Smart Electronic Locks and Their Reliability

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Abstract

Our research focuses on an analysis of electronic smart locks and explores the influences of faults on its controller unit. Electronic smart locks often utilize stepper motor as an actuator. Stepper motors, however, need a controller, which is usually implemented in a processor. The aim of our research is to examine the consequences of a failing controller processor. In our previous research, we developed a platform for fault tolerance testing with the ability to monitor the impacts on the mechanical part. We also developed a framework for accelerated testing of fault tolerance properties. The processor can be implemented in an FPGA (Field Programmable Gate Array) in order to be able to emulate HW faults inside the processor.

The concept of testing a smart lock is presented in Fig. 1, where all components are running on PC which allows us rapid prototyping and evaluation. Our experimental results utilizing the direct generation of invalid stimuli for the stepper motor. In our research, we found out that random errors probably could not be used for an unauthorized unlock, especially if the lock utilizes a mechanical gearbox. Deeper logic and knowledge of the correct sequence of steps used by the selected motor are needed to perform an attack to unlock the lock. On the other hand, random sequences could cause that lock not to be locked by falsifying the lock request sequence. The second interesting fact is that *x%* of faults in the valid sequence give the same rotation angle as *100-x%* of faults.

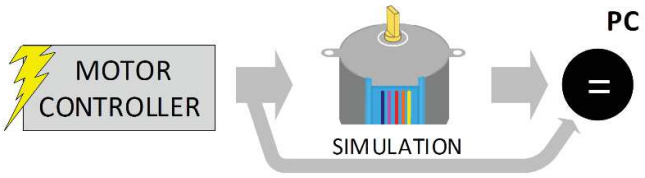

Fig. 1: The concept of testing a smart lock – the first step.

Paper origin

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References

[1] Čekan, O.; Podivínský, J.; Lojda, J.; Pánek, R.; Krčma, M.; Kotásek, Z.: Testing Reliability of Smart Electronic Locks: Analysis and the First Steps Towards. In: 2019 Euromicro Conference on Digital System Design. Kallithea: IEEE Computer Society, 2019, accepted for publishing.