Counterfeit IC Detection: A Defect Database and Test Procedure

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Counterfeit electronics are a long-standing problem, which pose an enormous threat to the electronics industry and supply chain. Critical systems used in medical, transportation, defense, etc. have long life cycles which make it easier for long-term counterfeiting success. Physical inspection and electrical tests are the most common approach for counterfeit parts detection. During the physical inspection, exterior, interior, and material composition are examined to detect anomaly from the component under test. There are a diverse set of counterfeit IC types, all of which have their own unique defects. Thus, detection process requires a long time to test an IC against a long list of defects [2]. It is immensely difficult to classify and provide a universal physical inspection process for all counterfeit types. Apart from this, physical inspection requires subject matters expert (SME), and a wide range of expensive test equipment which makes the process costly. An automated approach [1] to physical inspection with reduced cost and time can be a solution to above problems. The main barrier towards overcoming the above challenges is the lack of defect data of counterfeit components as in general academia do not have access to costly equipment and samples. To address this, we developed a large database www.counterfeit-ic.org [2] for counterfeit electronic ICs that provides a great opportunity to student, practitioners, and researchers to study the defects. On contrary, electrical tests are used to compare the IC parameters such as current, voltage, delay, etc. to the specifications or any known reference data.

The demonstration will show the website of counterfeit IC database, a video presentation showing data collection procedures, and electrical tests for counterfeit IC detection. This demonstration will use an internet connected computer and monitor to explain the resources available in the database. The website as shown in Fig. 1 contains a public repository that allows researchers, students, and practitioners to view, export, and upload defect images found by physical inspection of counterfeit ICs. It also contains statistical information related to each defect. The defect database contains a variety of products like memory, processor, amplifier, converters, microprocessors manufactured by Intel, Texas instrument, Integrated Device Technology Inc., AMD, Philips semiconductor, Tundra semiconductor Corporation, etc. In real time, we will show the procedures to access the database. We used equipment like X-ray, Tomography, SEM, optical microscope to obtain the IC images for the database. Since, all the equipment is large, costly, and needs a sophisticated setup, it is difficult to show the image collection process in real time. We will present a video demonstration that will provide an insight of the image capturing processes. Counterfeit chips from different manufacturing companies will be exhibited in this demo. Some of them are shown in Fig. 2.

The demonstration also includes electrical tests aiming the counterfeit IC detection. We will show a targeted electrical test to detect recycled FPGAs [3]. These types of tests aim the specific electrical property of the chip and compare it with reference chip data. Here, the propagation delay of the FPGA circuits are measured by implementing ring-oscillator. Due to prior usage, the propagation delay of the used FPGAs is expected to be higher than the fresh FPGAs. This delay difference can be used to detect recycled or aged FPGA. We developed a test process based on the machine learning algorithm that uses the propagation delay data from known fresh components and known aged FPGAs. Aging setup includes thermo-steam, DC power supply, oscilloscope as shown in Fig. 3. In this demo, a computer equipped with machine learning-based detection scheme developed by authors [3] will be used to detect the recycled or aged FPGA.

References

1. N. Asadizanjani, S. Gattigowda, N. Dunn, M. Tehranipoor, D. Forte, “A Database for Counterfeit Electronics and Automatic Defect Detection Based on Image Processing and Machine Learning,” ISTFA, Nov. 2016.
2. http://www.counterfeit-ic.org/.
3. M. M. Alam, M. Tehranipoor and D. Forte, “Recycled FPGA detection using exhaustive LUT path delay characterization,” ITC, 2016, pp. 1-10.

Figure 1: IC counterfeit website.


Figure 2: Counterfeit ICs.

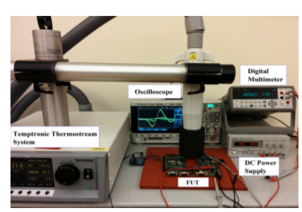

Figure 3: Electrical test setup.