Analysis of Automation Testing on E-Commerce Websites and User Responses
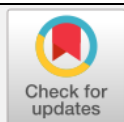
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ABSTRACT

This study compares two automation testing tools, Robot Framework and Cypress, applied to e-commerce websites. The testing procedure is based on predefined test case flows utilizing the Black Box Testing method, which focuses exclusively on functional validation according to requirement specifications, without reference to backend systems or source code. The research aims to evaluate the efficiency and effectiveness of both tools in executing identical test scenarios and to assess user responses concerning website access speed. Robot Framework, recognized for its keyword-driven testing approach, is compared with Cypress, a JavaScript-based end-to-end testing framework. The findings indicate that Cypress outperforms Robot Framework, particularly regarding execution speed and automated report generation. Cypress's modern architecture and real-time interaction capabilities contribute to faster and more stable test execution. Conversely, while Robot Framework offers significant flexibility and extensibility, its performance is comparatively slower in this context. User feedback suggests that the Bhinneka, Gramedia, and Uniqlo websites are generally responsive and user-friendly; however, Uniqlo is notably preferred due to its accurate stock information and efficient delivery services.

1. Introduction

E-commerce websites have become central to the modern digital economy, enabling businesses to reach global markets and deliver seamless customer experiences. The reliability and performance of these platforms are critical, as system errors or bugs can directly affect customer satisfaction and commercial success (Goyal et al., 2019). Automation testing frameworks have been widely adopted to ensure robustness and maintain quality assurance. Among these, the Robot Framework and Cypress have garnered significant attention for their capabilities in web application testing (Nagalingam et al., 2024). Despite their popularity, comprehensive comparative evaluations of these tools, particularly in the context of e-commerce systems, remain limited (Sarhan et al., 2024).

Testing is vital in the software development life cycle (SDLC) to verify that the system functions according to predetermined specifications. Depending on the complexity and criticality of the system, testing activities may consume between 30% and 60% of the total development budget (Ebert, 2011). For web applications, rigorous testing ensures that all integrated components align with functional requirements and operate without failure (Silitonga et al., 2023). Automated testing, especially during regression testing phases, offers significant speed, repeatability, and consistency advantages. Automated testing supports timely decision-making by enabling rapid feedback cycles, allowing organizations to adapt swiftly to evolving market demands and maintain a competitive advantage.

Robot Framework and Cypress are prominent automation tools that integrate Selenium-based testing environments. Robot Framework is an open-source tool primarily used for acceptance testing and robotic process automation (RPA), with a keyword-driven testing syntax that supports multiple libraries and programming languages, such as Python and Java (Patwardhan & Davison, 2024; Walker, 2020). Its simplicity and human-readable test case format make it accessible to testers with minimal programming expertise. The framework facilitates integration with a wide range of tools, enabling the automation of web, API, database, and mobile testing workflows (Peldszus et al., 2023).

Cypress, by contrast, is a JavaScript-based end-to-end testing tool tailored for modern web applications. It runs directly in the browser, enabling real-time interaction and debugging. Cypress is particularly effective for dynamic, JavaScript-heavy sites, as it includes built-in commands for interacting with the Document Object Model (DOM), simulating user actions, and automatically waiting for elements to load before proceeding with test steps (Hashimoto et al., 2023). Developers favor it for its rich debugging features, detailed error messages, and seamless integration with modern development environments.

This study contributes to the growing body of literature on automated testing by providing a comparative analysis of Robot Framework and Cypress in executing identical test scenarios on selected Indonesian e-commerce websites (Bhinneka, Gramedia, and Uniqlo). Additionally, the research incorporates user feedback to assess perceived performance and usability. Previous studies have demonstrated the utility of both frameworks in regression testing contexts. For example, Strizhakov and Nescoromniy found that Robot Framework supports structured and readable test flows, making it effective for non-technical users (Strizhakov & Nescoromniy, 2019). Similarly, Batni and Shetty emphasized its utility in reducing manual testing costs and increasing traceability of test results (Batni & Shetty, 2018). On the other hand, Jyolsna and Anuar highlighted the advantages of Cypress in terms of ease of setup, debugging efficiency, and control over network-layer interactions (Jyolsna & Anuar, 2022). Comparative findings by Mobaraya and Ali also suggest that Cypress requires fewer lines of code and facilitates more efficient test script development than traditional Selenium tools (Mobaraya & Ali, 2019). This research builds upon

these insights by conducting parallel tests using both frameworks and analyzing user responses to site performance.

2. Literature Review

2.1. E-Commerce

E-commerce refers to buying and selling transactions via the internet, utilizing digital technologies as the primary medium. This transaction model offers users enhanced convenience by enabling economic activities to be carried out efficiently and flexibly, without time or location constraints. It allows consumers to purchase goods or services without face-to-face interaction, thereby reducing geographical and temporal barriers to trade (Firmansyah & Herman, 2023). These advantages have rendered e-commerce increasingly relevant in modern societies, where speed, convenience, and accessibility are essential to consumer satisfaction. Moreover, the expansive reach of e-commerce, from local markets to global platforms, facilitates broader business expansion and market integration, positioning e-commerce not only as a tool for trade but also as a catalyst in the digital transformation of economies.

