A compact arc fault detection device based on FPGA

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Abstract:

Arc fault detection in residential electrical networks is a worldwide subject; it has been studied for long time in many different companies and laboratories. Some standards for the arc fault detector device have been also introduced in North America and Europe [1] [2].The team IJL-MAE 406 is currently working on this field. A good performance algorithm for arc fault detection has been developed and tested on simulation environment. The quality of signal input (the line current) and complexity of algorithm have a significant influence to the reliability of arc fault detection system. On the other hand an arc fault detector device (AFDD) should meet all the required specifications such as: size, performance, cost, power consumption and reliability.... In this research a real-time, embedded solution for all of these needs will be presented.

The role of an AFDD is: detect a dangerous arcing condition as soon as possible and should not trip in any other case, to achieve that the protection device needs to compute many difference analyses in real-time. For this type of application, a parallel architecture has many advantages compared to sequential processing. Therefore a FPGA based system is more appropriate than GPU or CPU. The very first step of this research consist of modify the proposed arc fault detection algorithm to adapt on a mass parallel architecture and conserve its efficiency. As a second step, a study for signal acquisition platform has been realized. And the last step includes: optimize and implement the algorithm on the chosen FPGA platform.

The detection method is implemented and functioned as expected on a FPGA platform with very low resource needed: 827 logic elements and 7284 bits memory. The whole system is compact and can be integrated on a circuit breaker; response time of system is 60 milliseconds which is faster than the requirement of the standard for all arc fault situations [1] [2].

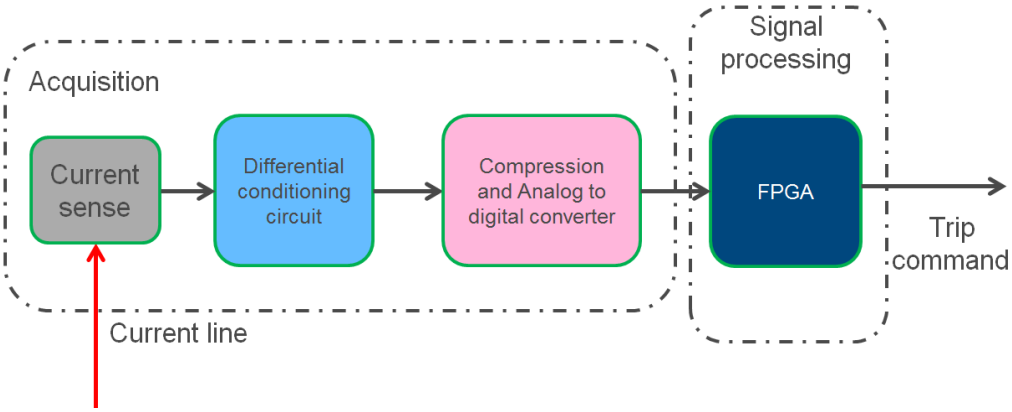

Figure 1: FPGA based arc fault detection device

Reference:

[1] IEC62606, "General requirements for arc fault detection devices" 2013

[2] UL1699,"Standard for safety arc-fault circuit-interrupters" 2006