Microfluidics Microscope

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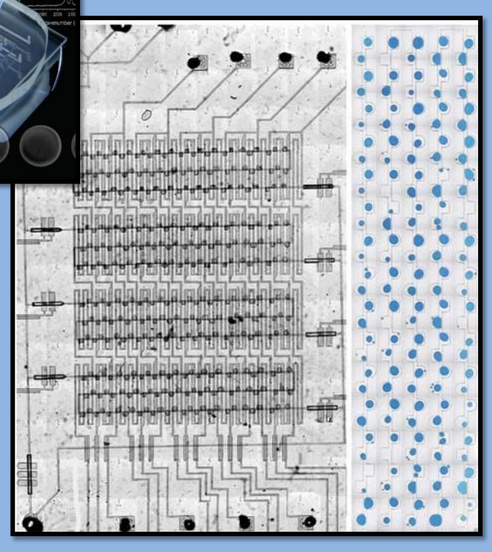


A microfluidics chip (above) and an image of a typical well pattern embedded (right). The microscope needs to track the change over time of each well on this chip.

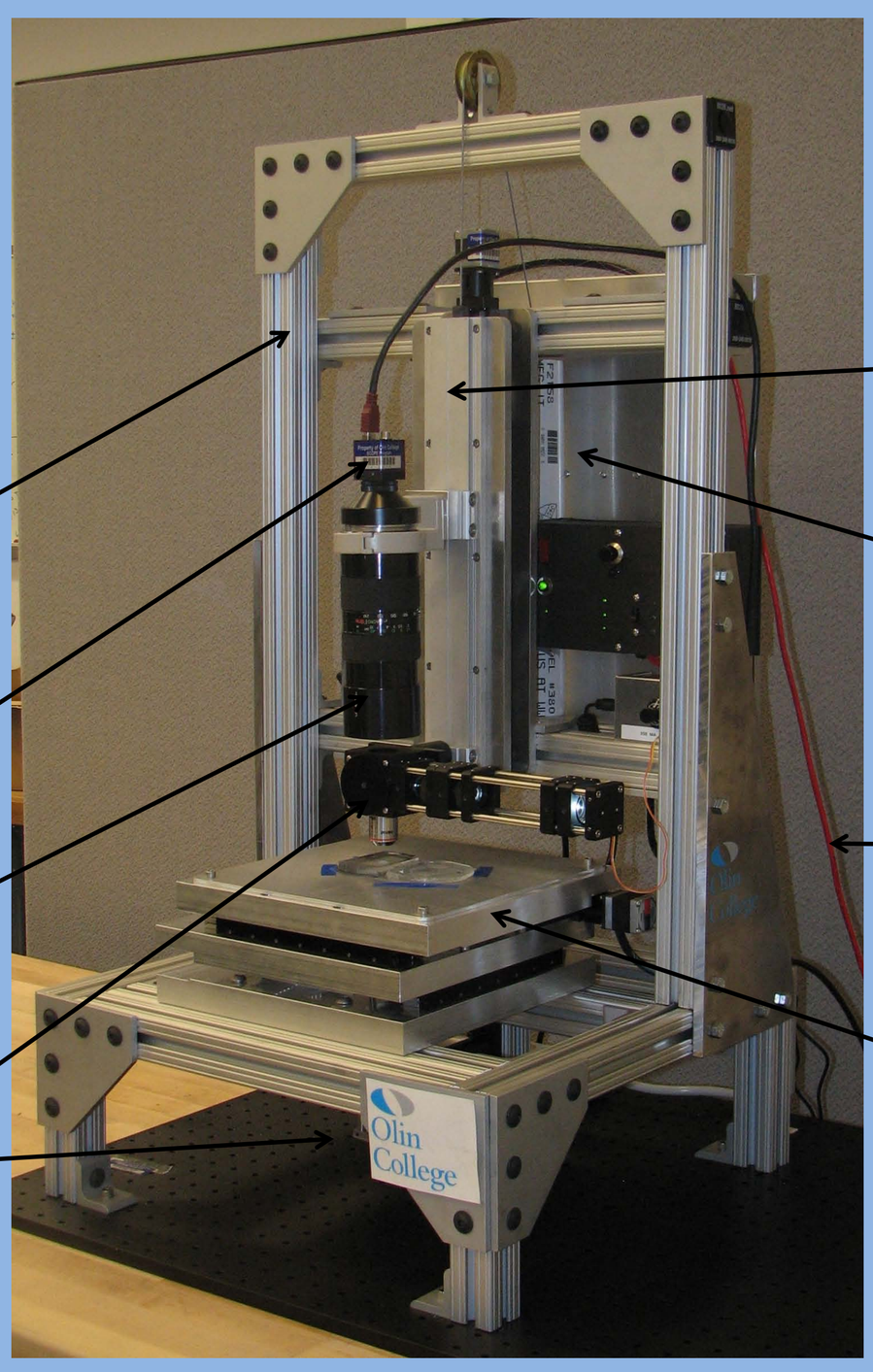
Project Description

The goal of this project was to design and prototype an automated microscope that is flexible, reliable, robust, cost effective, easy to use, and isolated from its surroundings. The microscope was designed for experiments that need to image the exact same location on a microfluidics chip over the course of days to track changes with time.

Examples of microfluidic microscopes in various university laboratories

