Abstract

Hydrocephalus is a condition in which patients have too much cerebral spinal fluid in the ventricles of their brain. This fluid build up leads to pressure that can cause several complications including death. Medtronic Neurosurgery develops medical devices that allow the release of the C.S.F. from the brain of the patient to their abdominal cavity. These devices are tested on a test bench that is intended to simulate conditions within the human body. The goal of our senior project was to improve the existing test bench in order to better test the medical devices before they are implanted in patients.

Fill system

A new mechanical fluid filling system was designed which would be closed to the outside environment, decrease filling time, and protect the hydrocephalus shunt from excess pressure and damage during the procedure. Filling times for the new system were tested with untrained personnel using only the system manual and are recorded in Figure 2. Performance of valves in the system during filling during this procedure were characterized before and after this procedure and negligible changes in performance were found as depicted in Figure 3.

LabVIEW

The LabVIEW program which automates the test bench was modified to include a more user friendly Graphical User Interface (GUI) and easy single-click start up as opposed to the old tedious initialization process. The program controls all the hardwires in the system including the three main parts of the system which are the linear and rotational motors, the peritoneal tank and the ventricle tank. The GUI is organized in columns with each column pertaining to each of the mentioned main parts.

Valve Chamber

The Valve Chamber is the part of the test system that was designed to simulate the location in the cranium where the shunt rests. The existing Valve Chamber was an air tight chamber that utilized water pressure to simulate the water in the brain. The chamber, however, was difficult to use which is why our redesign of the Valve Chamber focused on making the chamber both easy to use and more physiologically accurate. To do so, we changed the valve to a sliding system that simulated pressure on the shunt using synthetic skin that slid over a synthetic skull backing, a representation of what actually takes place in the skull, making the redesigned Valve Chamber more physiologically accurate and easier to change and replace shunts.

Conclusions

While the efforts of our team were divided into three major categories the common goal of all of those efforts was to make the Test Bench easier to use. The fill system was successful in that it decreased the start up time required to get the system ready for operation. The modification of the GUI was successful in making the complicated system user friendly. Finally the redesign of the Valve Chamber was successful in making the chamber both user friendly and more physiologically accurate.

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