TestCafe: grinding automation issues (End-to-End web testing approach)

Author: Juan Delgado

Co-Author: Erick Gutiérrez, Juan Carlos Patrón, Iván Medina

Juandedios.delgadobernal@gmail.com, erickd.gutierrez@up.edu.mx, 0194229@up.edu.mx, 0189863@up.edu.mx

Abstract

Testing is a crucial activity in the Software Development Process and effective testing produces high-quality software.

Software test automation is used widely to improve the quality and efficiency of the software, using techniques such as End-To-End (E2E) to test an entire flow such as the final user simulating their actions (clicks, inputs, etc.). This is quite useful since as the project grows the number of scenarios to test also increased but building a test automation framework handling E2E testing is not easy on the programming world and even more if so would like to be configured to run on a Continuous Integration (CI) system that can execute all the tests every X amount of time or after a deploy.

We'll be using TestCafe as our tool of choice, a free and open source node.js end-to-end automation tool used to test web applications able to run tests on different popular browsers to carry over multiple tasks and with the possibility to integrate our tests with CI pipelines.

In this paper we are going to dive into the world of this test automation framework and will show how to create a simple and efficient test automation framework project with TestCafe, making a demo with a script running across different web browsers configured with CI.

So, grab a cup of coffee, and let's try to finish our test before our coffee gets cold.

Biography

Juan de Dios Delgado has more than 15 years of experience as engineer. Currently as Test Manager, with Mobica. With strong project management skills, key areas of expertise include understanding complex business requirements & formulating robust test strategies; developing automated test solutions with the ability to interface between Development, Project, QA & Test Teams to ensure execution of test strategy; and extensive software engineering skills. Involved in the test management of Agile/Waterfall projects throughout Software Testing Life Cycle (STLC). Also creating structured processes & best practices to manage defects right through to resolution.

He has participated in several projects, in the last years. He has worked on site in the US and Europe; near shore from Mexico to the US, and offshore from Mexico and India to Europe; working strongly with Functional Testing focusing on Automated Testing and Business Analysis.

Also he is a Professor at Universidad Tecnológica de Aguascalientes and Universidad Panamericana in Aguascalientes, Mexico.

Creator of the "Enhanced Performance Engineering" program that aims to improve a career path of engineers to become them the high-performance professionals by way of improved learning through practice derived from participation in hands-on projects with close customer involvement, intensive teamwork, and the use of modern software development tools and processes. The program is acting as a support of learning experienced center (called Delber) inside of the Universities in Aguascalientes for the IT industry due to the current lack of engineers with experience in the latest trends in technology.

Co-authors:

Ing. Erick David Gutiérrez Hernández

Erick Gutiérrez is an Artificial Intelligence Engineer specialized in Engineering and Quality of Software Projects, also he is doing a Master in Sciences where is working in a project with Deep Learning in Computer Vision about Medical research. He has worked as a Machine Learning developer but also has experience with Software development, quality, and management.

Currently working as Lead Developer in a Company where he can combine his leadership, software skills, and quality assurance experience.

Also, has a passion for social projects were have been working in alliance with Teletón (the world's largest private child rehabilitation system) and Aguascalientes county with technological projects where it has been possible to continue helping people and developing himself a person.

Ing. Ivan Medina Dominguez

Ivan Medina is the co-creator, lead programmer and designer for two new startups in the sectors of 3D Printers and fashion accessories. Before that Ivan worked as an independent Automatic developer for testing webpages and mobile applications. When he's not working in the startups, you would find him learning German or researching about financial analysis, cryptocurrency and blockchain, because he thinks that those will be the next big thing for developers and the World.

Ing. Juan Carlos Patrón Ruano

Industrial Engineer with a specialization in Engineering and Quality of Software Projects. Primarily focused on Full-Stack Development with a passion for joining the Software and Business/Industrial worlds of a company.

1 Introduction

What is an e-commerce? You probably already know the answer to this question. One of the first e-commerce transactions dates back to 1982. Today, there is an estimated 12 to 24 million currently active e-commerce companies worldwide. However out of these millions of websites, only a significantly smaller percentage of these breakthrough $1000 in annual revenue.

The question arises as to why so many of these websites are not reaching this goal? "X", an e-commerce company that is currently in the development stages of their online sales platform, which is based on React, tasked our team with the responsibility of developing an automated testing framework that would test and guarantee their products end quality.

