Using 3D Printing to Engineer a Microcentrifuge for Open-Source Research

Teal, Keegan (School: Barrington High School)

Many potential researchers in underdeveloped countries do not have access to the tools they need to make medical discoveries or solve health problems in their communities. One such tool is the centrifuge, used to separate blood samples and extract DNA, which is common in biomedical research. The aim of this project is to create a cost-effective centrifuge design that can be made with readily available components and a 3D printer. The centrifuge design was based around a brushless DC motor spinning a custom 3D-printed centrifuge head, designed to hold standard size Eppendorf tubes. This was housed in a custom plastic and polycarbonate enclosure and powered by a LiPo battery. An Arduino running custom software was used to control the speed of the centrifuge, using input from a potentiometer. The RPM of the centrifuge head was measured using a laser tachometer and the RCF at various speeds (relative centrifugal force) was calculated using the RPM and the radius of the head. At the end of 3 design iterations, the centrifuge is capable of exceeding an RCF of 3000 x g for blood separation and an RCF of 8000 x g for DNA extraction from tissue samples. The RPM display is most accurate in a band of speeds from 64 to 92 ESC value, and the centrifuge runs within this range consistently off of battery power. This centrifuge met all design criteria and succeeded in the project goals. This design will enable low-cost and portable blood sample processing and DNA extraction.

Awards Won: