MICROSCOPE CELL CULTURE INCUBATION HOUSING

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Outline

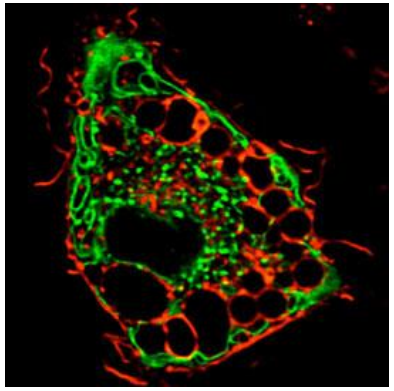
- Problem Statement
- Background Information
- Design Specifications
- System Components
- Designs & Matrix
- Future Work

Problem Statement

- To develop a cell culture incubation chamber with interchangeable culture plates that is compatible with the Olympus IX71microscope. This incubation chamber must be able to maintain an internal environment of 37˚C, 5% CO_2 and 90-100% over long durations for time course experiments, without compromising the integrity of the microscopes optics or functionality.

Background Information

- Olympus IX71
  - Inverted Microscope
  - Fluorescence imaging
- Live-Cell Imaging
  - Asses cellular dynamics



Olympus IX-71 Inverted Microscope

Existing Products

- Four problems
  - Expensive
  - Temperature gradients
  - Condensation buildup
  - Evaporation of cell culture fluids

