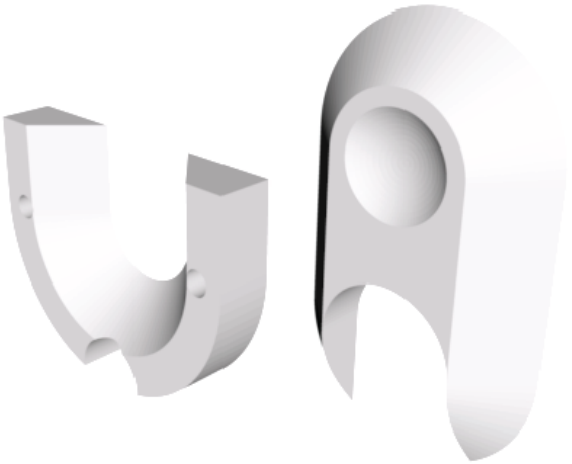
Three-way Valves

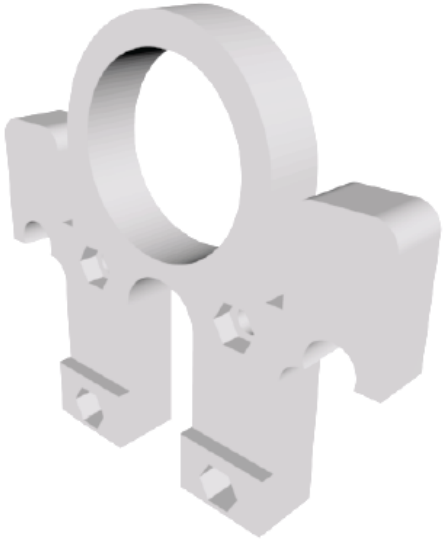
Syringe Pump Structure/Frame Elements

