

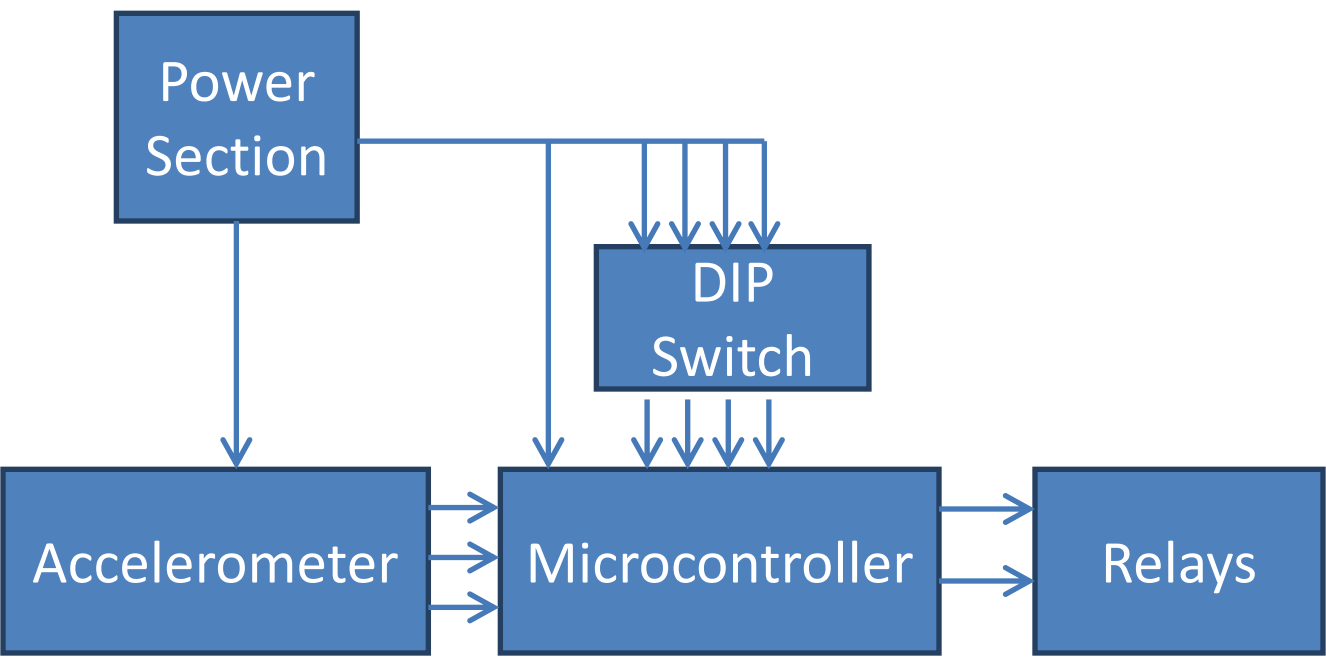
The User Settable G-Switch



ECE 480 Team 7 Fall 2012

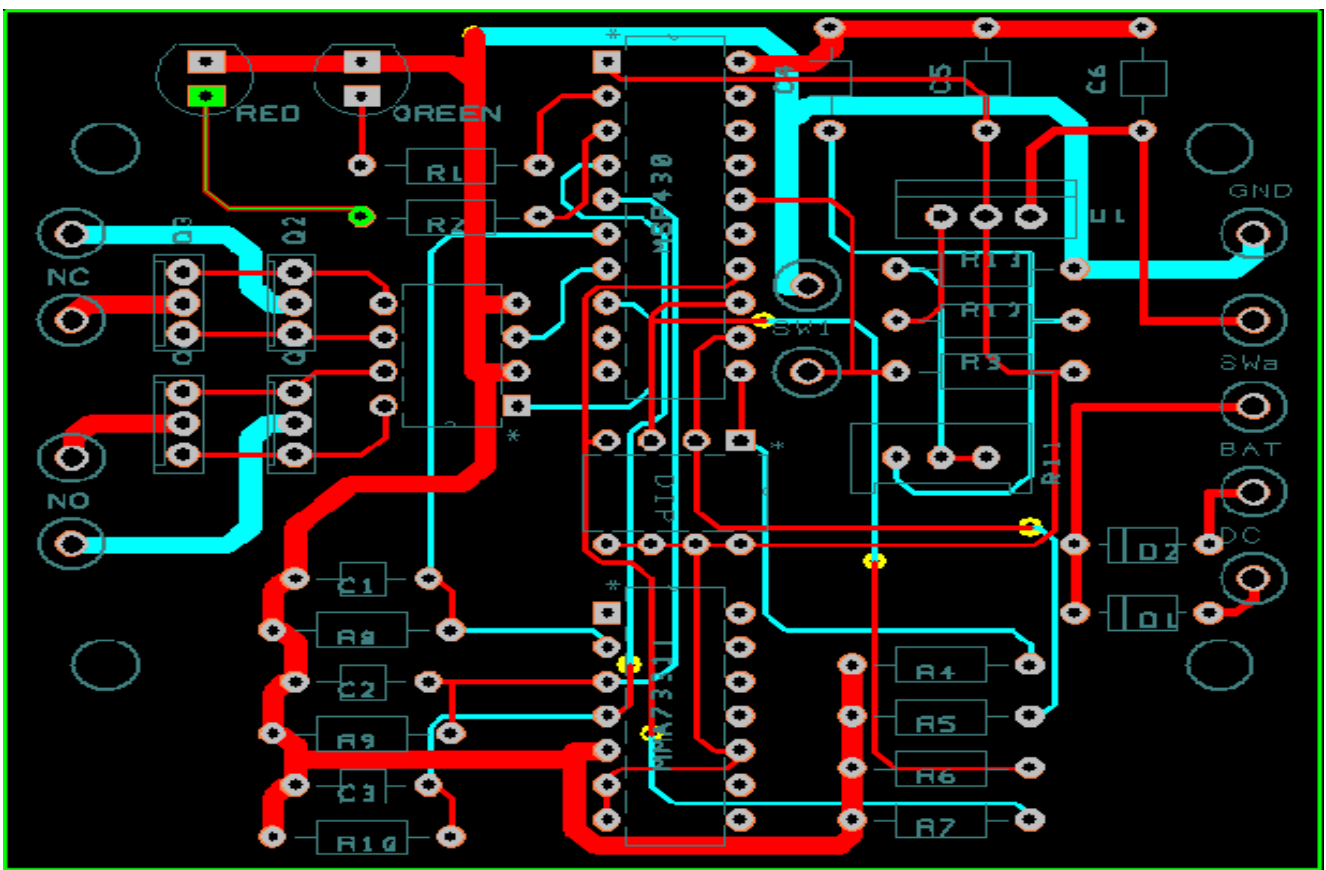


Our Design



PCB Schematic

The printed circuit board, or PCB, is an integral part of electronics fabrication in this era. PCBs are used to connect electronic components mechanically using conductive signal traces etched from copper sheets set onto a non-conductive substrate. The g-switch's PCB schematic was designed to fit into the 2-5" by 2" casing and is shown below.



