RemoteOB: A Device to Remotely Control Environmental Conditions and Record Real-Time Behavior of Live Cell

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Introduction

- Incubator is the necessary equipment for any laboratory conducting cell culture and tissue culture work.
- Advanced live-cell imaging microscopes with onstage chamber have been developed for the purposes of enabling precise control of temperature and gases for time-lapse imaging of live cells under both physiological and non-physiological conditions.

Problem Definition

Common drawbacks of available competitors (EVOS, ZEISS, WPI, LEICA):

- Not able to remotely control the environmental condition inside the chamber
- Not portable and detachable form microscopes
- Charges at least 70k CAD

Objectives

RemoteOB serves as an accessory for existing inverted microscopes and it consists of four Separable modules:

- **Environmental control unit**

  Detect and adjust current environmental conditions such as *temperature*, *humidity* and *CO2 concentration* in the chamber.

- **Environmental onstage chamber**

  The enclosed chamber where live cell culture is placed.

- **Position Adjustment System**

  Adjust the position between the objective of the microscope and the chamber.

- **Imaging System**

  Record the image or video captured by a digital camera associated with the inverting microscope and transmit the information to web-interface.

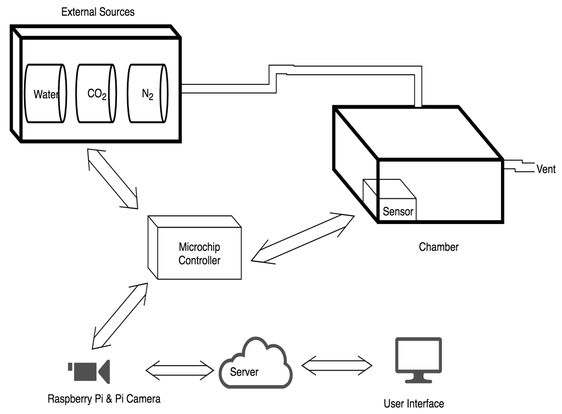
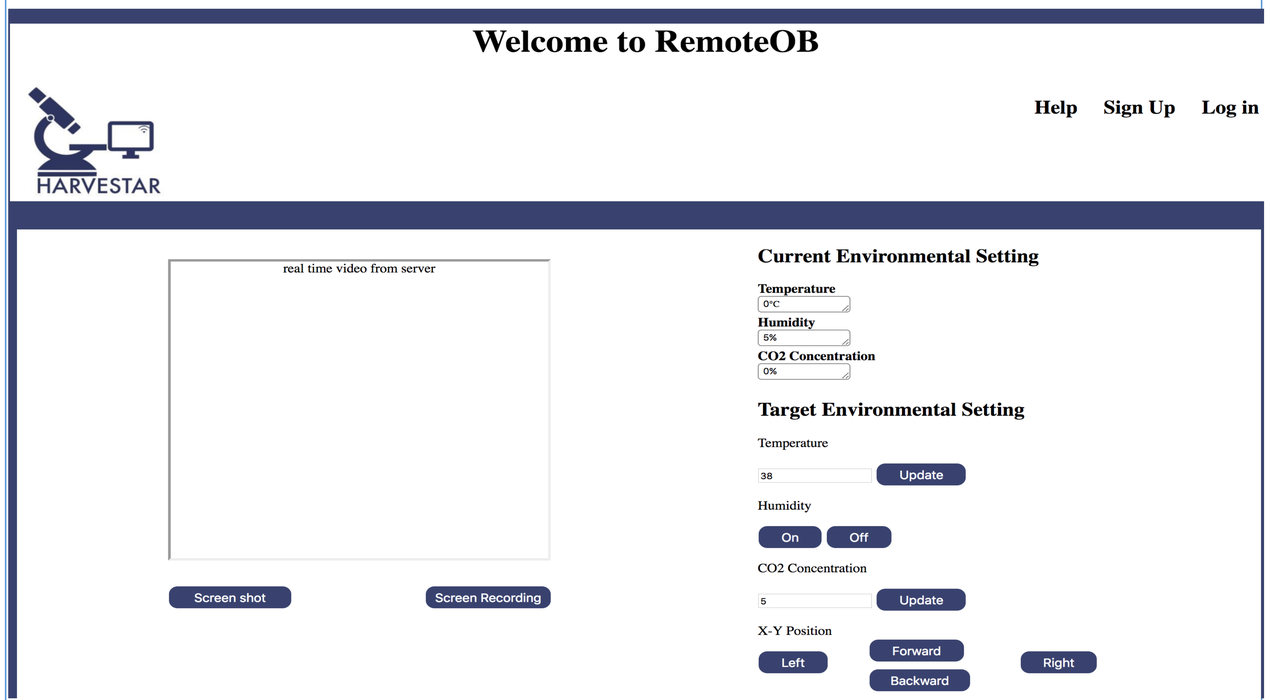