The following paper will discuss the technologies and methodologies that were implemented for the development of our automated testing framework and explain the reasoning as to why these choices were made. We will also analyze the structure of our framework as well as the results and benefits our end product yielded.

2 E-Commerce

2.1 Background information

E-commerce, or electronic commerce refers to transactions which are conducted via the internet. It can be either individuals or companies buying and selling products or services online, as well as online auctions, online banking, ticketing, etc. An e-commerce is a very attractive option for expanding a business's reach especially for small business owners or startups since it offers the possibility to sell your products 24/7, anywhere in the world, with extremely low operational costs. Due to the exponential growth of the internet and globalization it is projected that during this year retail commerce sales will reach an estimated $4.13 trillion. To put this projected growth into perspective, according to Nasdaq, it is estimated that 95% of all retail purchases will be conducted via e-commerce by the year 2040. However, with the ever-growing number of new e-commerce sites being deployed, new challenges begin to arise as well. Your e-commerce must stand out amongst the sea of websites and inspire confidence in the consumer, create customer loyalty, offer security and the best possible user experience.

A key metric to observe in an e-commerce is shopping cart abandonment rate. This is a term used to refer to visitors placing items in their shopping cart but leaving the site before completing a purchase. According to Baymard Institute the average shopping cart abandonment rate for e-commerce sites is approximately 70%. It is crucial to observe this metric since the customer displayed an obvious interest in a product, however something went wrong along the process and abandons the page before completing the transaction.

Of these reasons for abandonment 13% are caused by a website error, bugs, or crashes, 17% of the abandonments are due to the customer not trusting the platform with their credit card information. This lack of trust in the website can also be attributed to a website which is bugged or did not perform as intended. Lastly a staggering 21% is related to a long and complicated check out process. Baymard Institute also reports that with an optimal checkout process and design, a site can increase a second Key Performance Indicator which is conversion rate by 35.2%. This KPI refers to the percentage of your website visitors who conclude their visit with a purchase. The average conversion rate for an e-commerce worldwide is between 2.89% and 3.31%.

3 Business Case

"X" 's development process was stagnant, due to the lack of an adequate testing strategy. Manually testing their e-commerce was a long and tiresome process and validating that their platform upheld quality standards in a variety of browsers and versions was an extremely time-consuming task. This ultimately led their website to have an array of bugs and outstanding issues. Aware that the current situation would impact the quality of the final product "x" wanted to develop an automated testing framework based on Python utilizing Selenium Driver to test their platform. "X" contacted Juan De Dios to consult on the optimal way to approach this possible solution. Juan De Dios formed a team of his previous alumni, composed of a diverse group engineers to analyze this proposal.

After researching and understanding the ins and outs of the e-commerce market, it became apparent to our team that the framework would not only improve the development cycle of the e-commerce website, but it could potentially improve the KPI's previously mentioned. Since these indicators are so intricately related to the performance of the website in the final users' hands, the automated testing framework would directly increase the revenue in the stakeholders' pockets.

If an automated solution would standardize their checkout process, and test these thoroughly they would ultimately provide the customer with an easy bug free process to follow, building sense of confidence, and security inside their platform, thus the 70 % shopping cart abandonment rate can possibly be reduced by 51 % and the average conversion rate can be increased by over a third!

3.1 Mission Statement

As we know, in the e-commerce field, you can't afford any errors since it will directly lead to client and sale loses. The cost of opportunity is too high; thus, security is the key to have a better business and the best and most important way to get a secure site is though testing.

"X" company hired us to perform tests on their site, this was a simple e-commerce web app, however one in which we did not want to take any risk.

After the analysis, we realized that according to the needs of the client and our capabilities, it was best to make an automated test framework taking advantage of a simple tool in which we had some experience that is also easy to use, TestCafe which allows us to do E2E automation. After researching, we concluded that the best suited option for our framework was BrowserStack but to take advantage of the wonders of Continuous integration, we used Jenkins with GitHub for the control and management of versions.

3.2 Proposal

Before making the decision about what tools we were going to use to carry out our tests, we set out to analyze what would be most convenient for our clients. We observed that for the size of the project and the desired speed, we could choose TestCafe, a tool that is quite simple, very clean and incredibly simple for initial configuration.

