WHITE PAPER

Using Augmented Intelligence to Address the Perils of Risk-Based Testing

by

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INTRODUCTION

Few projects, if any, have ever met all deadlines with time to spare. Inevitably, software development is delayed, resulting in a crunch in the time available for comprehensive testing. Naturally, quality takes a hit. Until now, Risk-Based Testing (RBT) provided relief to testing teams by allowing for logical de-scoping of testing and offering higher visibility of risk coverage, thus enabling project teams to make informed decisions based on the QA teams' risk assessments. Risk was typically calculated as the product of Probability of Failure X Cost of Failure. [(1)]

This approach, however, brings its own set of disadvantages. This paper examines an alternative approach that combines human experience and Artificial Intelligence to deliver an Augmented Intelligence-based testing solution that addresses the main challenges of RBT.

CRITICAL ISSUES WITH RISK-BASED TESTING

QA teams have relied on various testing approaches to attempt to deliver high quality applications within challenging timeframes. Some of these include:

Equivalence partitioning or equivalence class partitioning (ECP) is a software testing technique that divides input data into equivalent partitions from which test cases can be derived. In principle, test cases are designed to cover each partition at least once.

Boundary value analysis (BVA) is another testing technique in which the tests focus on boundary values in a range. It is a black box test design technique for testing the value of a boundary between both valid and invalid boundary partitions. With this technique, the boundary values are tested by the creation of test cases for a particular input field.

Heuristics testing is yet another approach where testing strategies rely on past data about probabilities. Heuristics are simple, efficient, fallible guidelines that help make decisions. In this method, engineers bring high-level, experience-based, decision-making skills to make testing more efficient. Heuristics help reduce personal biases, making tests more reliable, and also facilitate better defect detection and early optimization.

Different RBT techniques such as Product Risk Management (PRisMa), Pragmatic Risk Analysis and Management (PRAM), and Systematic Software Testing (SST) have been developed and matured over the years. However, the choice of RBT is subjective since it depends upon both technology environments and business domain. Thus, RBT has different requirements for an e-commerce website, avionics software, supply chain management, financial systems, medical device companies, and so on. For instance, since medical device development must comply with regulatory requirements, which are fundamentally focused on reducing risk to medical patients and healthcare professionals, the risk management requirements are much more critical than other domains.

Broadly speaking, RBT techniques follow four phases, viz., Risk Identification, Risk Analysis, Risk Response, and Risk Monitoring and Control.

All these approaches, however, come with drawbacks that can lead to unacceptable drops in final product quality. These include:

Reliance on human intervention

The onus of risk assessment falls squarely on the shoulders of the QA team. While things work out reasonably well with highly experienced engineers, this method gets increasingly unreliable with relatively inexperienced teams.

Low test coverage

Manual testing automatically puts a cap on the number of test cases that can be handled. Being a “brainual” task, RBT cannot entirely be offloaded onto a machine for fully automated testing.

Unsuitable for production environments

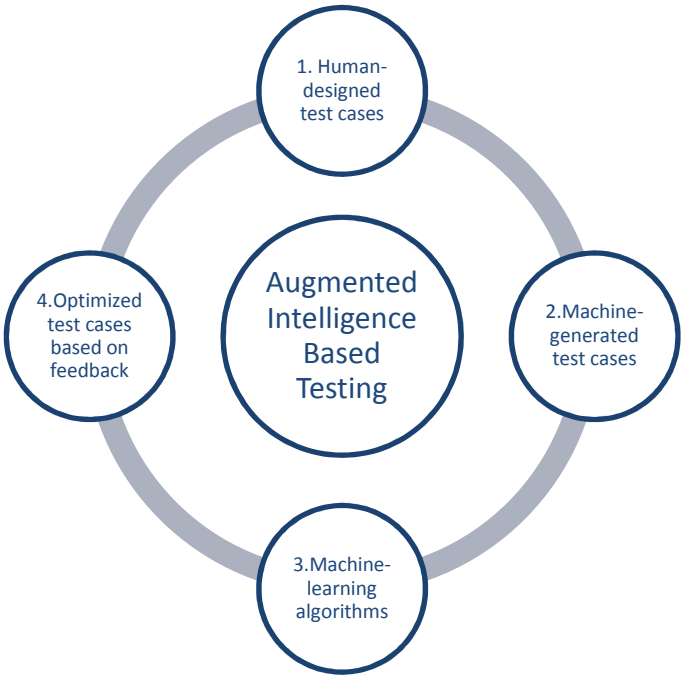
Production environments are marked by time pressures and high cost of failure. Hence methods that work in Continuous Integration (CI) environments do not work in production environments.