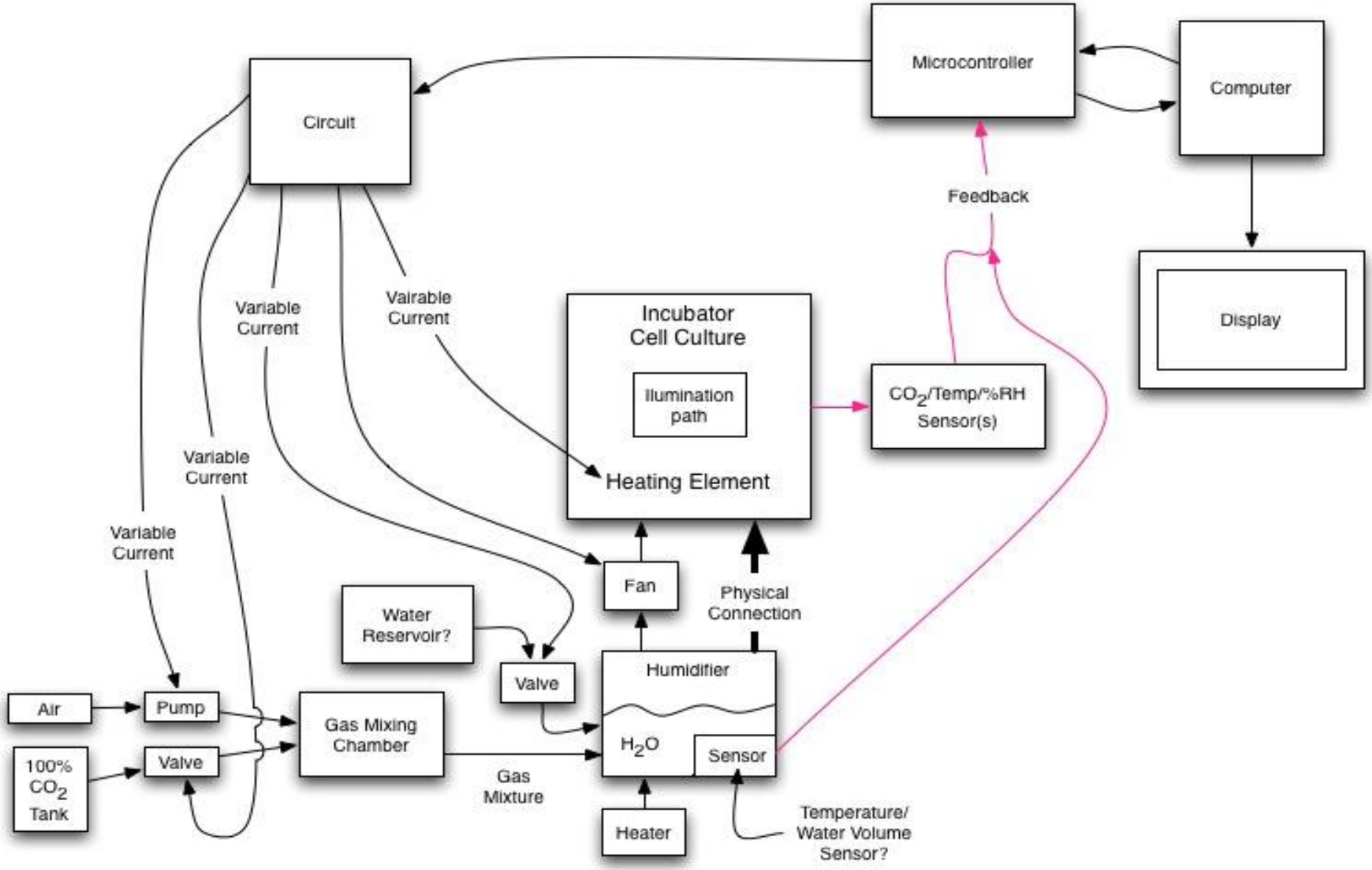
Product Design Specifications

- Environmental Conditions
  - 37°C ± 2°C; 5% CO_2 ± 1%; 90-100% RH
- Compatible with various cell culture plates
- Incubator is a closed system
- Condensation cannot interfere with microscope optics
- Easy to assemble and remove from microscope
- Incubator housing cannot interfere with microscope operation

Components

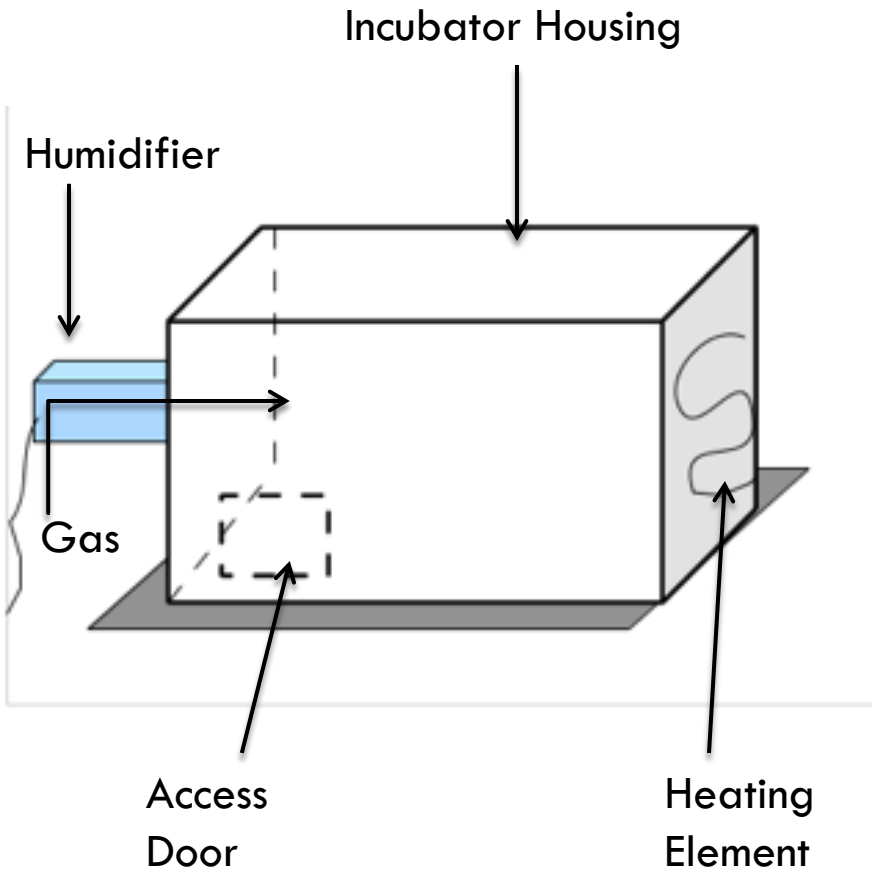
- Heating Element
  - Nichrome wire with variable current
- Humidifier
  - Bubble gas humidifier
- Sensors
  - Non-dispersive infrared CO_2 sensor
  - RH sensor and Thermometer
- CO_2 Regulation
  - Valves controlled by microcontroller
- Housing Material
  - Acrylic (Plexiglass)

