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Portable Impact Tester

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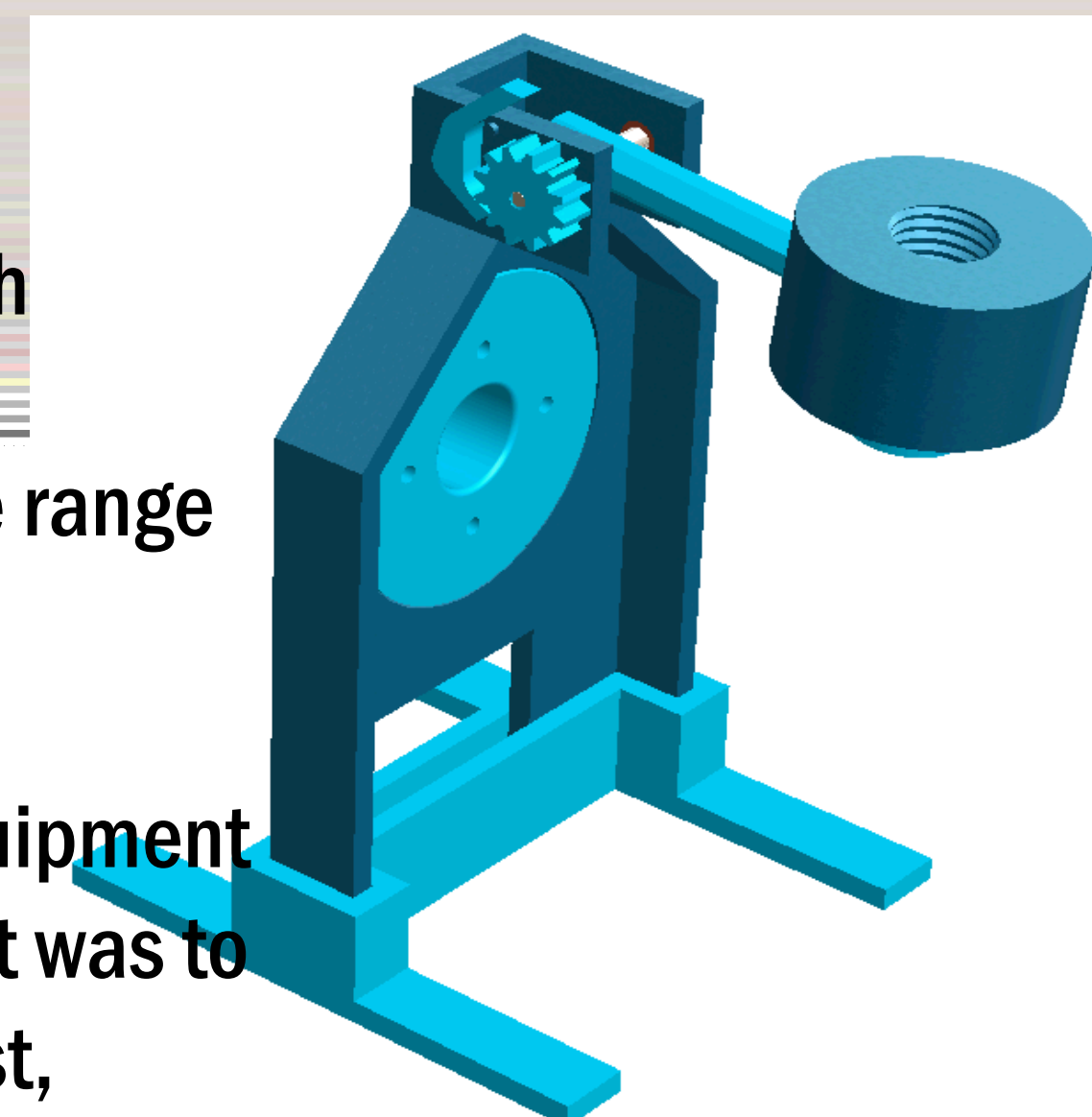
Abstract