Augmented Intelligence — When Human meets Machine

"Artificial Intelligence" was one of the most searched terms in the Scopus scholarly database in 2018, joining cancer, heart attacks, and Big Data in the top ten.

Continuous quality improvement, a cyclical process of assessing performance, implementing improvement plans, and reassessing results is the goal for every organization across industries and software is no exception. Effective testing helps in improving quality by identifying and removing defects early in the cycle and emerging technologies such as Artificial Intelligence and allied areas such as Data Sciences, Machine Learning (ML), are expected to make a significant impact in performing better testing in the years to come.

However, as noted earlier, testing cannot entirely be relegated to machines. Zuci Systems presents an alternative approach that combines both human intelligence and machine learning to solve most of the issues that ail RBT today. This "Augmented Intelligence-Based Testing" can help achieve end-to-end automation in production environments and lead to a virtuous cycle of test case generation and optimization driven by Machine Learning.



Virtuous Cycle Using Augmented Intelligence-Based Testing

For instance, QA teams can put together a strategy around testing in a production environment, based on experience and past test data, which act as input into the testing system. Essentially QA builds a shopping cart for test cases and recommends optimal test cases,

Using Horus API Bot's ML algorithm & Predictive Analytics, the system generates and recommends optimal test cases to QA and DevOps teams.

Based on the results, the system optimizes and refines tests cases for the next cycle, and so on.

With Zuci Systems' Augmented Intelligence-Based Testing, issues were fixed with >90% test coverage as compared to 70-80% using traditional RBT.

REPLICATING AI SUCCESS STORIES

Software testing and quality as a discipline has borrowed heavily from manufacturing and other industries. Kaizen, Kanban, Lean manufacturing, Just-in-time manufacturing, and other approaches have been used in software to improve quality over the years. Similarly, the use of artificial intelligence techniques to identify and eliminate defects in other industries can be adopted and applied in the world of software testing and quality. Some examples include:

Automated visual inspection

Motorola takes help from "Instrumental Inc", a company that helps in real-time defect detection of both known and unanticipated issues on manufacturing lines using machine learning algorithms. Instrumental aggregates all of the image data into a cloud database, where it can be analyzed by tens or even hundreds of machine learning algorithms to identify defects or changes that engineers care about. [(2)]

Intelligent fabric defect detection

The Hong Kong Polytechnic University (PolyU) has recently developed an intelligent fabric defect detection system, called "WiseEye", which leverages advanced technologies including Artificial Intelligence (AI) and Deep Learning for quality improvement in the Textile industry. [(3)]

Textile manufacturers currently rely on human efforts to randomly inspect the fabric by naked eyes. Due to human factors such as negligence or physical fatigue, defect detection by human labor is usually inconsistent and unreliable. The research team at "WiseEye" has overcome the challenge by applying Big Data and Deep Learning technologies. By inputting thousands of yards of fabric data into the system, the team has trained "WiseEye" to detect about 40 common fabric defects.

Conclusion

"Data" is at the heart of Artificial Intelligence and as we can see in the examples above, the path to better quality comes from past data, which is used to train AI systems. This is a big area of learning that can be applied from other industries to software testing and quality. Collecting past defects, categorizing them accordingly, and using them to train AI systems can help detect defects and raise the quality bar in production environments.

RBT poses one of the biggest quality challenges in supply chain logistics, banking and finance, to name a few, where timelines are tight and the cost of risks is too high. In such cases, Augmented Intelligence Based Testing can play a vital role in building better test suites, which would go a long way in consistently delivering high quality applications.

About the author

VASUDEVAN SWAMINATHAN is President & Principal Consultant at Zuci Systems, where he has played a pivotal role in developing innovative solutions in the Fintech space. He has envisioned various solutions including HORUS, HALO, and ZUJYA Handyman, among others.

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