Flow Diagram



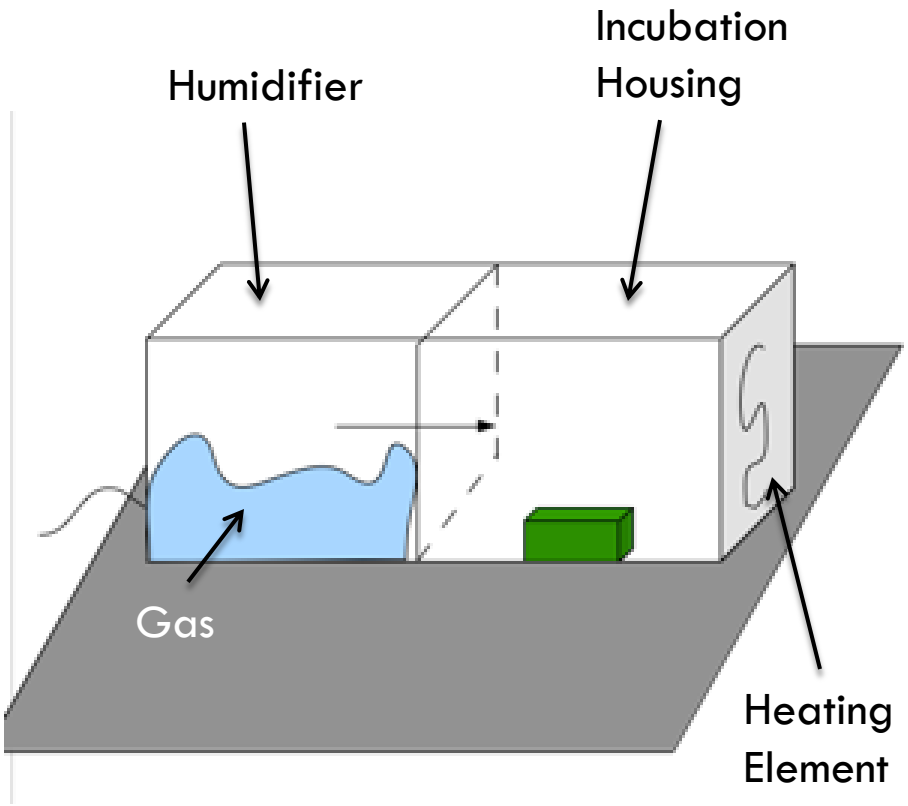
Design 1

- Pros
  - Culture plate is directly on microscope stage
  - Smaller % loss of environmental conditions during culture access
- Cons
  - More difficult to regulate CO_2 and RH
  - Greater temperature gradients