The rapid growth of e-commerce has been driven by advancements in internet technologies, resulting in transformative innovations across industries. Implementing e-commerce systems benefits stakeholders, including consumers, producers, and retailers. In addition to accelerating transaction processes, e-commerce minimizes operational costs by reducing the dependency on physical storefronts. In the fashion industry, for instance, key business functions, such as marketing, purchasing, and sales, have increasingly shifted to digital platforms supported by internet technologies. This development has popularized the concept of remote transactions, now widely recognized as online commerce. A concrete manifestation of this transformation is the rise of web-based e-commerce platforms, the primary medium for conducting digital sales activities (Santoso et al., 2022).

2.2. E-Commerce User Responses

User experience (UX) plays a pivotal role in determining the success and competitiveness of e-commerce platforms. From usability theory, key indicators of a positive user experience include ease of use, fast access speeds, and clear navigation structures (Nielsen, 2012). In interactive digital technologies, e-commerce functions as a transactional interface and a dynamic space for continuous interaction between users and system environments. Consequently, technical aspects such as website loading speed, device responsiveness, and the reliability of features such as product search and checkout processes significantly influence overall user satisfaction. A seamless and intuitive interface enhances the likelihood of both user conversion and long-term platform retention.

Previous studies have examined the correlation between technical performance and user perception in e-commerce environments. Arora et al. found that fast page load times and intuitive navigation systems substantially increase user satisfaction and positively affect purchase intent (Arora et al., 2023). Similarly, Yu et al. highlighted the importance of perceived reliability, particularly regarding stock availability and information transparency, in fostering consumer trust in digital platforms (Yu et al., 2023). In both local and global contexts, comparative studies of platforms such as Amazon, Tokopedia, and Shopee indicate that even minor differences in system performance or information accuracy can significantly impact user loyalty and platform preference (Mardiani et al., 2023). Accordingly, evaluating technical performance and user perception is not merely a matter of system optimization but a strategic imperative in developing user-centered e-commerce platforms.

3. Research Methodology

This study presents a performance analysis of automation testing outcomes using two tools: Robot Framework and Cypress. **Figure 1** illustrates the key research steps followed throughout the study.
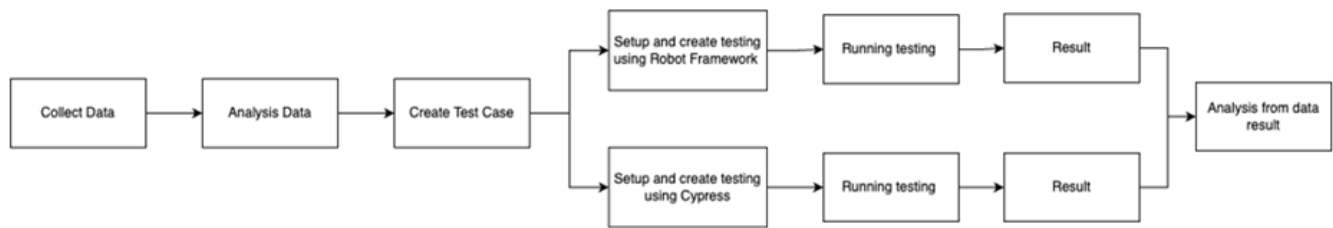

Figure 1. Research Process Flow

The automation testing was executed on a system with the following hardware specifications:
1) MacBook Air (2020) equipped with an M1 processor
2) 8 GB RAM
3) 512 GB Solid State Drive (SSD)

For data collection, information was obtained from three e-commerce platforms: Bhinneka, Gramedia, and Uniqlo. A survey method was employed to collect user perception data regarding their experience with these websites. This method was chosen due to its effectiveness in reaching a broad population and ability to gather quantitative and qualitative data efficiently. The survey instrument was a structured questionnaire incorporating a Likert scale to measure user satisfaction, ease of navigation, access speed, and information reliability.

The survey was administered to 250 respondents with experience using at least one of the three platforms. Meanwhile, the automation testing involved analyzing key features of each e-commerce website and identifying relevant components to develop into test cases. These test cases were categorized based on their respective input-output functionality.

The features selected for testing included:
- Home page
- Product search
- Menu navigation
- Login
- Product ordering
- Order tracking
- Logout

Positive and negative test cases were created and implemented using Robot Framework and Cypress. **Table 1** presents a summary of the test scenarios.

Table 1. Test Case Scenarios

Type of Test Case	Scenario
Positive	Home Page, Search Product, Menu List, Login, Order Product, Tracking Order, Logout
Negative	Home Page, Search Product, Login with Incorrect Email, Login with Incorrect Password

Each test scenario was translated into executable steps and code using both tools. **Table 2** and **Table 3** provide the details of positive and negative test case scenarios.

Table 2. Positive Test Case Scenarios

Feature	Test Scenario Description
Home Page	Open the browser and navigate to the website's home page. Verify successful display of the home page.
Search Product	Open a browser, go to the home page, input the keyword, and click search. Verify that the product list matches the keyword input.
Menu List	Open a browser, go to the home page, and verify that the main menu is displayed at the top.
Login	Navigate to the login page, enter a valid email and password, and verify a successful login.
Order Product	Log in, select a product, proceed to checkout, input payment and shipping data, and verify the order summary.
Tracking Order	Log in, navigate to order history, and verify that the tracking feature displays the correct order status.
Logout	Log in, click the profile menu, select logout, and verify redirection to the home page.

