Proposal for the design of innocuous Electronic circuits for airplane systems and space shuttles

Mohamed Soliman Elkomy

Abstract— Air plane control systems should be designed to correct their behavior in case of unexpected operating conditions. Airplanes are still considered the safest method to travel. But more effort should be pointed to make the control systems fault free. In this document an idea is presented to use automation testing as a layer that can detect drift from normal operating characteristics, based on the amount of change an intelligent system with readjust the operating characteristics of the control system to achieve stability in operation. [LLWZLG10] describe a hardware method to achieve control, in this document a SW variant is proposed.

Index Terms— Software automation, Simulation, Electronic Circuits, monitoring systems, Transistor, End of Life, Machine learning, and self healing.

ELECTRONIC CIRCUIT DESIGN:

Electronic circuits are composed of components that are manufactured from metals and semiconductors. A transistor is one of the key components of any electronic circuit. When manufactured a transistor has certain operating characteristics. For digital circuits a transistor can have two operating points: one corresponding to true and another corresponding to false. For analog circuits a transistor operates in a range continuous domain and range of current and voltage. However these characteristics drift from their foundry state with time which can be described as transistor aging.
Most electronic circuits are dependent on batteries; these batteries tend to supply constant voltage to feed the electronic circuit load with current. These batteries are then modeled in electronic circuits as constant voltage or current sources. However again with time this model becomes inaccurate and the voltage drop across electronic components starts to differ causing the behavior of the electronic circuit to change.

COMPUTER AIDED DESIGN SIMULATION:

Computer Simulation can be used to verify and validate the behavior of real systems. Simulation is used in electronic circuit design and can also be used to check how well a circuit will function after a long time of operation. A computer aided design simulator is a software product that goes through a software life cycle to be produced. Testing is a phase in this life cycle.

AUTOMATION TESTING AS A MONITORING SYSTEM:

Automation testing is the process of writing a program that can be used to mimic the human tester doing an action and evaluation the response of the electronic circuit. If that response is as expected then the program reports that the software is performing as designed. On the other hand if the program shows unexpected behavior this means that there is something wrong with the CAD program.

Automation software eavesdrops on program execution to have readings that can be used to decide the correctness of the program itself. This idea can be used to extend automation software into an intelligent system that can be used to generate feedback operating conditions to drive an electronic circuit. So if we have an electronic circuit that is derived by a preliminary voltage when is begins to operate and with the elapse of time it starts to degrade in performance, we can use a well-designed automation software to detect such inconsistency in behavior, then that will be communicated to an intelligent system which will decide on the new operating voltage of the circuit to restore the original behavior.

[LC14] proses some methods to assess circuit reliability (end-of-life). This method can be used to set a checkpoint that when the automation testing system detects a signal is fired to the intelligent system to generate new operating condition.

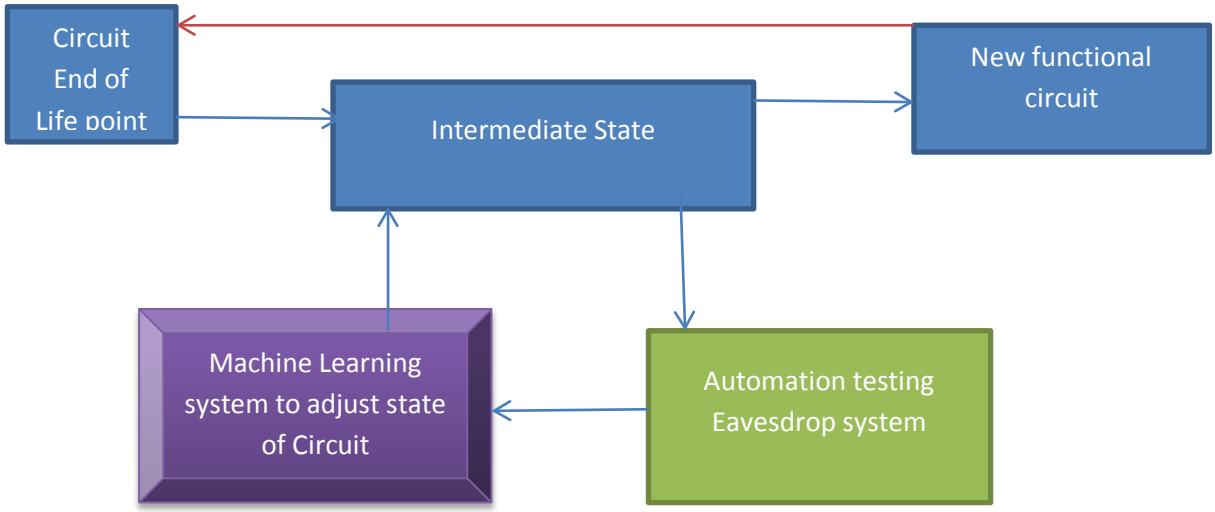
[LPV13] present an approach based on machine learning techniques to link test results from the application of different testing techniques. This can be used a second step to gather feedback data from the electronic circuit after it had reached its end-of –life state. Again an intelligent system will adjust the circuit operating points based on such feedback. It really very similar to neural network behavior where there is a feedback path from the output to the input to reach a stable point.

[JGH09] talks about using supervised machine learning methods on a set of 11,360 pairs of protein domains. This can be applied to our case which will have much less domains that are the new driving voltage and current sources that will reach a new well-functioning operating circuit, which means the new battery voltage, In case that we cannot made an automatic adjustable battery we can

make the electronic circuit design to function from different voltage batteries that are replaced depending of a schedule.

[BM09] talks about self-healing transistors, this idea can be extended to a self-healing electronic circuit.

A new learning by example mechanism and its application for digital circuit design automation. This mechanism uses finite state machines to represent the inferred models or designs [Choi02]. Finite state machines could be used to represent the inner adjustable models of the system in its journey toward reaching a new operating point after reaching the so called end of life state.



Proposed system: when the circuit reaches end of life a machine learning system starts to take as input what an automation testing eavesdrop system is producing to adjust the electronic circuit intermediate state, this process continues until we reach a new functional state, when the new functional state reaches end of life the process starts from the beginning

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