Figure 1: System Block Diagram

Web Interface



Schematic Detail

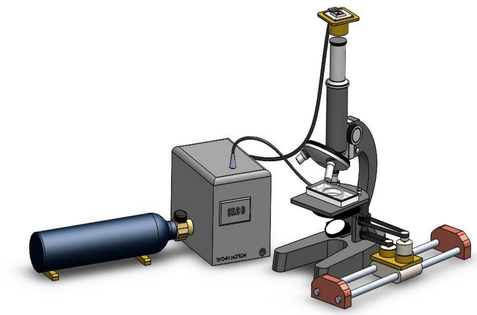


Figure 2: Blueprint of RemoteOB

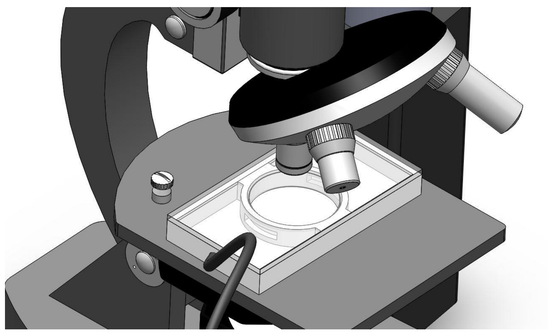


Figure 3: Onstage Chamber

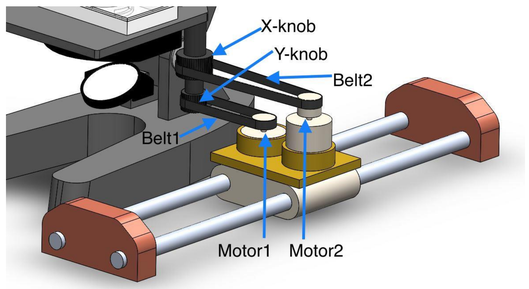


Figure 4: X-Y Stage Schematics

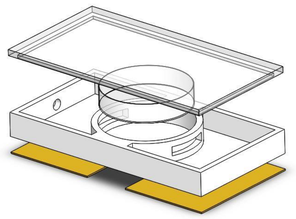


Figure 5: Chamber Schematics

Conclusion

- By finishing the stage of the proof-of-concept, a confident conclusion can be made that the final product can be delivered with promised features
- By assembling RemoteOB to the existing inverted microscopes, the whole integrated system enables remote control of environmental condition and real-time imaging of live-cell growth.

Results

- Temperature sensor should function properly within designed circuits
- The temperature should be adjusted by 12V heating pad controlled by 5V relay
- The circuit design should consider components for safety and protection purposes
- The dummy values of carbon dioxide and humidity are fed into the system, illustrating the working mechanism of the system feedback
- Data reading from the temperature sensor to the microcontroller
- Enable the two-way data transmission between microcontroller, Raspberry Pi and Web server.
- A basic web interface displays outputs from the temperature sensor and CO2 sensor

Future Work

- Be able to inject CO2 and N2 into the chamber through a long tube by using the electric valves
- Build the x-y stage position adjustment system
- Build the humidity system by injecting mist into the chamber through the tube that connects to Ultrasonic mist-maker to provide enough humidity for the cell to grow.
- Integrate existing modules and planned modules together and test the overall functionality of control unit and web app

Acknowledge

Daniel Cao, Product Development Engineer, Evo-in-motion Technology, EIM PCB

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Reference

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