Table 3. Negative Test Case Scenarios

Feature	Test Scenario Description
Home Page	Open a browser and navigate to the home page. Verify that the page loads correctly.
Search Product	Input an invalid or nonsensical keyword, and verify that no matching products are displayed.
Log in with the Wrong Email	Input an incorrect email with a valid/invalid password, and verify an appropriate error message.
Log in with the Wrong Password	Input a correct email with an incorrect password, and verify that an appropriate error message is displayed.

The test development process included setting up the necessary tools, coding the test scenarios, and running the test executions using Robot Framework and Cypress. Upon execution, the results were documented and analyzed to evaluate the comparative performance of both tools.

The primary goal of automation testing in this study was to ensure optimal website functionality across all defined test cases. Evaluation criteria included test execution success, runtime efficiency, usability, maintainability, and the clarity of output reports. Through this analysis, the study aims to determine Robot Framework and Cypress's relative strengths and limitations in e-commerce platform testing.

4. Results

4.1. Automation Testing Results

The results of this study show that Cypress significantly outperforms Robot Framework in terms of execution time. The average (mean) execution time per test case using Cypress was 13.2

seconds, whereas Robot Framework required an average of 109.4 seconds. **Table 4** presents the total execution time and mean score from the 33 test cases performed using each framework.

Table 4. Execution Time Results and Mean Score

Testing Method	Total Execution Time (33 Test Cases)	Mean Execution Time
Robot Framework	3,512 seconds	109.4 seconds
Cypress	435 seconds	13.2 seconds

Figure 2 and **Figure 3** illustrate the detailed test execution results using Robot Framework and Cypress, respectively.
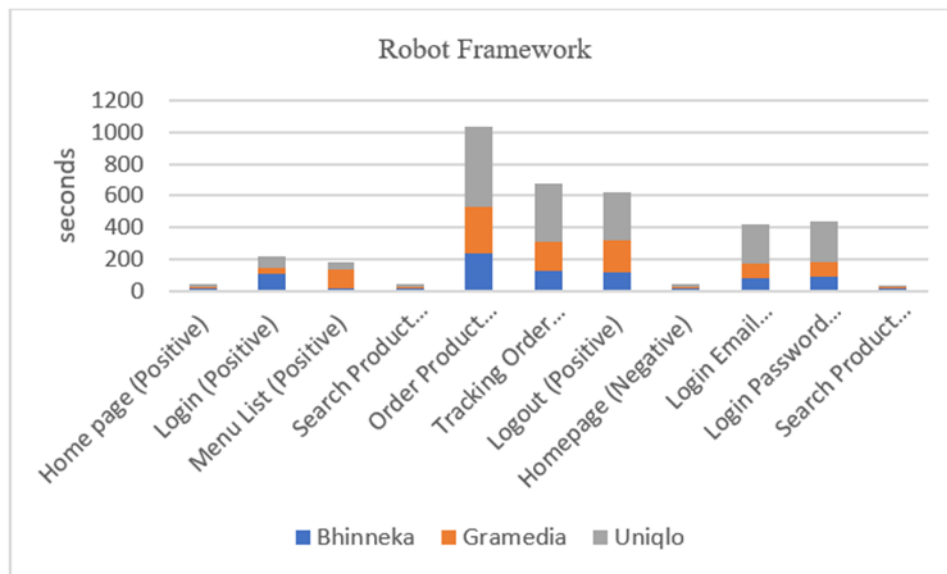

Figure 2. Automation Testing Results Using Robot Framework
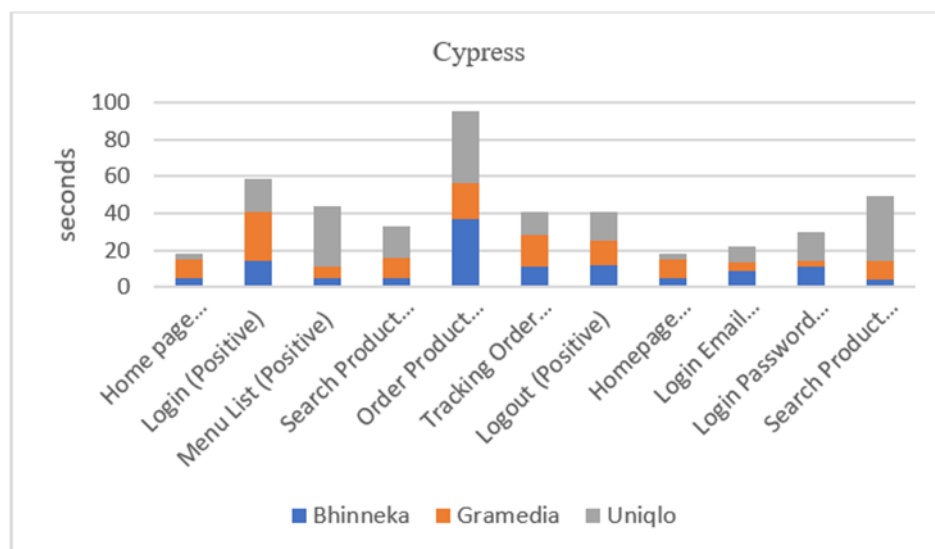

Figure 3. Automation Testing Results Using Cypress

Usability issues were identified during the automation process, particularly in Robot Framework. Delays occurred due to failed element path detection, which required additional

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wait commands to handle timing inconsistencies in dynamic web elements. **Table 5** displays the total wait time and mean score for both tools.