System Design

A 4-10x microscope system that costs approximately $9,300 was designed and built with the following features.



Chassis: 1.5 inch 80/20 aluminum extrusion that can be easily reconfigured

Camera: monochrome AVT Guppy FireWire camera with 1392 x 1024 pixel resolution and an 8 bit image depth

Optics: zoom lens with infinity corrected feedback

Illumination: Koehler axial reflective and transmission illumination

Z Stage: a roller slide and a linear actuator driven by a stepper motor to focus with submicron step size and 100 mm travel

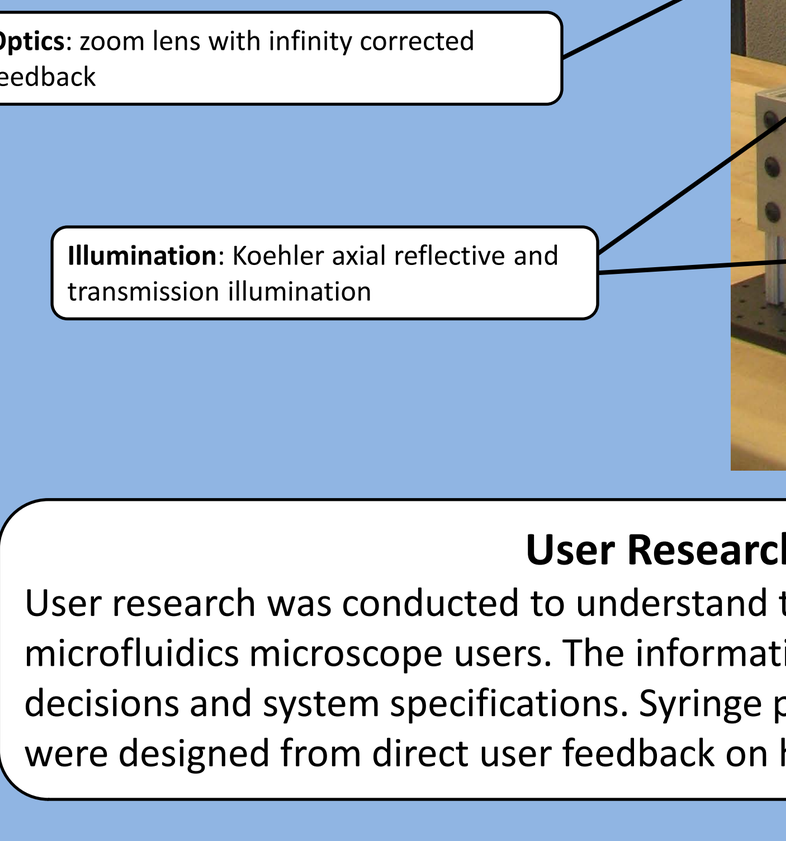
sbRIO: for real time control; can be expanded to include analog input and additional motors and sensors