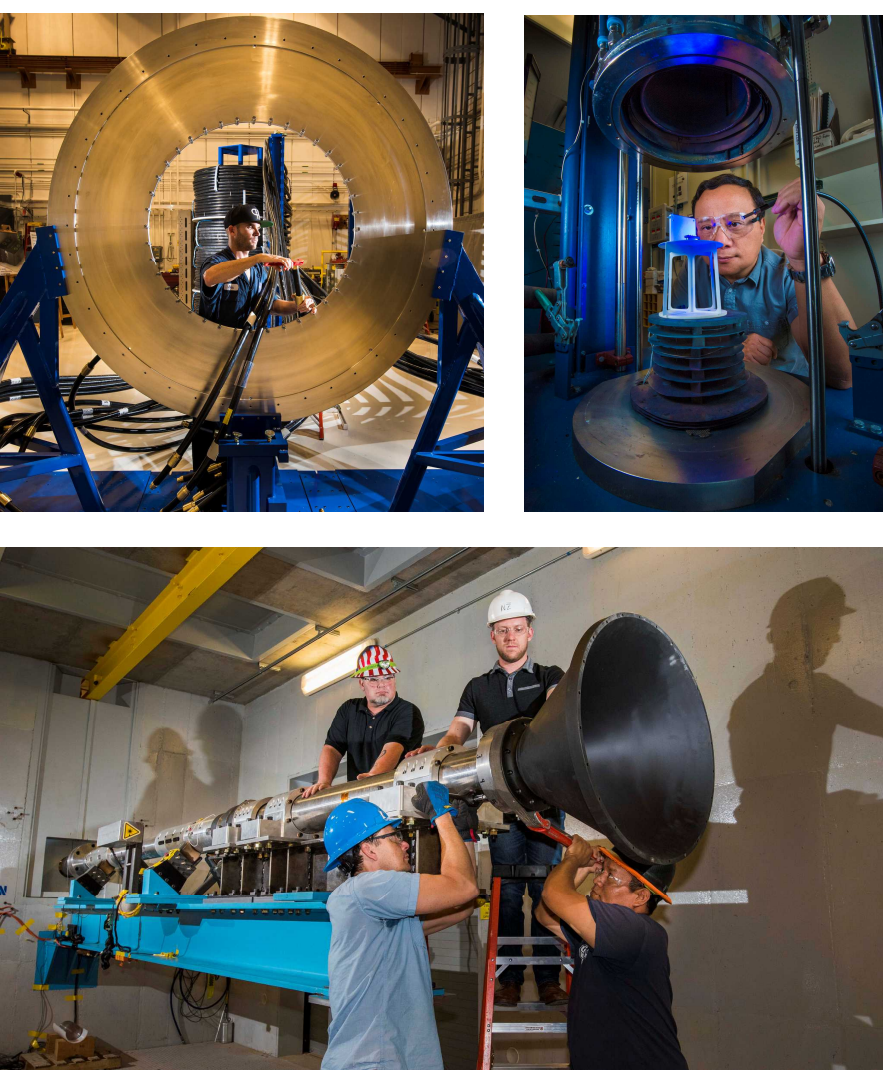
Nuclear weapon components are required to be reliable in many diverse environments. For testing purposes, components are subjected to these environments and tested to determine proper function. Standard test equipment used to verify functionality is large, expensive and not portable. A small, handheld tester has been designed and built as a portable means of testing the basic functionality of components after exposure to harsh environments.

Introduction

Because nuclear weapons are high consequence systems, each component is subject to careful testing. This involves testing each component's ability to withstand standard conditions as well as a wide range of nonstandard and improbable conditions. This rigorous testing is harmonized with the ideal of always-never.

Testing for any nuclear component must be robust, and the equipment required for such testing is large and expensive. The idea of this project was to design a smaller impact fuze tester that, while not being quite as robust, would produce consistent, useable results and could be used in between environmental tests at remote or offsite locations. The goal of this project was to produce an impact fuze tester which is portable, consistent, and easy to use.





Methods

There were two major challenges in this project. The first was to build an impactor that would generate consistent and readable output from the sensor. The second was to take the output of the sensor, read it, and then display it in a useful way. This tester was built using 3D printed rapid prototyping which allowed for several iterations. For each of the iterations, the consistency and usability of the design was discussed and revised. A 3D printed impact hammer (as shown) with steel axle and brass bushings was decided on. For the data processing, a teensy3.6 development board was used because we needed enough memory to store the entire output waveform. The teensy also had the advantage of an onboard microSD to store data which could be more thoroughly evaluated on a computer.

Results and Discussion

The impact tester design generates a pulse from the sensor that can be easily read by the microcontroller. The hammer design is very easy to use, and it is very portable. The biggest problem is consistency. Most of the impacts have a variability less than $\pm 10\%$, but every 10 impacts or so there will be an impact that is outside of a $\pm 50\%$ range. More testing needs to be done to find the source of these outliers so that the tester will be consistent enough for use.