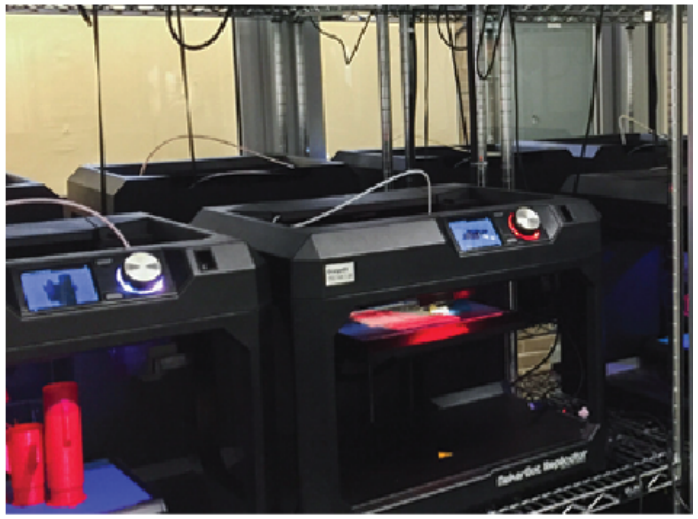




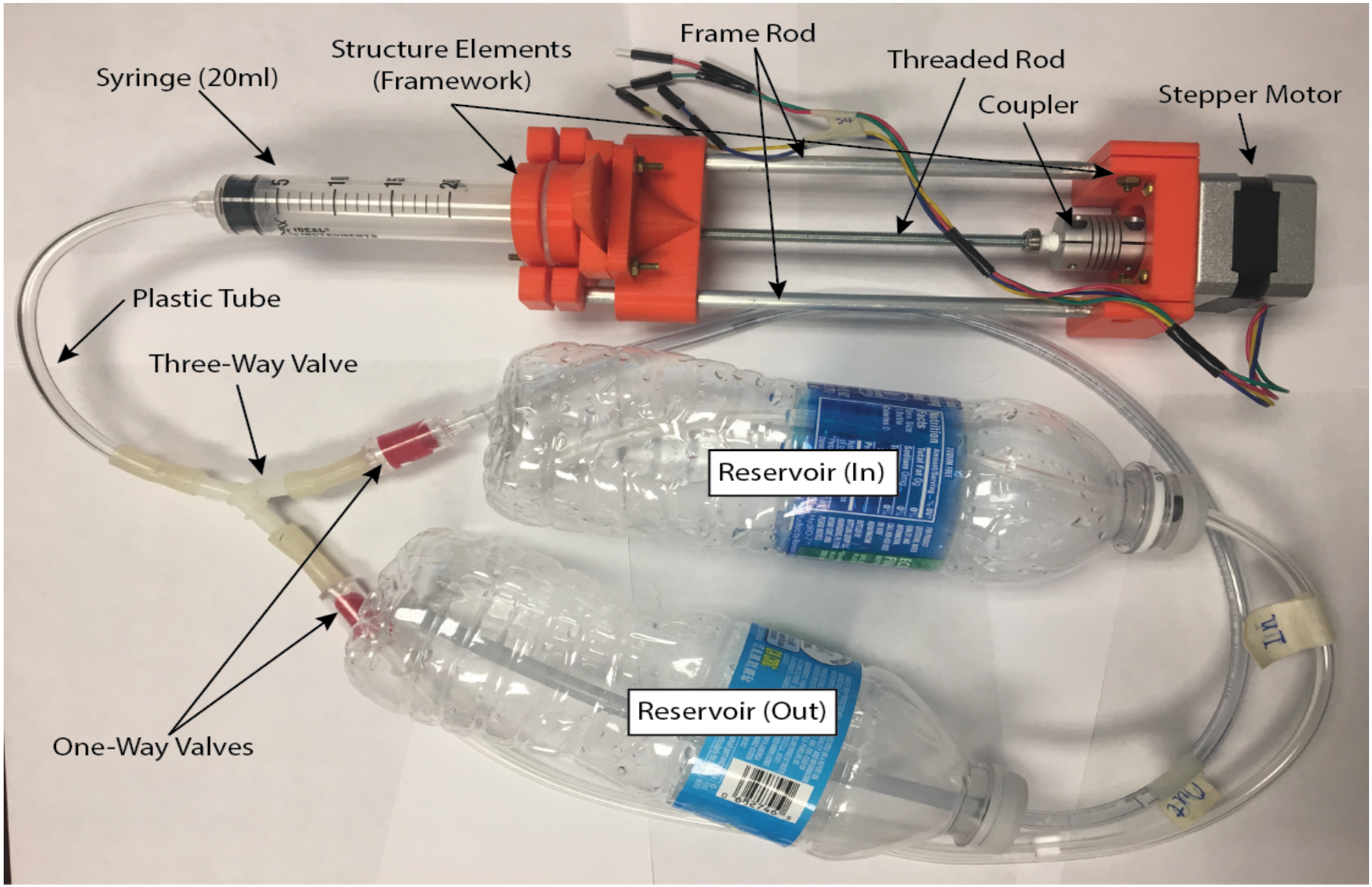








What does it look like after assembled?