Also, we combined the tests with BrowserStack and took advantage of its ability to test on different devices and in turn some browsers. Jenkins was employed for Continuous Integration to get an updated delivery project and for developing a simpler way to integrate the changes.

Thanks to the fact that both BrowserStack and TestCafe have had a lot of acceptance by the community, there is a way to integrate them together. When running our tests in TestCafe they will end up being reflected in the device and browser of our interest in BrowserStack with a log that will allow us to have control over our executions and their results.

We decided to use GitHub for version control of our code so that everyone could contribute to the project. The help of a software architect doing a code review for each code modification resulted in higher quality for each push. Continuous Integration let us create version of our project any time and detect errors in an easier way making our testing more secure, that as we said, is a key in this field.

3.3   Goal

Our intention is to build trust in our customers. To achieve this, it is necessary to have a complete flow of tests in which we can identify each type of error that may present itself to us so that, while in production, we can maintain and increase potential customers thanks to the created trust.

To achieve the objectives, the first thing to do is to acknowledge our strengths and weaknesses. We identified that our team has experience with an automated E2E test tool and that thanks to it we can take advantage of different options. Despite being simple tools, together they can be very powerful and we will be able to cover all the types of tests necessary for this project. Compared to other tools that need more set up time, we can take advantage of this by using this time for the development of our framework skipping the learning curve and taking better advantage of the time in an environment known to all members and be able to start contributing to the community.

This coupled with the wonder of continuous testing with the agile scrum methodology, we can have deliverables quite frequently and with version control and project quality monitoring with GitHub.

In conclusion, the goal of electronic commerce is to sell, but what if there is no trust? Exactly, there are no sales, and without sales, it ceases to be electronic commerce, so to maintain it is necessary to prevent all possible errors.

4   Methodology

4.1   Scrum

Working with Scrum methodology begins with identifying the problem and its core components. Nonetheless, one key identifier factor of this methodology is the subdivision of tasks to achieve, making the workflow more fluent. Knowing this we can work in a series of schedules, or sprints, to achieve our goal. We decided to work in sprints with a duration of one week, that way we tackle specific requirements and do not overwhelm ourselves with work that can be accommodated into another sprint. At the culmination of every sprint there must be a meeting held in order for the team to discuss the tasks assigned and their status of fulfillment.

The team was divided into three roles that ensure the workflow needed. First, we have the role of Scrum Master, this role is akin to a coach, who helps the team with its expertise. He focuses on improving the team effectiveness. In our project, the Scrum Master also serves as the link between the team and the e-commerce company, ensuring that the tests were fulfilling the e-commerce requirements.

The next role is the Development team, they work to deliver a potential releasable increment of finished tasks at the end of every sprint. Their task is to give structure to the project and determine the amount of tasks given to each member. The Scrum Master informs the developers what are the areas of interest for the e-commerce and propose a number of tests to evaluate the web page's performance. They also carry out the task of working on writing the paper.

Finally, we have the role of the Developer, this person writes the tests proposed by the Development team, using all the given tools, for identifying the possible flaws of the web platform. This person analyses the outcome of each test and documents their conclusions. Owing to the fact that this is an automated framework, the Developer also integrates the tools needed for the scalability and automation of the project.

4.2   Best practice testing

Working with Scrum methodology begins with identifying the problem and its core components. Nonetheless, one key identifier factor of this methodology is the subdivision of tasks to achieve, making the workflow more fluent. Knowing this we can work in a series of schedules, or sprints, to achieve our goal. We decided to work in sprints with a duration of one week, that way we tackle specific requirements and do not overwhelm ourselves with work that can be accommodated into another sprint. At the culmination of every sprint there must be a meeting held in order for the team to discuss the tasks assigned and their status of fulfillment.

4.2.1 Testing

During the development of this automated framework our team focused primarily on three main types of testing. Functional testing, black-box testing, and regression testing.

For functional testing we used a Business-process-based approach where we tested the scenarios involved in a day-to-day business use on an e-commerce. The four most important processes that were tested include the login and new user creation, password recovery, shopping cart, and the payment process. These four processes are the common denominator in every e-commerce platform and their optimal performance is crucial for the quality of the product and to inspire confidence in the end user. Black-box testing worked hand in hand with our functional testing approach, as the inputs used for our test suites where based on inputs any consumer could introduce, and we verified the output of the system, thus guaranteeing E2E testing. After corrections were made, by fixing bugs or defects regression testing was employed to ensure that modifications did not cause any unintended side effects.