Table 5. Wait Time Results and Mean Score

Testing Method	Total Wait Time (33 Test Cases)	Mean Wait Time
Robot Framework	372 seconds	11.3 seconds
Cypress	183.4 seconds	5.6 seconds

Figure 4 shows the wait time variations across the three websites. The Bhinneka platform required longer wait times than Gramedia and Uniqlo, regardless of the testing tool used.
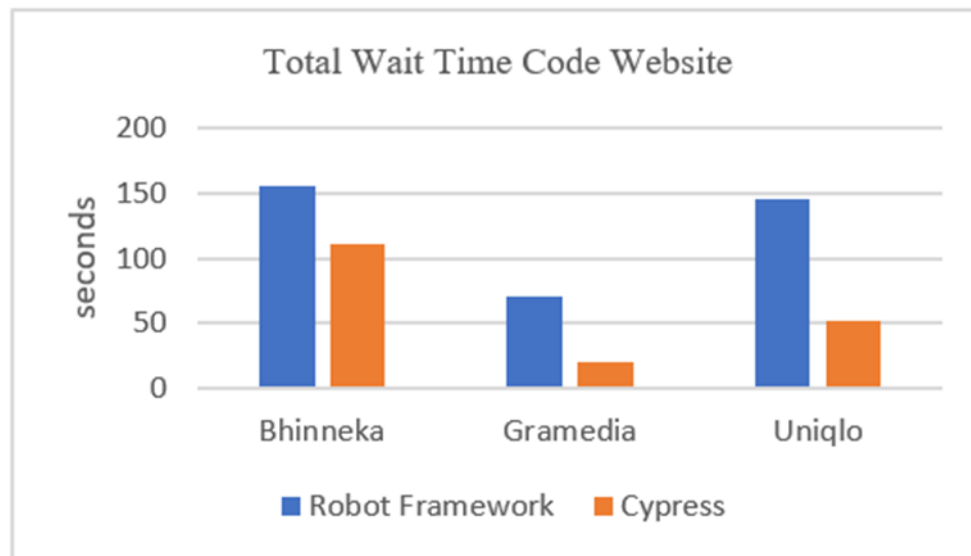

Figure 4. Wait Time per Website

Efficiency analysis indicates that the home page is the fastest feature to test across all platforms. As shown in **Table 6**, Cypress completed home page testing in as little as 3 seconds (Uniqlo), compared to more than 10 seconds for Robot Framework. For more complex test cases, such as product ordering, Cypress maintained performance under 100 seconds, while Robot Framework exceeded 4 minutes on average.

Table 6. Execution Time for Home Page and Order Product Features

Feature	Test Tool	Bhinneka	Gramedia	Uniqlo
Home Page	Robot Framework	12 s	15 s	11 s
	Cypress	5 s	10 s	3 s
Order Product	Robot Framework	3m 56s	4m 51s	8m 26s
	Cypress	37 s	19 s	39 s

In terms of maintainability, both frameworks require periodic maintenance, particularly due to dynamic data elements on the e-commerce platforms. With Robot Framework, version mismatches between ChromeDriver and the Chrome browser may trigger execution errors, requiring configuration updates. Additionally, product identifiers used for testing often change dynamically, necessitating updates in the test scripts.

As shown in **Table 7**, although Cypress requires slightly more lines of code for test maintenance (93 lines) compared to Robot Framework (86 lines), the Robot Framework was considered more maintainable due to more straightforward and less repetitive scripting.

Table 7. Lines of Code Requiring Maintenance by Test Tool

Testing Method	Lines of Code to Maintain
Robot Framework	86
Cypress	93

Regarding output reporting, Robot Framework generates detailed HTML reports after each test run (see **Figure 5** and **Figure 6**). These reports include test logs, step-by-step execution summaries, and the status of each case (pass, fail, skip).


```
==================================================================
gramediaHomePage :: Positive Test Case Homepage Gramedia
==================================================================
Should be able to visit homepage Gramedia :: Homepage Gramedia Web... | PASS |
------------------------------------------------------------------
gramediaHomePage :: Positive Test Case Homepage Gramedia            | PASS |
1 test, 1 passed, 0 failed
==================================================================
Output:  /Users/mutiaraar/Downloads/crm/results/output.xml
Log:     /Users/mutiaraar/Downloads/crm/results/log.html
Report:  /Users/mutiaraar/Downloads/crm/results/report.html
```

