Electronic Stability System for a Digital Grip Gauge

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Abstract

For this project, a digital grip gauge was designed for Lockheed Martin to measure the grip length of the aircraft skin of the F-35. The objective of the electrical group is to ensure that the gauge will be capable of recognizing when the measurement has stabilized. When stabilized, a light will turn on, which allows the operator to know the measurement is ready for reading. We developed three prototypes to complete this objective. The three prototypes utilize Arduino, comparators, or push buttons. While each of these prototypes satisfies the objective, the third prototype was ultimately selected due to size constraints of the gauge design.

Background

The surface panels of the F-35 contain hundreds of holes that will be filled with fasteners. Due to surface flushness restrictions, as well as structural and weight concerns, it is vital that the correct size fastener is installed at each hole location. The only way to guarantee the correct length of fastener is to measure the grip length at each hole prior to fastener installation.
One specification:

- The gauge must be capable of recognizing when the measurement has stabilized.

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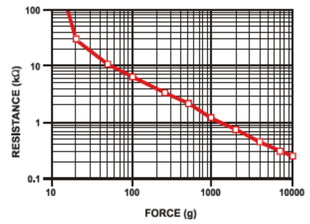
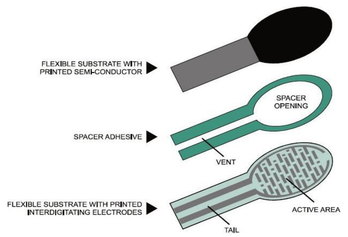
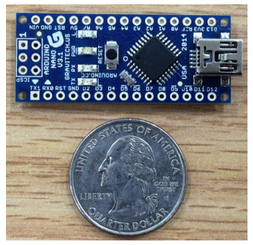
The goal of this project is to allow the gauge operator to know when the gauge is stabilized and the grip measurement is ready for reading. When both buttons are pressed, the gauge will be flushed with the aircraft skin, and the circuit will be completed. The completed circuit will turn on a green light that verifies stability.



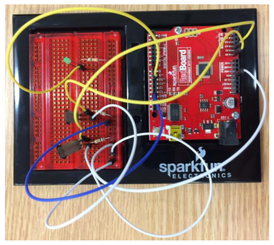
Resistance vs. Force



FSR Construction



Arduino Nano



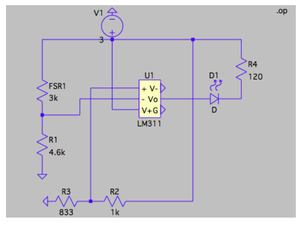
Arduino Circuit

2-input AND gate

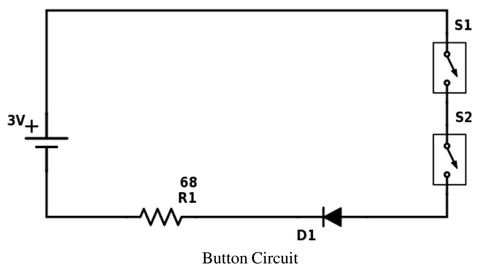
Input$_A$
Input$_B$
Output

A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

AND Gate Truth Table



LTSpice Model for Comparator Circuit



Button Circuit

FSRs

Force Sensitive Resistors, or FSRs, are polymer thick film devices that experience a decrease in resistance as force is increased on the active surface.
FSRs consists of three layers: an active area, a conductive film, and a plastic spacer.

Arduino

The first prototype uses two FSRs powered by Arduino. The Arduino code is programmed to turn on a light when the forces on the sensors are equal for a certain range within different zones.

Comparator Circuit

The second prototype consists of a comparator circuit with two FSRs connected to an AND gate. When both FSRs measure the same force, within a range, a light will turn on.

Push Button Circuit

The third prototype utilizes two small push buttons that complete a circuit. When both buttons are pressed, the circuit is completed, and a light will turn on, indicating to the operator that the part is flush with the aircraft skin and the measurement is stabilized.