4.2.2 Testing techniques

To improve the quality of the tests inside our automated framework we utilized various techniques during the design process of our test suites. Our design process was dynamic, a combination of specification based with experience-based techniques. The specification-based techniques are primarily based on black-box testing which included techniques of its own such as use case testing, "state transition testing", boundary value analysis, equivalence partitioning, among others.

Using experience-based techniques, such as exploratory testing or error guessing was an important part of our test design process due to our team being composed of engineers with different skill sets and backgrounds. This allowed us to have a variety of perspectives and insights which led our framework to be more robust.

4.3   Best practice coding

There's no standard process when it comes to coding. Therefore, industries have been working on creating rules or tools that ensure that all code has the same structure and have an organic flow throughout the code structure.

4.3.1 ESLint

ESLint is a Tool that Find and Fix structural and compilation problems in the JavaScript code. ESLint is a pluggable tool that help identify and report patterns found in JavaScript code, with the goal of making the code more consistent. You can make your own set of rules, or you use the rules that industries like Google or Airbnb employ.

4.3.2 Code reviews

Code Review is the process in which a programmer consciously and systematically checks the code for mistakes or structural mistakes. The code reviews have proven that it helps to accelerate the streamline of the development process for projects.

Code Reviews, when done right, can improve the programmer workflow, reducing the amount of time the Quality Assurance Team requires to check the code, therefore saving time in general.

Particularly in this project we employed the Over-the-Shoulder style of code review. We decided to use this technique because it's the easiest and more intuitive type of style to adopt. Once the code is ready, the supervisor of the code downloads the branch of the GitHub that has the new code that needs to be reviewed. Once the code is reviewed and the team agrees with the changes, the programmer makes a merge from the review branch to the main branch of GitHub.

5   Framework

Web Pages undergo rigorous functional tests that ensure the correct functionality of the page fulfill the expectations of the customers. Usually we have two types of testing; manual and Automation testing. Maintaining and Automating these tests help maintain the quality of the web page releases.

By implementing the appropriate framework for the automated testing, we can significantly increase the speed and accuracy of testing, providing a higher ROI from the project.

Following the standards for a good Framework would result in achieving: Relevant automated test, Concise Reporting, Team Consistency, Implement and Maximize Re-Usability.

5.1   Tool

After discussing about what the tools used together in our project do, we will now talk in a particular way:

5.1.1 BrowserStack

It is a fairly simple tool to use that was perfectly adapted to our project for its power and ease. It was created for Node so its installation is very simple, just run the following lines of code on our console (having Node v6 installed and npm):

npm install -g testcafe

It is developed in JavaScript, so it will be easy for you to understand and do your first tests. Below there is a link where you can find the official documentation for this incredible tool:

https://devexpress.github.io/testcafe/documentation/getting-started/

5.1.2 GitHub

A tool that as a programmer, the more you use the more you begin to depend on it due to its incredible ability for version control and management. It allows us to collaborate remotely with all team members, something that today has even more value due to the ongoing world situation. This makes it perfectly suited for our project. Thanks to our use of the agile Scrum methodology we will have a higher quality and security of deliverables for each sprint, which is combined with a software architect who will constantly help us have better code in our project.

5.1.3 Jenkins

Last but not least, after having talked about GitHub, it is the turn of continuous integration. This system allows us to have deliverables perform a certain action. For example, if we want to do some tests from the master branch and depending on the result being able to deploy to production. This is possible thanks to this great tool. Automatic tasks that allow us to have greater quality and security in our code, in addition to taking advantage of our software architect will allow our code to be better. Thanks to the fact that the community has adopted it quite well, it is easy to integrate it with our GitHub repository, which makes it fit perfectly into our project.

5.2 Core (code structure)

5.2.1 Page model

This section contains the Model JavaScript files. Each file gather the web elements that will be used by the tests. It is important to point out that each Model JavaScript file corresponds to a Suite JavaScript file.

The files contain the precise web elements (input, button, span or an element) that are needed for each particular test.

- **LogIn_model:** Contains the web elements required for the Log In process.
- **Purchase_model:** Contains the web elements required for the Purchase process.
- **Registration_model:** Contains the web elements required for the Registration process.
- **ShoppingCart_model:** Contains the web elements required for Shopping through the web page.