Figure 5. Test Execution Summary Using Robot Framework
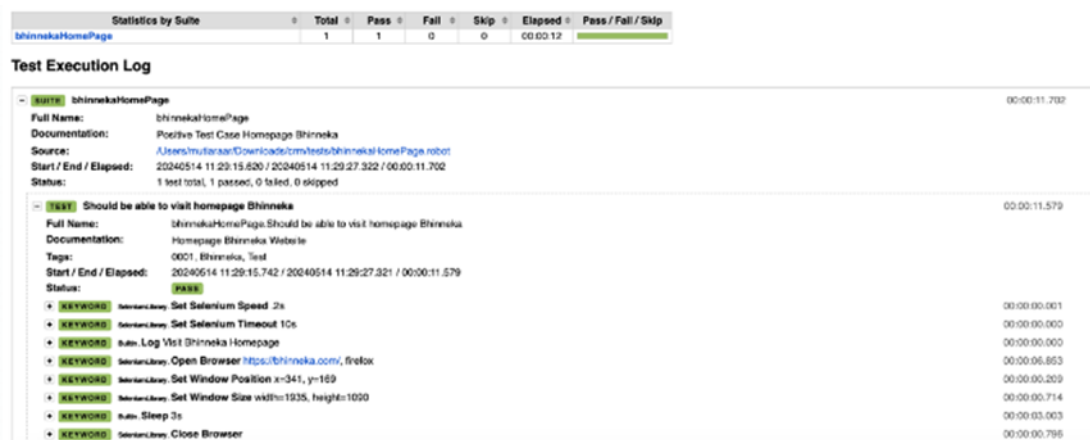

Figure 6. HTML Report Generated by Robot Framework

Cypress, on the other hand, provides real-time reporting. As shown in **Figure 7**, the test status and steps can be monitored directly during execution, offering more immediate feedback and troubleshooting capability.
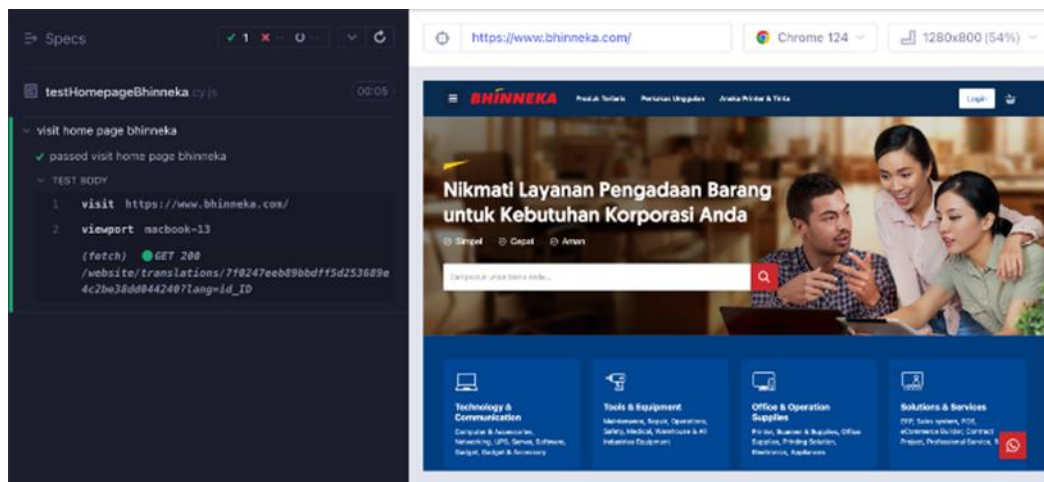
Figure 7. Real-Time Test Output Report in Cypress

4.2. Website User Survey Results

A user survey was conducted with 250 respondents who had used at least one of the three e-commerce platforms: Bhinneka, Gramedia, and Uniqlo. The results indicate that Uniqlo received the highest satisfaction ratings, with 84% of respondents expressing satisfaction with the platform's fast access speed, intuitive navigation, and accurate product information.

Regarding stock availability and delivery accuracy, Uniqlo was rated highest by 87% of users, followed by Gramedia (68%) and Bhinneka (62%). While Gramedia was positively recognized by 74% of respondents for its user-friendly interface, particularly in searching for books and stationery, significant concerns were raised regarding stock information accuracy. Specifically, 35% of Gramedia users and 41% of Bhinneka users reported issues with inaccurate stock data, diminishing user trust.

Uniqlo also demonstrated superior reliability, with only 6% of respondents reporting transaction-related issues. Most users indicated a consistently smooth and dependable shopping experience across multiple transactions.

Overall, the survey results highlight three key factors that strongly influence user satisfaction with e-commerce platforms: website speed, accuracy of stock information, and ease of checkout. Among the platforms evaluated, Uniqlo consistently outperformed its counterparts across all major indicators.

5. Discussion

The results of this study reveal that both Robot Framework and Cypress offer distinct advantages and limitations when applied to the testing of e-commerce websites. With its keyword-driven architecture and broad support for external libraries, Robot Framework is well-suited for complex, large-scale projects requiring extensive customization and system integration (Walker, 2020). In contrast, Cypress provides a more streamlined and developer-friendly experience, making it highly suitable for smaller teams or projects emphasizing speed and ease of implementation (Taufique et al., 2024).

Regarding test execution, Robot Framework demonstrated greater flexibility across platforms, including support for legacy web systems (Capitaine et al., 2021). However, Cypress achieved superior performance when testing modern JavaScript-based applications, owing to its ability to run directly within the browser environment. This feature enables faster feedback loops, simplified debugging, and tighter integration with popular development toolchains (Psujek et al., 2021).

