Concept and Vision

The aim of this project is to design a portable liquid delivery system that can dispense nanoliter droplets based on piezo actuation. The significance of such a device is immense. It can be applied anywhere from laboratory testing of different elements that requires a low-volume delivery of liquids to medical uses to even in some cases military uses where a small amount of a liquid can be used to arm a weapon or even disarm it. When we started this project there were a few things that we wanted to accomplish with our design:

I. Portability and Simplicity
II. Develop a fabrication process that will be cheap to mass produce
III. Design an actuation mechanism in a way to make it easy for average person to operate.
IV. It will dispense liquids at an accuracy of .5 nanoliter

Project Scope Statement

Most liquid dispensers, regardless of the method used, are relatively simple. All one does is squeezing a trigger and droplets of water come out. It is as simple as that, or is it? It really is, for most dispensers. However, for nanoliter liquid dispensers, it is not that simple. For one, the small size requires much precision in the building and design. Two, water has high adhesive properties that make it want to stick to the tip as it is coming out, often leading to imprecise measurements. That is why a reliable dispensing of less than half a micrometer is very hard to achieve. The design objectives for this project is to design a nanoliter liquid dispenser, using a hydraulic and piezoelectric actuator combination system, that can accurately dispense water droplets with precision. That is something that is very difficult to do on the nanoscale.

Objectives include designing a nanoliter liquid dispenser system using hydraulic and piezoelectric principles, proving it with mathematical calculations, 3D modeling and simulating the process, 3D printing, and once all of that is done, testing and fine tuning the design. All of this is to be done with a relatively low cost, as well. The successful completion of this design can ultimately lead to success in the medical field or any other field that would be positively affected by the design of accurate and precise nanoliter liquid dispensers. The reason is because the successful completion of this design will be of a relatively low cost and will therefore make this type of product much more attainable. This design should enable (confirm or improve on) measurements to be made that have been made because these devices are already out, but the current designs are very costly, limiting access to them. For the same reason, it should improve process safety and energy savings because people will be able to dispense liquid on the nanoliter scale, which could help with much more precise medicinal dosages, among other fields of improvement.