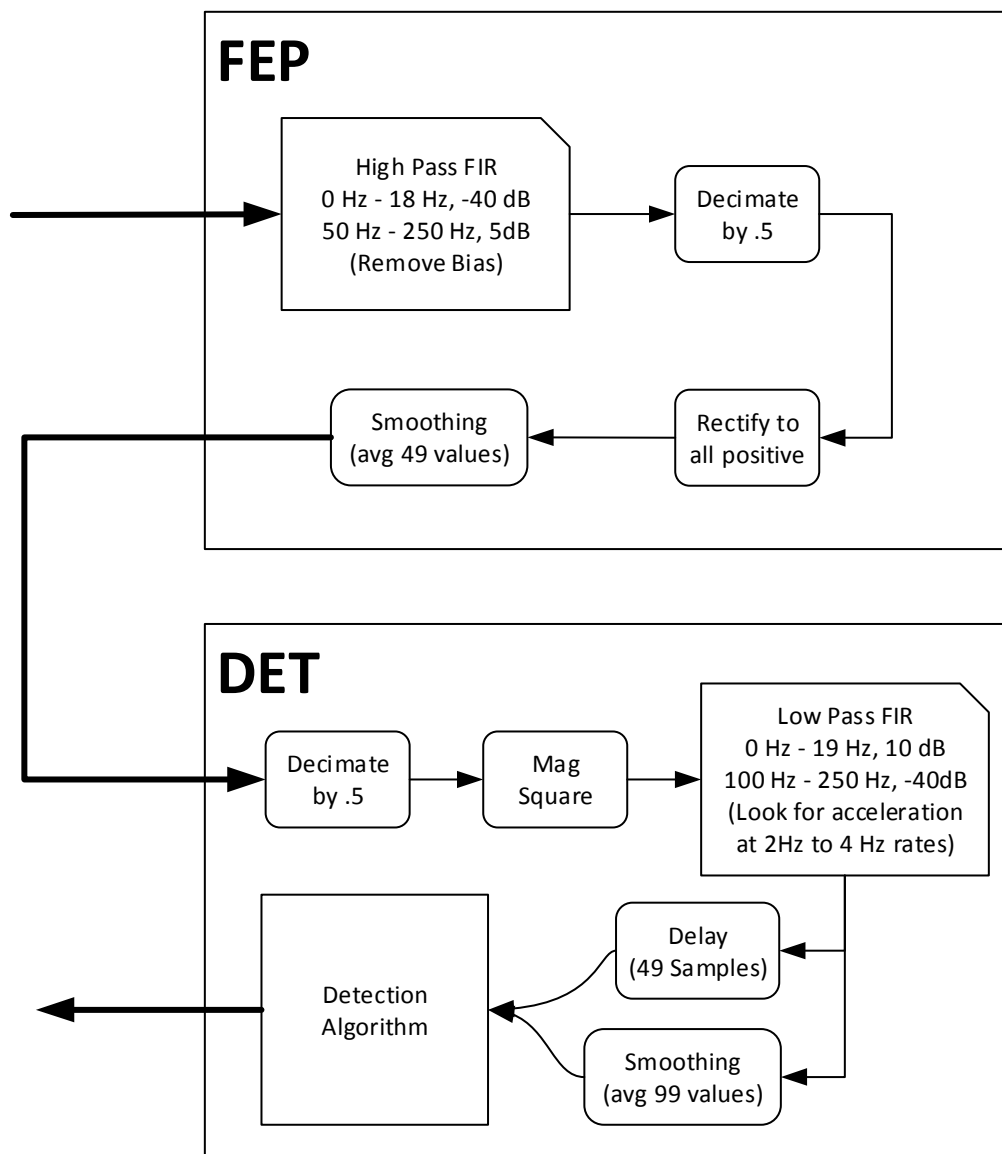*Approach:*

Since this is to run on a micro controller I decided to not use any floating point or time consuming math functions. All math used by run6() is integer addition, subtraction, multiplication or division. I used a Front End processor to remove bias and condition the raw input signal, next a detection processor to further condition the signal and find the minimums and maximums to be used to count punches. Right now I'm using a fixed time to gate triggering to early on the next punch when the signal gets too noisy, but I want to add a tracking processor to track the punches and be able to open and close amplitude and frequency thresholds plus the possibility of lighting an LED when the rhythm is staying consistent.

FEP

High Pass FIR
0 Hz - 18 Hz, -40 dB
50 Hz - 250 Hz, 5dB
(Remove Bias)

Decimate
by .5

Rectify to
all positive

Smoothing
(avg 49 values)

DET

Decimate
by .5

Mag
Square

Low Pass FIR
0 Hz - 19 Hz, 10 dB
100 Hz - 250 Hz, -40dB
(Look for acceleration
at 2Hz to 4 Hz rates)

Delay
(49 Samples)

Smoothing
(avg 99 values)

Detection
Algorithm

Front End Processor:

The FEP starts with a High Pass FIR filter to remove static bias, then decimating the signal to squelch noise and then taking the absolute value of the signal and followed by a small smoothing average to clean up the signal so it can be fed into the detection processor.

Detection Processor:

The DP first decimates the signal squelching more values near the floor to zero and then taking the magnitude squared (Mag Square) of the signal. The mag square signal is then feed into a Low Pass FIR filter to help smooth the signal since the acceleration events that are of interest occur in a 2 to 4 hertz range. The output of the FIR filter is fed into a medium size averaged smoothing algorithm that also spits out a delayed original signal that is right in the middle of the averaged signal so it is aligned in such a way to be used as a punch threshold template. The algorithm adjusts automatically to amplitude variations to keep from getting confused on the many resonant addition and subtraction phases that seem to occur. Right now punch frequency gate is fixed at 260 ms, but this may be a problem for the same algorithm working for amateurs and speed bag pros, which is why a Tracking processor would most likely be needed to be highly accurate across boxers and different speed bag platforms.

Tracking Processor:

Not implemented yet, but will track the frequency of peak punch detections and be able to better regulate a punch frequency gate to be able to increase tracking accuracy for amateurs and speed bag pros with the same detection algorithm.