

The Mimscope: Low-cost Imaging System for Microfluidic Devices

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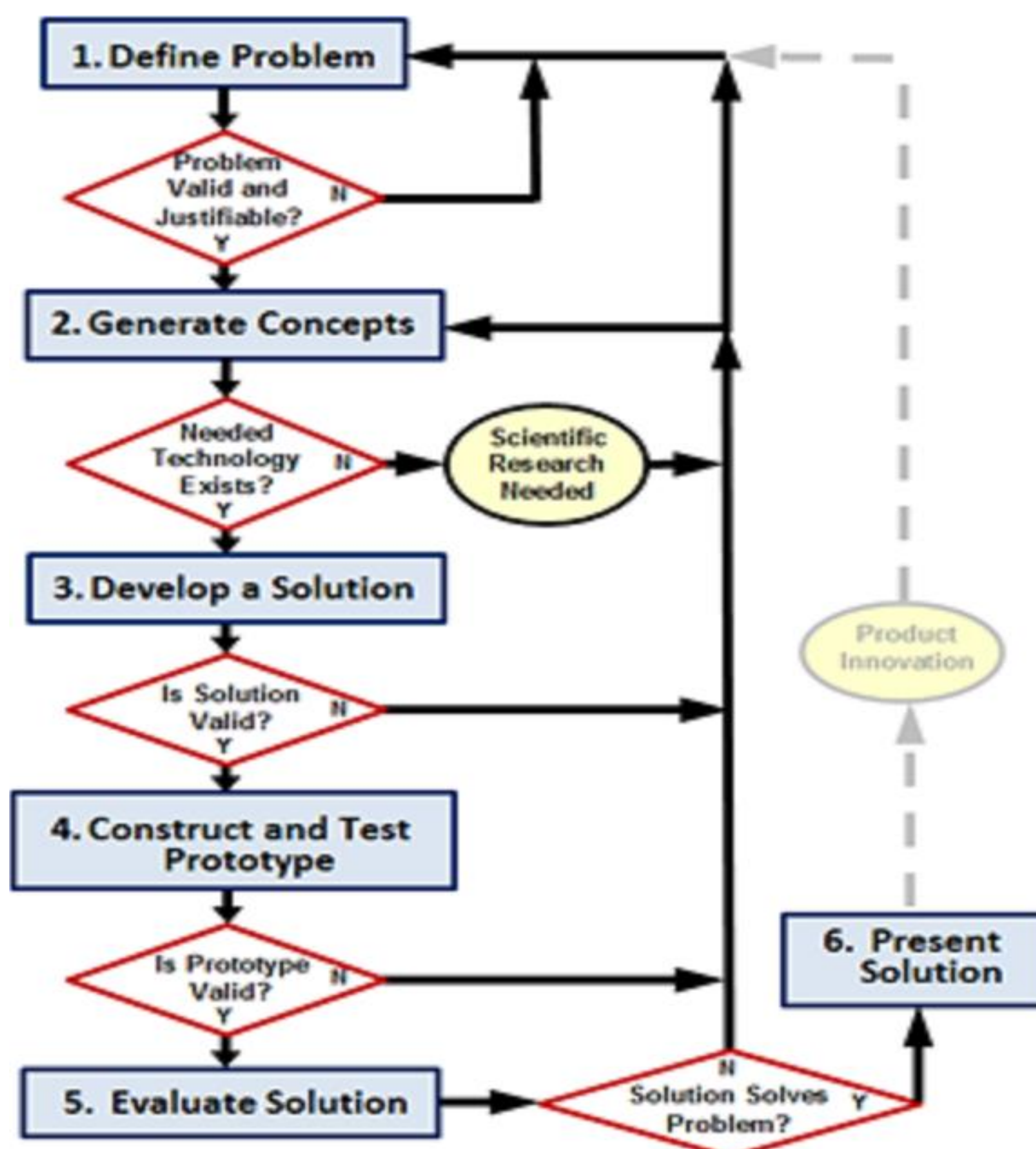
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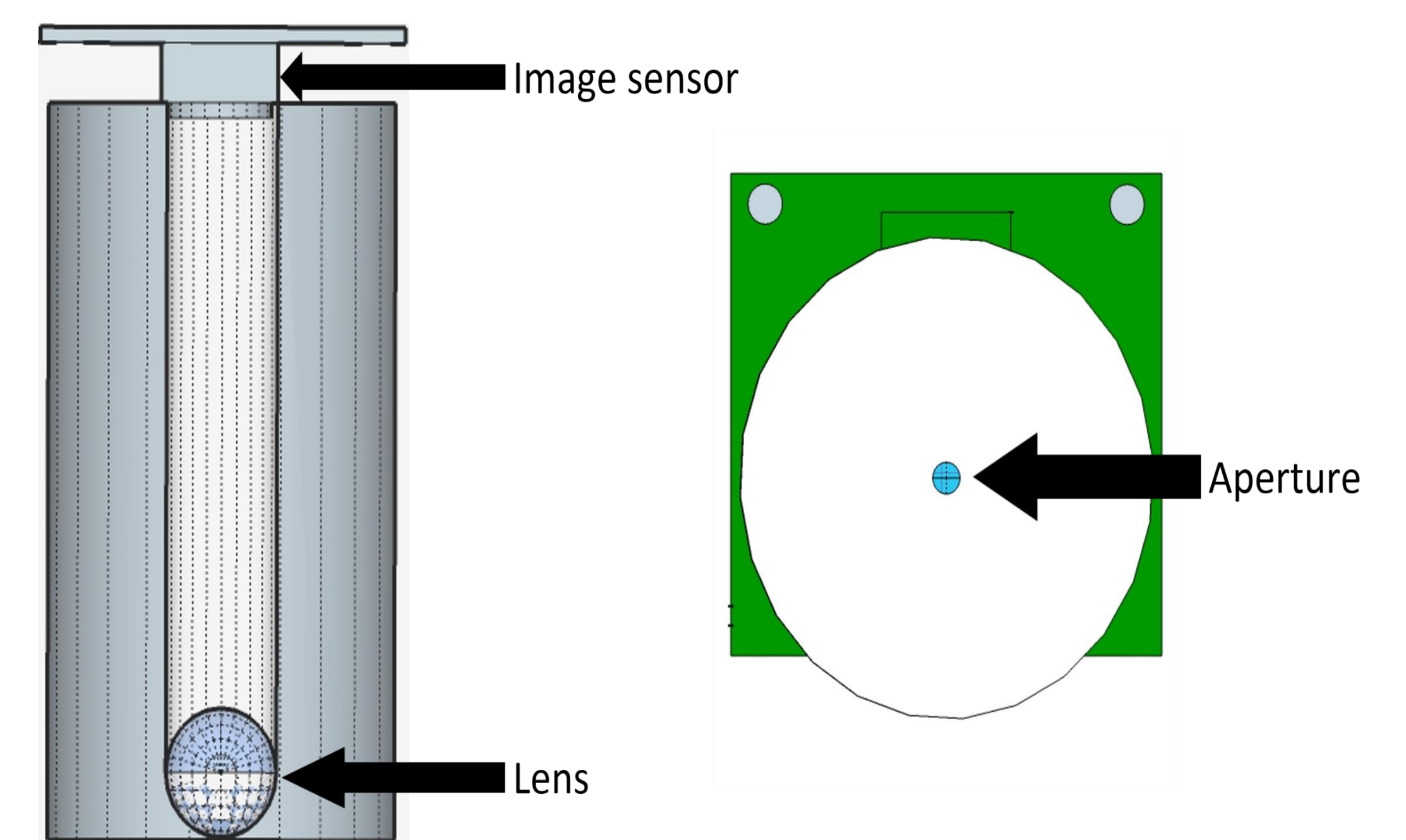
ABSTRACT