Abstract

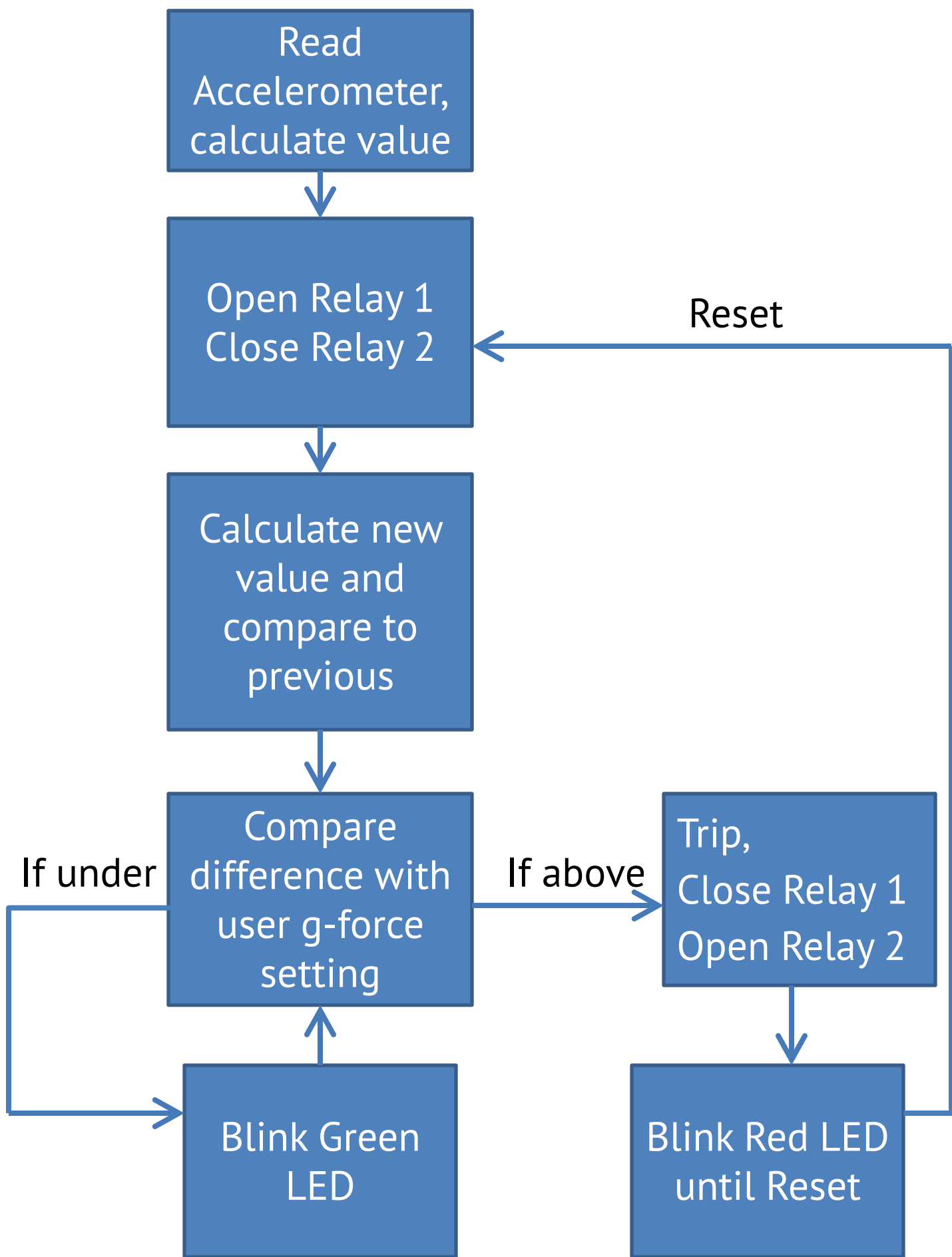
Vibrations and vigorous movement can be very damaging to commercial and industrial machines. Consumers require safety equipment that can prevent the costly damage that would result from this extreme g-levels. The g-switch design is a small self-contained device that will open or close a relay contact in the event that a dangerous g-level is reached. The device uses a 3-axis accelerometer and associated data acquisition and processing electronics that can measure g-levels and notifies users when relays have been tripped. This switch will improve the safety and efficiency of commercial and industrial machines, saving both lives and cost for consumers.

Examples of G-force	
Free fall	0
Max acceleration of typical car	0.4
Space Shuttle, maximum during launch and reentry	3
Roller coaster (max at bottom)	4.5
Loss of consciousness	4.5 – 6.3
Typical fighter jet	7.2
Death or serious injury	>25
Formula one engines, maximum piston acceleration	8,600

Budget

Parts	Cost
TI Launchpad Experimenter	\$4.30
MMA7331 Analog outputting Accelerometer	\$3.54
MMA7331 breakout	\$10
MSP430 microcontroller (free from TI)	\$0
Small components: DIP switch, capacitors, resistors, diodes, voltage regulator, transistors, LEDs, perf board (from lab)	\$0.00
Relay parts (15 MOSFET, 2 photocouplers)	\$45.00
PCB Printing (4PCB.com)	\$33.00
Power - wall wart and 9V (from lab)	\$0.00
2 Cases	\$22
Buttons (reset and power)	\$6
TOTAL COST: 123.84	