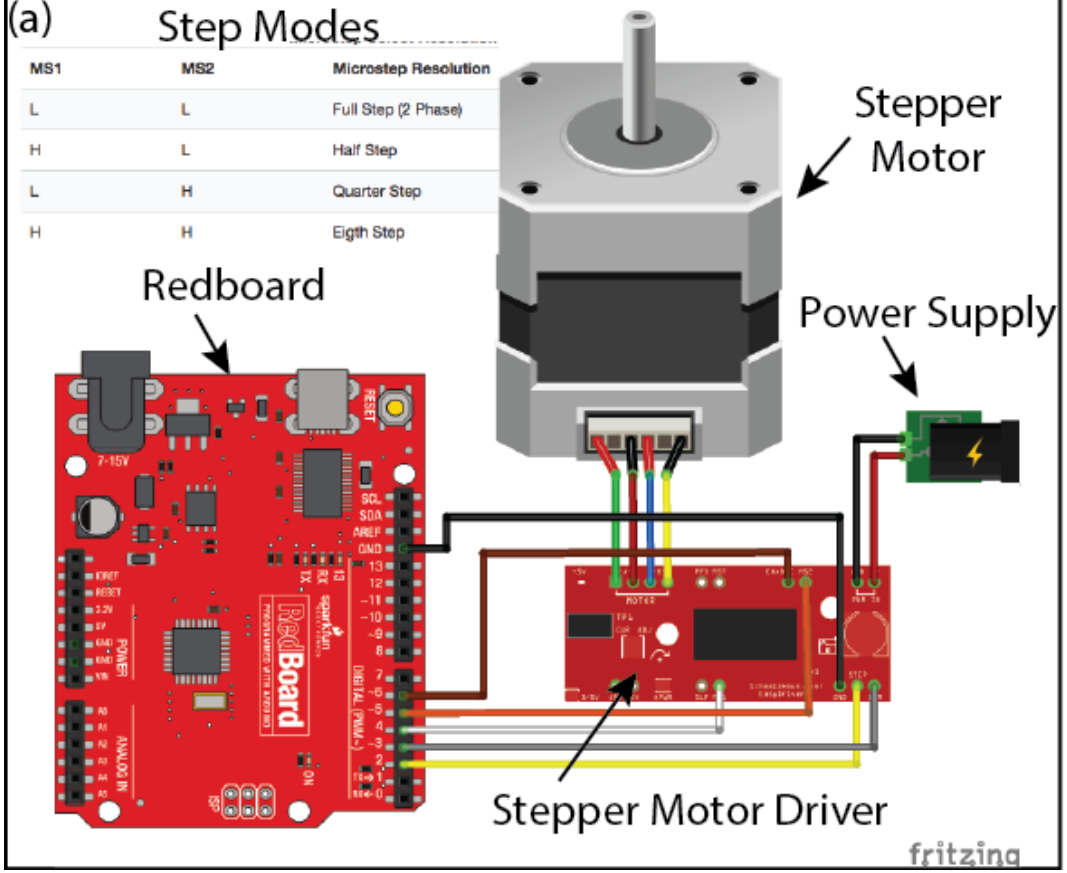


❖ Control System

(a)

Step Modes

MS1	MS2	Microstep Resolution
L	L	Full Step (2 Phase)
H	L	Half Step
L	H	Quarter Step
H	H	Eigth Step



(b)

Fang_project §

```
//GEOSC 597 Project
//Name: Yi Fang
//Date: 12/1/2016
//Function: Control the injection/refill of syringe pump

//Declare pin functions on Redboard
#define stp 2
#define dir 3
#define MS1 4
#define MS2 5
#define EN  6

//Declare variables for functions
char user_input;
int x;
int y;
int state;

void setup() {
  pinMode(stp, OUTPUT);
  pinMode(dir, OUTPUT);
  pinMode(MS1, OUTPUT);
  pinMode(MS2, OUTPUT);
  pinMode(EN, OUTPUT);

  resetEDPins(); //Set step, direction, microstep and enable pins to default states
  Serial.begin(9600); //Open Serial connection for debugging
  Serial.println("Begin motor control");
  Serial.println();
  //Print function list for user selection
  Serial.println("Enter number for control option:");
  Serial.println("1. Turn at default microstep mode.");
  Serial.println("2. Reverse direction at default microstep mode.");
  Serial.println("3. Turn at 1/8th microstep mode.");
  Serial.println("4. Step forward and reverse directions.");
  Serial.println();
}
```

❖ Input Manual

Send

```
Yi Fang - Syringe Pump System (GEOSC597 Project)

Operational Instruction:
Pumping Mode:         P1:Injection  P2:Refill  P3:Inject-Refill Cycling
Flow Rate Selection: (a):0.585ml/s  (b):0.293ml/s  (c):0.146ml/s  (d):0.074ml/s
1. Inject@0.585ml/s
2. Refill@0.585ml/s
3. Inject@0.293ml/s
4. Refill@0.293ml/s
5. Inject@0.146ml/s
6. Refill@0.146ml/s
7. Inject@0.074ml/s
8. Refill@0.074ml/s
9. Cycled Injecting & Refilling
```

Autoscroll No line ending 9600 baud

❖ Challenging Issues Encountered

1. Budget for realistic

2. Design the size of structure elements

3. Calibrating the flow rate

Results

Please watch the demonstration!


Thank you for your attention!
Any Questions?

❖ Acknowledgement

- Special thanks to John Leeman for ordering the project hardware for me and for his great lectures and guide in the class.

- Thanks to Dr. Chris Marone for his kind help throughout the class.