From a maintenance and reporting perspective, Robot Framework's modular structure and support for reusable test components are beneficial for long-term projects with evolving requirements. Its comprehensive HTML reporting capabilities, including execution logs and detailed test summaries, make it well-suited for teams requiring extensive documentation (Yuliansyah et al., 2021). Conversely, Cypress facilitates real-time test result visualization, making it easier for less technical users to diagnose and resolve issues efficiently.

Robot Framework is an open-source tool widely used for acceptance testing and robotic process automation (RPA) (Chen et al., 2016; Walker, 2020). Its tabular, keyword-driven syntax is accessible to testers with limited programming experience, enabling broad team collaboration across technical and non-technical stakeholders (Maric et al., 2020). The framework supports integration with a wide range of tools, such as Selenium for browser automation, and libraries for database, API, and mobile testing, allowing it to meet diverse testing requirements in e-commerce environments (Alok Chakravarthy & Padma, 2023; Patwardhan & Davison, 2024). However, its reliance on external libraries introduces potential friction during setup and test execution. Compatibility issues between Selenium and Robot Framework components may increase maintenance overhead compared to more integrated solutions like Cypress.

Cypress, in contrast, is a JavaScript-based end-to-end testing tool tailored for modern web applications. Its ability to execute tests directly in the browser provides low-latency interaction with the Document Object Model (DOM), enhancing speed and test reliability (Nagalingam et al., 2024; Zhang et al., 2020). Real-time reloading, detailed visual output, and the capacity to simulate complex user interactions, such as product searches, shopping cart modifications, and checkout processes, make it particularly effective for testing dynamic, user-facing features of e-commerce websites (Powers et al., 2016; Tuppo et al., 2019).

A key advantage of Cypress is its automatic waiting feature, which eliminates the need to insert manual wait or sleep commands. This ensures that elements are available before executing subsequent actions, reducing test flakiness, a frequent issue when testing content-rich or asynchronous e-commerce platforms (Mobaraya & Ali, 2019; Tuppo et al., 2019). Cypress's detailed error logs, screenshots, and video capture functionalities enhance the debugging experience, especially when dealing with complex front-end components.

Nonetheless, Cypress has limitations. Its primary reliance on JavaScript may present challenges for teams less experienced with modern front-end frameworks. Additionally, while Cypress continues to expand its cross-browser support, it has historically been limited to Chromium-based browsers. Although recent versions support Firefox, compatibility with Safari and Internet Explorer remains incomplete (Hussein et al., 2018; Pelivani & Cico, 2021). This may pose constraints for e-commerce platforms that require broad user access across diverse browser environments.

In terms of cross-platform support, Robot Framework maintains an advantage. It can be configured to execute tests across multiple browsers and operating systems using Selenium. This is especially relevant for e-commerce websites that must ensure uniform functionality across different user environments (Jagat et al., 2023). However, the dependency on external components such as ChromeDriver introduces occasional instability and version-related issues.

Robot Framework integrates well with CI/CD tools like Jenkins, GitLab, and CircleCI, enabling seamless automation within the development pipeline (Chen et al., 2016). Similarly, Cypress is designed for modern CI/CD workflows, providing real-time test execution and immediate reporting that align well with agile methodologies (Byrd et al., 2021; Jyolsna & Anuar, 2022). While Robot Framework offers greater extensibility, Cypress is distinguished by its

developer-centered design and faster execution cycles, an important consideration for teams operating in continuous deployment environments (Malik & Bilal, 2024).

Ultimately, the choice between Robot Framework and Cypress depends on specific project needs. Robot Framework is ideal for teams that require a versatile, language-agnostic platform with robust support for complex, multilayered test environments (Capitaine et al., 2021). In contrast, Cypress is best suited for fast-moving development cycles focused on modern, JavaScript-heavy web applications. Its browser-native execution, intuitive syntax, and responsive feedback make it highly efficient for front-end testing. Robot Framework may offer greater flexibility for organizations requiring extensive cross-browser testing or backward compatibility with older technologies (Hassanvand et al., 2024).

From a user perspective, manual testing conducted on Bhinneka, Gramedia, and Uniqlo websites highlights distinct usability characteristics. The three platforms generally offer intuitive interfaces, fast page load times, and efficient transactional workflows from product selection to payment.

Bhinneka, focused on electronics, provides detailed product specifications, assisting users in making informed purchasing decisions. Gramedia and Uniqlo excel in navigation, particularly for product searches in books, fashion, and household categories. Respondents noted that these sites support a seamless shopping experience with minimal friction during checkout.

However, discrepancies in stock availability were observed, especially on Bhinneka and Gramedia. In several instances, users completed transactions only to receive notifications about unavailable products later. Such inconsistencies diminish trust and satisfaction. In contrast, Uniqlo was praised for accurate inventory synchronization and reliable delivery timelines. Users consistently reported that the products displayed as available were in stock and fulfilled as expected. The alignment between user expectations and system performance at Uniqlo enhanced perceived platform reliability.

These findings corroborate earlier research by Nielsen, emphasizing that system reliability and information accuracy are central to fostering consumer trust and loyalty in e-commerce settings (Nielsen, 2012). Accurate stock information, transparent delivery timelines, and a responsive interface emerged as the most critical factors influencing user perception and satisfaction.