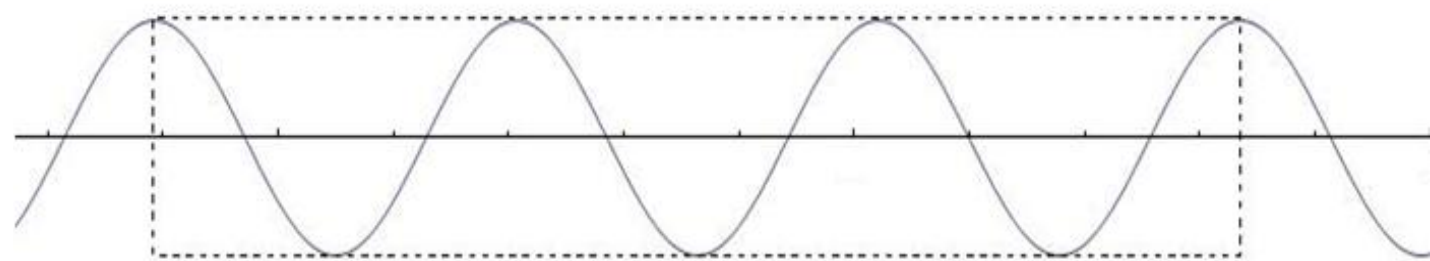
Code Flow Chart



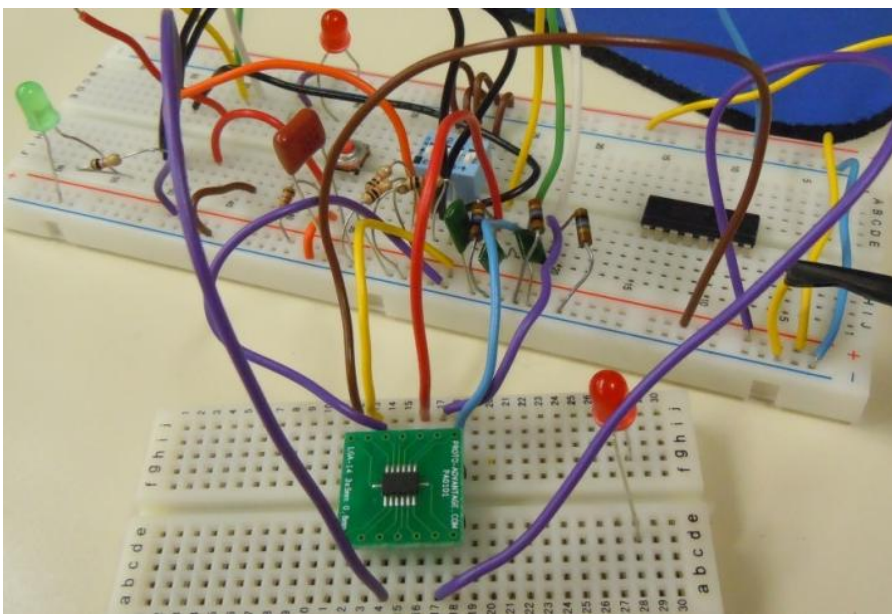
Trip Setting Calculations

The microcontroller reads the analog output from the accelerometer for all 3-axes and can do one of two calculations: RMS or peak detection.

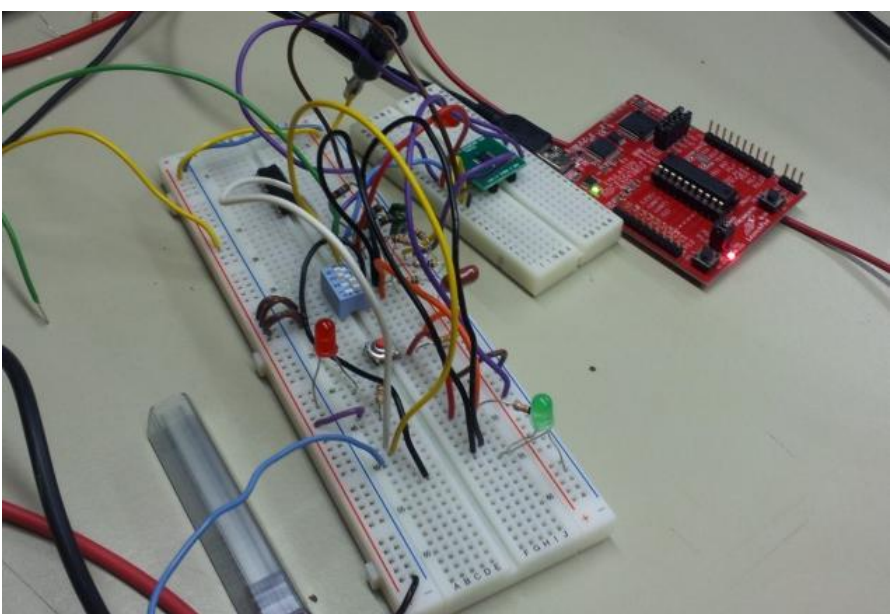
- RMS calculation is a useful averaging technique when dealing with positive and negative discrete values. It takes the quadratic mean value over a 4 second sliding window of the accelerometer's output to measure the movement of the device. The sliding window is shown below at one instance of time.