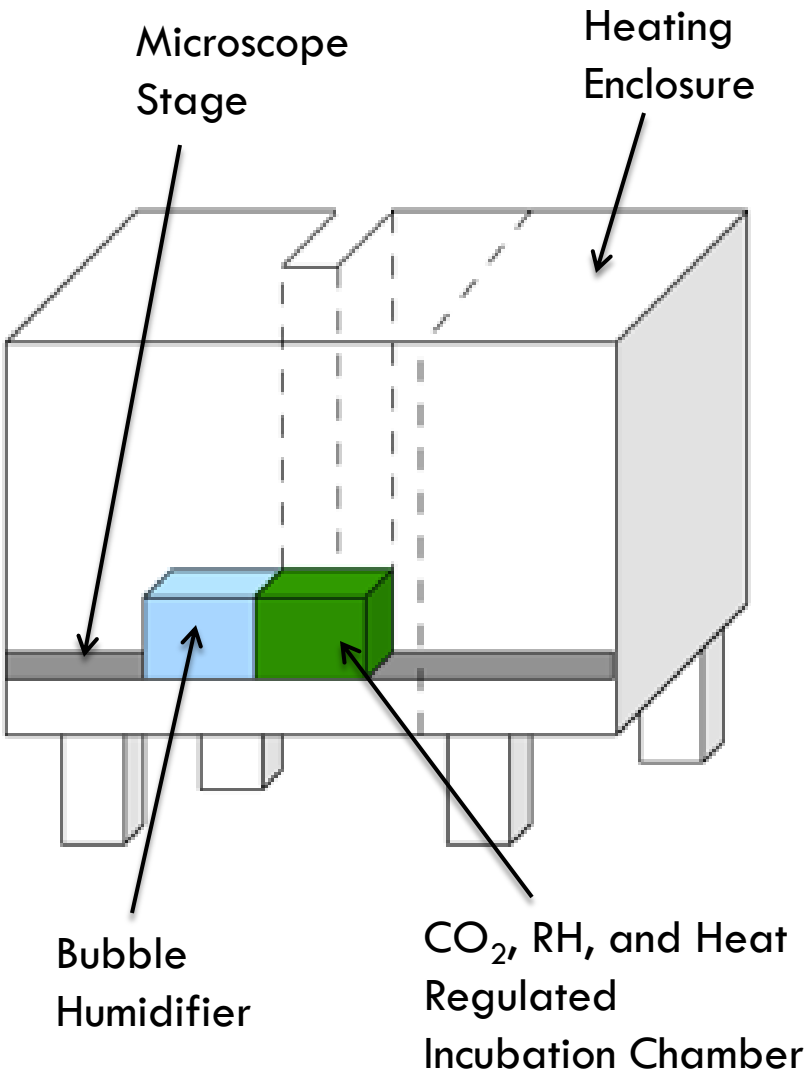
Design 2

- Pros
  - Cost effective
  - Higher precision of environmental control
- Cons
  - Difficult to access culture plate
  - Culture plate not in range of focus



Design 3

- Pros
  - Culture plate is directly on microscope stage
  - Entire microscope stage is heated, preventing temp gradient
- Cons
  - More complicated enclosure design
  - Difficult to regulate temperature



Design Matrix

Prototype	Weight	Design #1	Design #2	Design #3
Cost	15/100	10	12	**9**
Heating	20/100	12	16	**15**
Ease of Use	15/100	13	10	**14**
CO_2	20/100	5	17	**16**
Humidity	10/100	5	7	**6**
Microscope functionality	20/100	5	0	**18**
Total	100	50	62	**78**

Future Work

- Model design in SolidWorks
- Thermal testing
  - Test condensation buildup
  - Determine heating element placement
- Test “bubbling” humidifier for rate of evaporation
- Test air and CO_2 mixing
- Design circuit and microcontroller/sensor connections
- Build prototype

Acknowledgments

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References

Images

http://cellularimaging.perkinelmer.com/support/dr_simon_vipoir/detail.php?id=47

http://www.olympusamerica.com/seg_section/product.asp?product=1023

http://spectraservices.com/Merchant2/merchant.mvc?Screen=PROD&Product_Code=THSS&Category_Code=EC

http://sundaecorp.com/co2meters/Documentation/Datasheets/DS33-ICB-01.pdf