Microfluidics is a technology characterized by the engineered manipulation of fluids at the submillimeter scale, and is used widely in research and industry to conduct experiments and perform functions that would be difficult or impossible without such a high level of control. Currently the equipment surrounding engineering microfluidic devices are so expensive that access to this technology is difficult outside of a well-funded lab. Our focus is on reducing the barrier to entry of using and building microfluidic technology both in lab and in applications, by re-engineering the microscopes currently used with microfluidic devices each of which can cost upwards of \$20,000 each. The aim of this project is to develop a simple, portable, low cost microscope for microfluidic devices that we call the mimscope; “modular interchangeable microfluidic-device scope.” After conducting extensive background research, we designed a system composed of a single spherical lens, an aperture, an image sensor, and a raspberry pi computer. We created detailed drawings, a 3D model, and built a prototype of our microscope. We plan to test our final product on a microfluidic device currently used in biological research.

METHODS



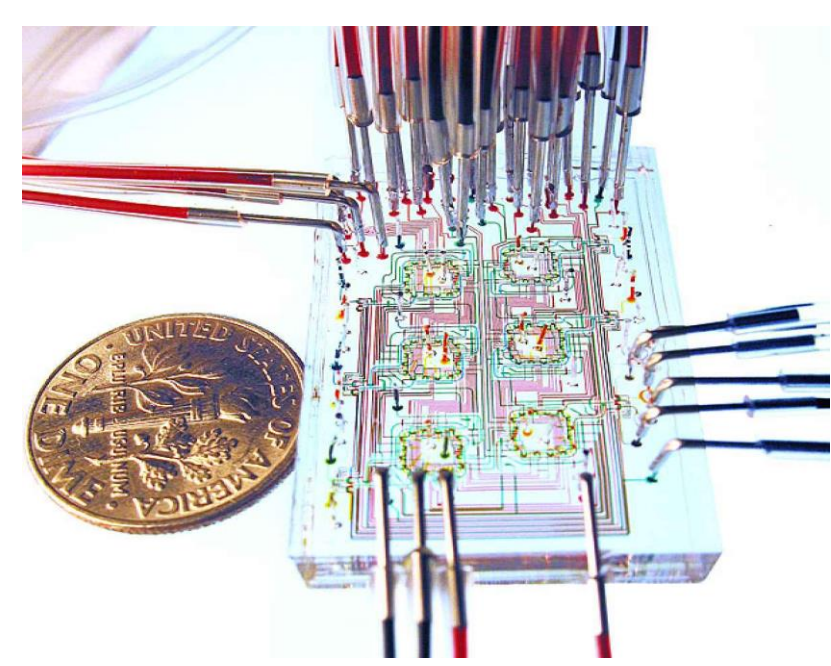
RESULTS



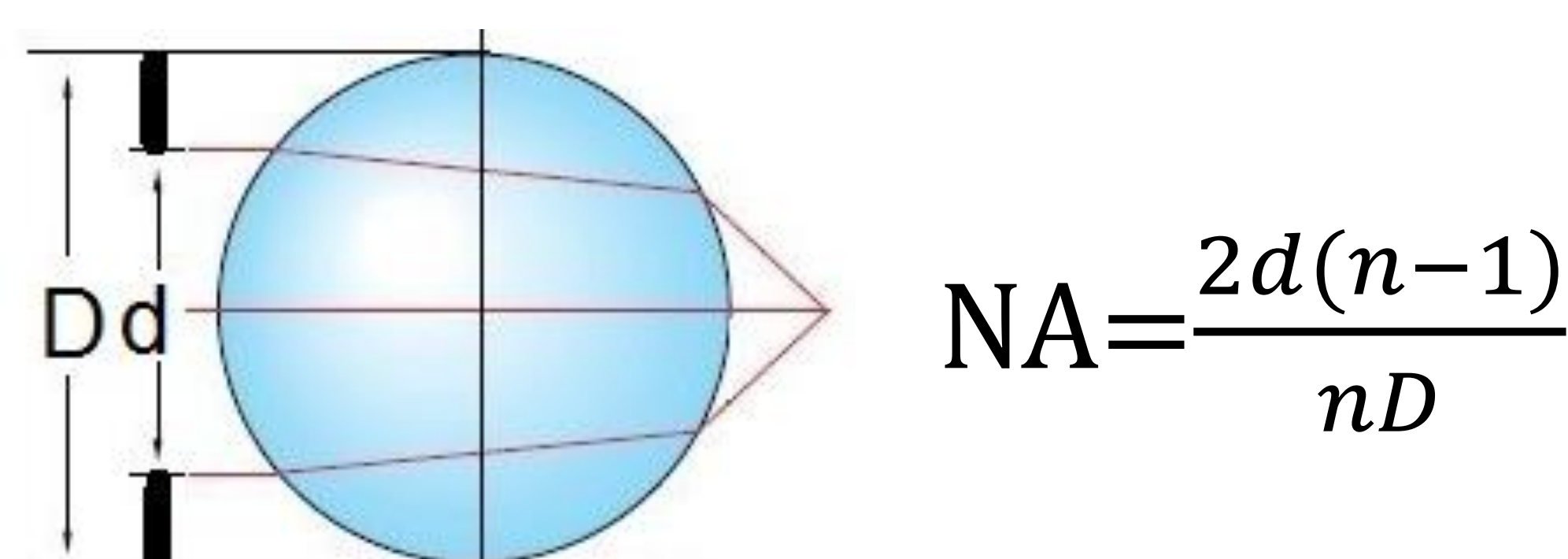
- Using our background research, conceptual drawings, requirements, and our limits we built a 3-D model. Building a 3D model helps us work out all the design “kinks” before ever setting foot in the machine shop allowing for much faster and smoother design by letting us see all the “conceptual flaws” and areas for improvement from our original drawings.