Software: LabView based for compatibility with Brandeis knowledge base

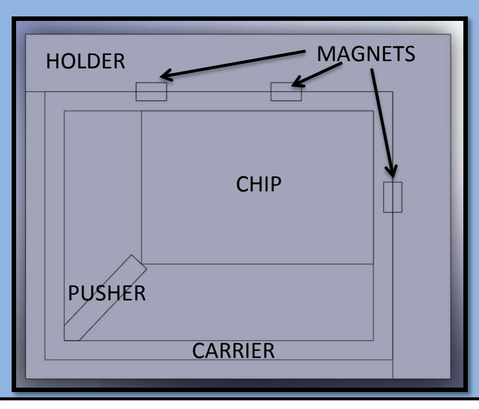
XY Stage: two roller slides and two linear actuators driven by stepper motor in the x and y directions to allow for scanning of the chip with submicron step size and 100 mm x 100 mm travel

User Research

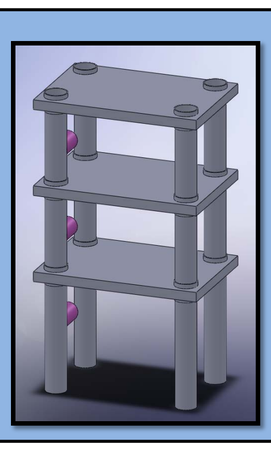
User research was conducted to understand the values and needs of microfluidics microscope users. The information informed the final design decisions and system specifications. Syringe pump tables and a chip mount were designed from direct user feedback on how to improve the system.



An interaction narrative that shows a users typical interaction with current microfluidics microscopes



Design for an improved chip mount that holds the chip in the x y plane to prevent drift



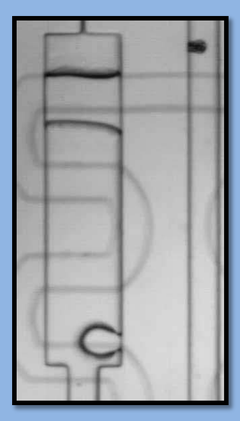
Stackable syringe pump tables to keep the pumps close to the experiment and the lab bench more organized

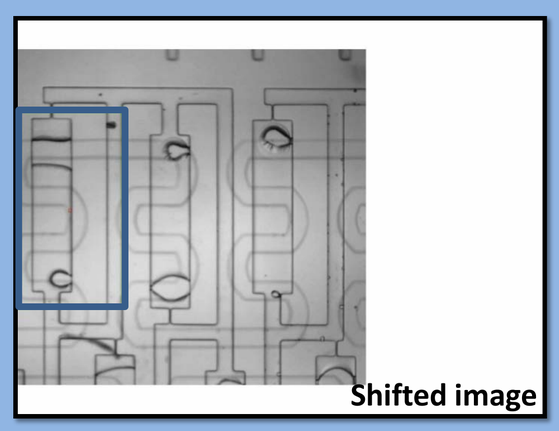
Image Processing

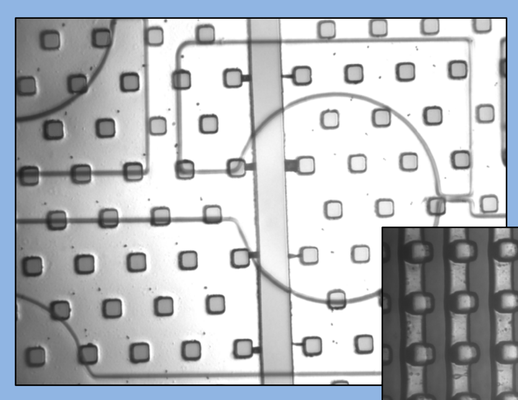
User research indicated that drift during experiments was a huge concern for users. Software was created to help correct for drift that may occur over the course of an experiment.

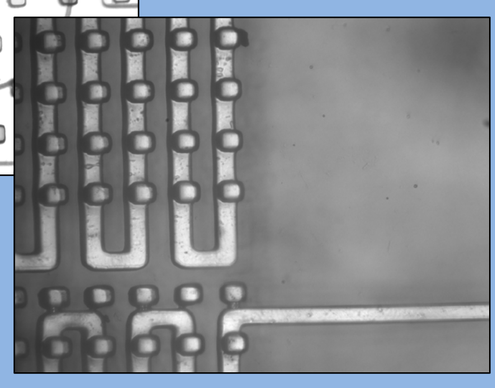
Template

Software Match









Images of microfluidics chips taken with the prototype