6. Conclusion

This study presented a comparative analysis of two automation testing tools, Robot Framework and Cypress, applied to e-commerce websites. Using identical test cases, the results demonstrate apparent differences in performance between the two tools. Regarding execution time, Cypress significantly outperformed Robot Framework, achieving an average of 13.2 seconds per test case, compared to 109.4 seconds for Robot Framework.

Regarding usability, both tools required pauses between steps to handle dynamic web elements; however, Cypress again proved more efficient, with a total wait time of 183.4 seconds, compared to 372 seconds for Robot Framework across 33 test cases. The authors sincerely thank Bina Nusantara University (BINUS), Jakarta, Indonesia, for providing the necessary support, facilities, and academic environment throughout the research process. We also acknowledge the valuable participation of respondents who contributed to the user survey, as well as the constructive feedback from peers and reviewers that helped enhance the quality of this study., such as product ordering, Cypress consistently executed tasks in under 100 seconds, indicating a more efficient handling of dynamic, multi-step workflows.

The findings suggest Cypress is better suited for testing modern, JavaScript-heavy e-commerce applications, particularly when fast execution and real-time debugging are essential. Robot Framework, while more flexible and extensible, requires more configuration and maintenance, making it more appropriate for larger, more complex systems with diverse integration needs.

User feedback from the three e-commerce platforms, Bhinneka, Gramedia, and Uniqlo, was generally positive. All three platforms were perceived as accessible and easy to navigate. However, Uniqlo received the highest ratings regarding stock availability accuracy and delivery reliability, which were identified as key factors influencing user preference.

Future research may explore applying these frameworks to other websites or expanding the scope of test scenarios to include more complex workflows and additional performance metrics. Additionally, refining testing strategies using framework-specific adequacy criteria may enhance the accuracy and relevance of automation testing in diverse web environments.

7. Acknowledgment

8. Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest regarding this article's research, authorship, and/or publication.

References

Alok Chakravarthy, N., & Padma, U. (2023). A Comprehensive Study of Automation Using a WebApp Tool for Robot Framework. In *Intelligent Cyber Physical Systems and Internet of Things* (1st ed., Vol. 2, pp. 577–586). ICoICI. https://doi.org/10.1007/978-3-031-18497-0_43

Arora, T., Chirla, S. R., Singla, N., & Gupta, L. (2023). Product Packaging by E-commerce Platforms: Impact of COVID-19 and Proposal for Circular Model to Reduce the Demand of Virgin Packaging. *Circular Economy and Sustainability*, *3*(3), 1255–1273. https://doi.org/10.1007/s43615-022-00231-4

Batni, N. S., & Shetty, J. (2018). A Comprehensive Study on Automation using Robot Framework. *International Journal of Science and Research*, *9*(7), 1033–1036. https://www.ijsr.net/getabstract.php?paperid=SR20710144623

Byrd, K., Fan, A., Her, E., Liu, Y., Almanza, B., & Leitch, S. (2021). Robot vs human: expectations, performances and gaps in off-premise restaurant service modes. *International Journal of Contemporary Hospitality Management*, *33*(11), 3996–4016. https://doi.org/10.1108/IJCHM-07-2020-0721

Capitaine, L., Genuer, R., & Thiébaut, R. (2021). Random forests for high-dimensional longitudinal data. *Statistical Methods in Medical Research*, *30*(1), 166–184. https://doi.org/10.1177/0962280220946080

Chen, H., Tian, G., Lu, F., & Liu, G. (2016). A hybrid cloud robot framework based on intelligent space. *Proceedings of the World Congress on Intelligent Control and Automation (WCICA)*, *2016-*

September, 2996–3001. https://doi.org/10.1109/WCICA.2016.7578487

Ebert, C. (2011). *Global Software and IT* (1st ed.). Wiley. https://doi.org/10.1002/9781118135105

Firmansyah, M. D., & Herman, H. (2023). Perancangan Web E- Commerce Berbasis Website pada Toko Ida Shoes. *Journal of Information System and Technology*, 4(1), 361–372. https://doi.org/10.37253/joint.v4i1.6330

Goyal, S., Sergi, B. S., & Esposito, M. (2019). Literature review of emerging trends and future directions of e-commerce in global business landscape. *World Review of Entrepreneurship, Management and Sustainable Development*, 15(1/2), 226. https://doi.org/10.1504/WREMSD.2019.098454

Hashimoto, A., Chiu, C. W., Onda, Y., Tateishi, M., Tsuruta, K., & Gomi, T. (2023). Satellite remote sensing model for estimating canopy transpiration in cypress plantation using in situ sap flow observations and forest inventory. *ISPRS Journal of Photogrammetry and Remote Sensing*, 206, 258–272. https://doi.org/10.1016/j.isprsjprs.2023.11.009

Hassanvand, F., Nassiri-Mofakham, F., & Fujita, K. (2024). Automated Negotiation Agents for Modeling Single-Peaked Bidders: An Experimental Comparison. *Information*, 15(8), 508. https://doi.org/10.3390/info15080508

Hussein, M., Nouacer, R., Radermacher, A., Puccetti, A., Gaston, C., & Rapin, N. (2018). An end-to-end framework for safe software development. *Microprocessors and Microsystems*, 62, 41–49. https://doi.org/10.1016/j.micpro.2018.07.004