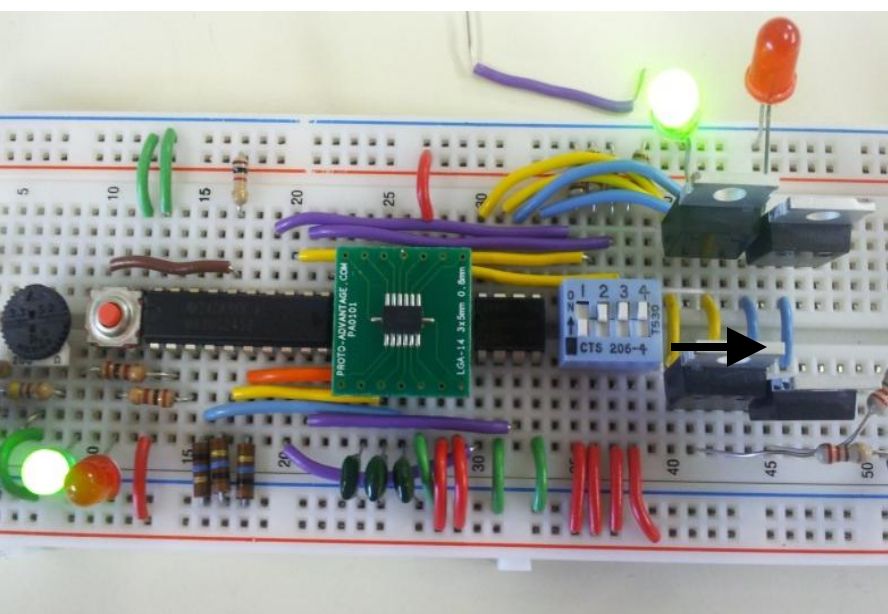
- In peak detection the code reads the accelerometer's output every 5ms and compares its values to the original input.



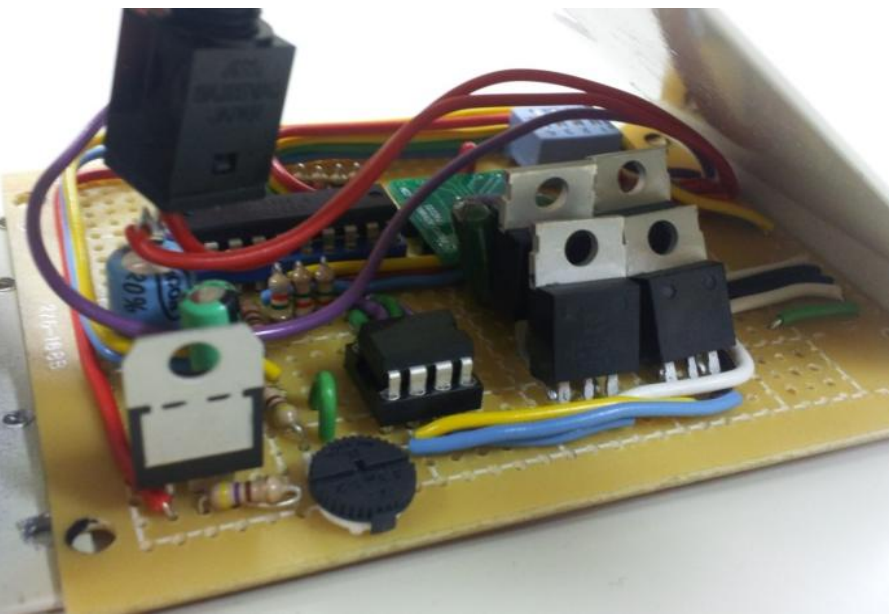
First breadboard layout of the accelerometer interfacing with the microcontroller



Reprogramming the MSP430 microcontroller with the TI LaunchPad



Functional user settable g-switch on breadboard



The components inside a project box



Fully operational prototype