Developing Technologies for a Multipurpose Flow Cytometer

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Introduction

Flow cytometry is the technology that can measure several physical characteristics of particles as they flow in a fluid stream through a beam of light. It measures properties such as the particle's relative size, complexity, and fluorescent intensity. A flow cytometer is made up of 3 main systems: fluidics, optics, and electronics. The fluidics system transports particles in a stream to the light beam, the optics system consists of the appropriate detectors and lights, which illuminate the particles in the stream and direct the resulting light signals to the electronics system, which converts the detected light signals into electronic signals that can be processed by the computer. When the flow cytometer is run, particles are carried in a fluid stream, called the sample core, to the optics system. For an accurate analysis, the suspended particles can range from 0.2 to 150 micrometers in size. When they pass through the light intercept, they fluoresce light and the data from this fluorescing is collected and stored on the computer (the electronics system). There are many practical, common uses for flow cytometry, especially biologically in studying topics such as medicine, blood, urine, and DNA.

Objectives

In our research, we aimed to create an effective portable flow cytometer. We aimed to make it cost-effective and small enough that it will not take up a large amount of space in a laboratory. Most flow cytometers, such as the one shown on the right, are very big and expensive, so our goal was to develop a smaller one that would save space and money. We also attempted to build it into a USB port so results of the flow cytometry experiments would go directly to a computer.

Methods

To create this device, a lot of work was done on getting the circuits to work. We ran a lot of experiments to test if this was working. Once we got the circuits to work, we worked on testing it with an actual sample core. We then began trials with this to see how that would work and what work could be done from there.

Results

Once our product's circuits were complete (seen above), we were able to run our sample core. The data we received on our computer did not show that our portable flow cytometer had worked properly. It gave results like as pictured below in Image A. If our device had worked properly, the data should have formed results as shown in Image B.

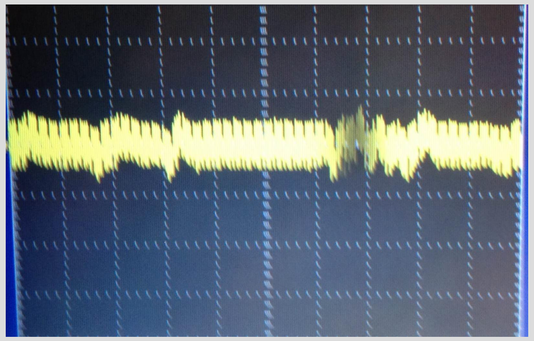


Image A

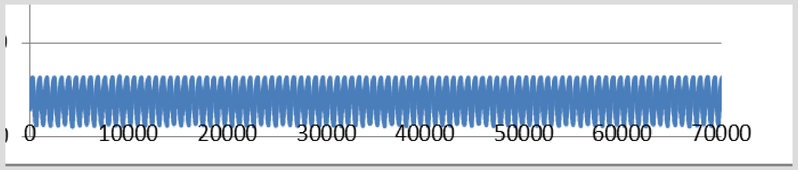
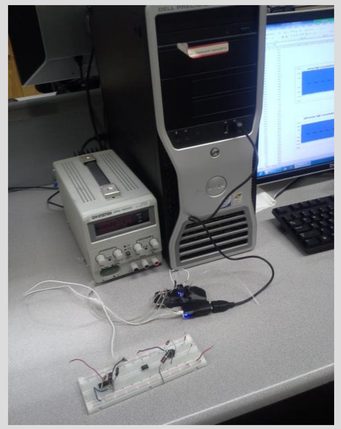


Image B

Our next step will be to replace the LED light that is being used to illuminate the sample. This will hopefully fix our problem and give us a cost-effective and more portable flow cytometer.

Here is a picture of what we have developed thus far. The circuit board can then be hooked up to a power supply. The sample core can be placed in a syringe and attached to the device. The size is appropriate for traveling, it is cost-effective, and once it works, it will make the process very efficient.



Conclusions

Through our work, we have made some progress toward developing a portable flow cytometer. If we can get the device to work, it will be both cost-effective and will save space in the laboratory. Although we have not achieved the final product yet, we are making significant progress and are very close to making it work. Once we reach this step, a wider range of applications for this product should open up and it will allow for easier use for all current applications.

Acknowledgements

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References

1. BD Biosciences. "Introduction to Flow Cytometry: A Learning Guide." San Jose: Becton, Dickinson and Company, 2000.
2. "Flow Cytometry." *SuRF@QMRI*. Shared University Research Facilities, 2012. Web. 22 Apr. 2014.
3. Kettlitz, Valouch, Sittel, Lemmer. "Flexible planar microfluidic chip employing a light emitting diode and a PINphotodiodefor portable flow cytometers". Lab Chip, 12. pp.197-203.