BACKGROUND

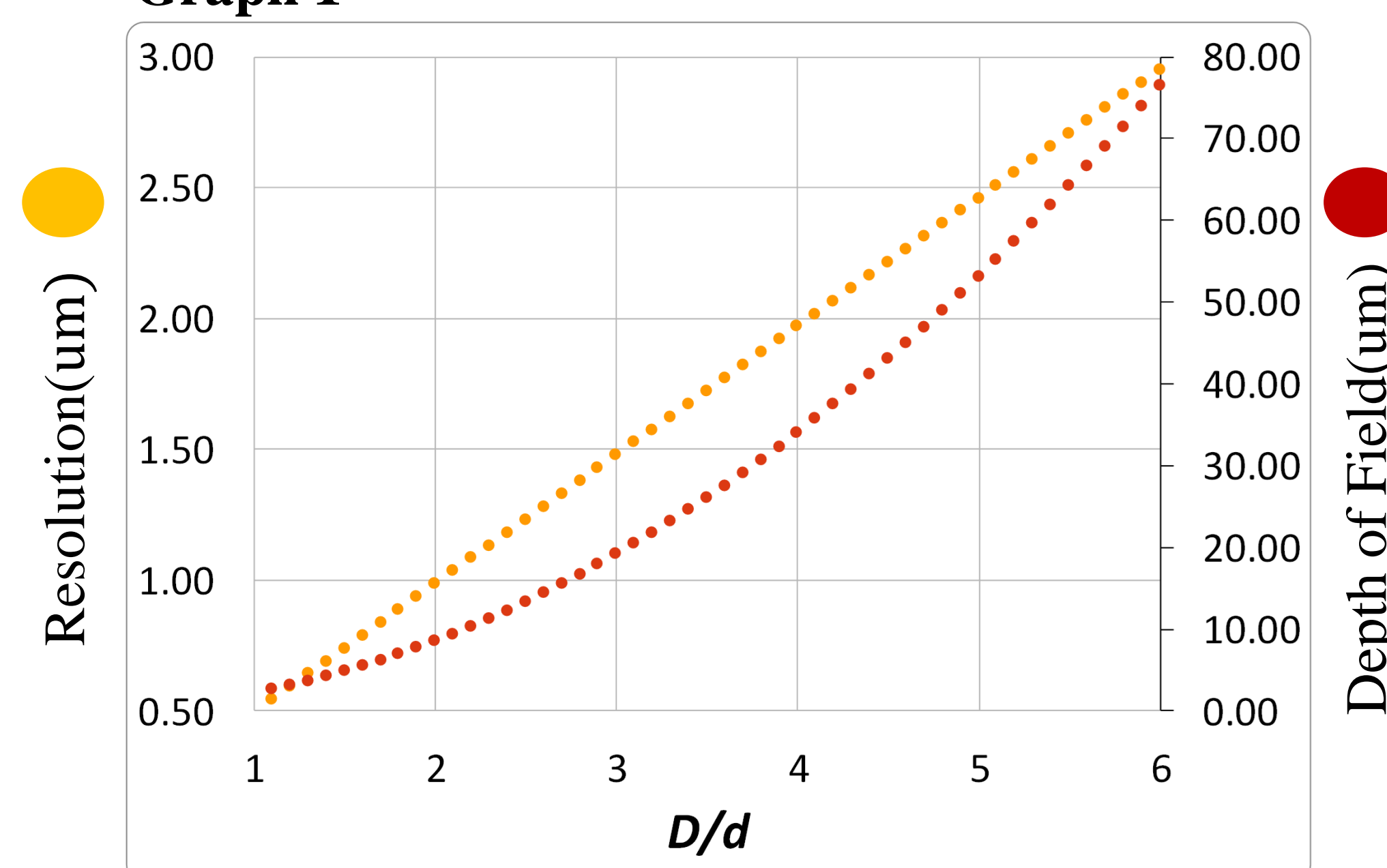
- During the span of the INSET-V research internship, I assisted Eric Terry in the development of a new microfluidic imaging system. Microfluidics is a technology that’s utilized in broad applications such as laboratory research, disease diagnosis, and drug testing. The key strength of microfluidics is the ability to conduct complex laboratory experiments on a small scale by utilizing certain fluid mechanical effects that emerge at the microscopic level, thus giving researchers unprecedented control of their experiments.



RESULTS



Graph 1



CONCLUSIONS

- In the future we will make improvements to our current design once we see how well our system performs in the field.
- By combining microfluidic devices with our new microscope and reducing the overall price will make it possible to use microfluidic devices in the field and it may be even possible to one day deploy microfluidic devices to third world countries where the closest hospital maybe miles away slowing the spread of dangerous illnesses like Ebola and malaria.

OBJECTIVES

- The first step will consist of background research and brainstorming by gathering data about current imaging technology and reading scientific journals then we will come up with design specifications that best fit the needs of microfluidic devices.
- The second step will be to create drawings of possible designs, and from there we will move on to building a 3D model of our final product.
- The last step will be building in the machine shop and testing our new optical system on microfluidic devices containing c.elegans embryos to gauge how well our new optical system performs in biological applications.

- What **Graph 1** tells us is that it is not possible to get a DOF above 50um and resolution of 1um with what we have. So we had to relax our original requirements and find the “sweet-spot” between DOF and resolution by picking the right lens to aperture size ratio.