5.2.2 Suites

This section contains the Tests JavaScript files. Each file contains the tests that were identified as inherent for assessing the correct functionality of the web page. The range of the tests go from Login, all the way to the Purchase process.

- **LogIn_tests:** Contains the following tests: Login into an existing account, login to a non-existing account, login with a special character, login with a Facebook Account, login with a Google account, try to login with an incorrect password three times, try to login without an email and try the forgotten account option.
- **Purchase_tests:** Contains the following tests: Fill with information the registration form, create an account associated to the web page, create an account associated with an error in one of the

password options, create an account associated with a special character and create an account with no information.

- **Registration_tests:** Contains the following tests: Add flowers to cart and check the availability of the flower, add to cart more than one type of flower, check if the web page has a limit of orders and modify the amount of flowers in the cart.
- **ShoppingCart_tests:** Contains the following tests: Pay with a Credit card, pay with a Debit Card, pay with PayPal, pay with the OXXO payment method, change the Payment method and add a Note.

5.3   Libs

5.3.1 TestCafe

TestCafe installs a series of packages locally, that permits the developer to test the code on the user's computer. In order for TestCafe to keep current with the updates made to the web applications it needs to constantly remain updated to guarantee functionality. The libraries that use TestCafe ensures the functionality and compatibility with the web application.

5.3.2 BrowserStack

BrowserStack installs libraries that ensure a connection between the developer's computer and BrowserStack cloud. BrowserStack runs the test in their own cloud, the libraries used requires the user to make a link with their account. Because of this, the developer not only downloads the necessary libraries but also needs to itemize its profile data and environment variables.

5.3.3 Package

This is a JavaScript Object Notation file; otherwise known as JSON file, that contains information of the project, such as: Author, name, version, dependencies, etc.

5.3.4 Package-lock

This JSON file contains all the dependencies that the pluggable tool ESLint may, or may not employ.

6   Benefits

6.1   Engineer career path

For this project, the team assembled constituted of a variety of engineers with different disciplines. Because of this not only the project got richer but we as professionals acquire new sets of skills.

As previously mentioned, in our team we have two Artificial Intelligence Engineers, one Industrial Engineer and ultimately one Mechatronic Engineer. It may seem that we vary in our career formation, and we do, but as we worked in this project, we developed skills given by our colleagues. It was very enriching to be able to work with people with different academic backgrounds and styles of working.

Furthermore, we have a different method of analyzing and problem solving. Being a motley group, we got the opportunity of discussing how each would undertake the problem and how to solve it, giving us the opportunity to appreciate the problem in different ways, being able to see the problem from multiple angles. This first encounter with our different mindset opened our mentality to be more open towards a given problem.

Since we wanted to challenge ourselves, we assigned unfamiliar roles to each other. By this we ensured we obtained skills and working methods that we were lacking or needed to enhance. Nonetheless we were assured that at any given moment, if any of us had a problem we would help each other, as the purpose of the project was not only to create an open source automation program for web testing, but also to aggrandize our expertise, proficiency and team working.

6.2   Project benefits

This project started as a challenge since despite having knowledge of the area, we tried to improve our weaknesses by selecting a different role than our expertise.

However, this not only benefited the team members, this goes further since being open source we intend to allow our framework to be followed by the entire community with the intention of adapting it to their different needs.

Knowing the great impact that e-commerce has but even more because of the situation of staying at home in which we find ourselves, today this type of commerce has benefited. We are very excited to be able to offer our work to continue growing together. We believe that we can become an effective and safe technological tool to face the challenges of this field and that it can also be used in different parts of the world.

6.3   Outcome (Conclusions)

This project initiated only to fulfil the initial request from the e-commerce but evolve throughout the process of creating the Automated Framework. At the last stages of the project it ended up being a wholesome project that can be used by the community for web automated testing. After finalizing the project, we realized that we had just made an open source project that anybody can use and help them with the first steps of making automated testing.

Therefore, we started to invest time to make the GitHub and the code more organic and intuitive for beginners, stating what we are using in the code and why. We also decided to include a set of explanatory notes in main files to ensure that whoever that uses this project can adapt it to the webpage they want to use.

Making this project open source, we think that we can give to the community code that has been tested and that has the information to start an automation project. By making the project open source we can also benefit from the community, because the project could grow and adapt to the new practices in coding.

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