Jagat, R. R., Sisodia, D. S., & Singh, P. (2023). Web-S4AE: a semi-supervised stacked sparse autoencoder model for web robot detection. *Neural Computing and Applications*, 35(24), 17883–17898. https://doi.org/10.1007/s00521-023-08668-w

Jyolsna, J., & Anuar, S. (2022). Modern web automation with cypress. Io. *Open International Journal of Informatics*, 10(2), 182–196. https://oiji.utm.my/index.php/oiji/article/view/229

Malik, N., & Bilal, M. (2024). Natural language processing for analyzing online customer reviews: a survey, taxonomy, and open research challenges. *PeerJ Computer Science*, 10, e2203. https://doi.org/10.7717/peerj-cs.2203

Mardiani, E., Judijanto, L., Syamsuri, S., & Sufa, S. A. (2023). Online Marketing Strategy and Customer Loyalty in E-commerce-Based Asian Business: The Case of Tokopedia and Shopee. *West Science Journal Economic and Entrepreneurship*, 1(04), 129–136. https://doi.org/10.58812/wsjee.v1i04.389

Maric, B., Mutka, A., & Orsag, M. (2020). Collaborative Human-Robot Framework for Delicate Sanding of Complex Shape Surfaces. *IEEE Robotics and Automation Letters*, 5(2), 2848–2855. https://doi.org/10.1109/LRA.2020.2969951

Mobaraya, F., & Ali, S. (2019). Technical Analysis of Selenium and Cypress as Functional Automation Framework for Modern Web Application Testing. *9th International Conference on Computer Science, Engineering and Applications (ICCSEA 2019)*, 27–46. https://doi.org/10.5121/csit.2019.91803

Nagalingam, S., Wang, H., Kim, S., & Guenther, A. (2024). Unexpectedly strong heat stress induction of monoterpene, methylbutenol, and other volatile emissions for conifers in the cypress family (Cupressaceae). *Science of the Total Environment*, 956, 177336. https://doi.org/10.1016/j.scitotenv.2024.177336

Nielsen, J. (2012). *Usability 101: Introduction to usability*. Nielsen Norman Group. https://www.nngroup.com/articles/usability-101-introduction-to-usability/

Patwardhan, A., & Davison, A. J. (2024). A Distributed Multi-Robot Framework for Exploration, Information Acquisition and Consensus. *Proceedings - IEEE International Conference on Robotics and Automation*, 12062–12068. https://doi.org/10.1109/ICRA57147.2024.10610185

Peldszus, S., Akopian, N., & Berger, T. (2023). RobotBT: Behavior-Tree-Based Test-Case Specification for the Robot Framework. *ISSTA 2023 - Proceedings of the 32nd ACM SIGSOFT International Symposium on Software Testing and Analysis*, 1503–1506. https://doi.org/10.1145/3597926.3604924

Pelivani, E., & Cico, B. (2021). A comparative study of automation testing tools for web applications. *2021 10th Mediterranean Conference on Embedded Computing (MECO)*, 1–6. https://doi.org/10.1109/MECO52532.2021.9460242

Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Fischl, A. H., Maryniuk, M. D., Siminerio, L., & Vivian, E. (2016). Diabetes self-management education and support in type 2 diabetes: A joint position statement of the American Diabetes Association, the American Association of diabetes educators, and the Academy of nutrition and dietetics. *Clinical Diabetes*, 34(2), 70–80. https://doi.org/10.2337/diaclin.34.2.70

Psujek, M., Radzik, A., & Kozieł, G. (2021). Comparative analysis of solutions used in Automated Testing of Internet Applications. *Journal of Computer Sciences Institute*, 18, 7–14. https://doi.org/10.35784/jcsi.2373

Santoso, S., Sitanggang, I. A., & Melisa, G. (2022). Perancangan Perancangan Website E-Commerce Ineed. Id. *Jurnal Teknik Informatika*, 14(1), 19–23. https://ejurnal.ulbi.ac.id/index.php/informatika/article/view/1915

Sarhan, A. A., Elmagrhi, M. H., & Elkhashen, E. M. (2024). Corruption prevention practices and tax avoidance: The moderating effect of corporate board characteristics. *Journal of International Accounting, Auditing and Taxation*, 55, 100615. https://doi.org/10.1016/j.intaccaudtax.2024.100615

Silitonga, G., Alim, M. S., Prabowo, H., & Sriwidadi, T. (2023). Online Customer Intention to Purchase Local Brand Shoes: The Role of Website Quality. *2023 8th International Conference on Business and Industrial Research, ICBIR 2023 - Proceedings*, 1041–1046. https://doi.org/10.1109/ICBIR57571.2023.10147508

Strizhakov, E., & Nescoromniy, S. (2019). Combined processes of environmentally friendly technology for magnetic-pulse welding. *E3S Web of Conferences*, 110, 01008. https://doi.org/10.1051/e3sconf/201911001008

Taufique, K. M. R., Sabbir, M. M., Quinton, S., & Andaleeb, S. S. (2024). The different impact of utilitarian and hedonic attributes on web-based retail shopping behaviour through the lens of extended technology acceptance model. *International Journal of Retail and Distribution Management*, 52(4), 443–460. https://doi.org/10.1108/IJRDM-08-2023-0505

Tuppo, L., Alessandri, C., Giangrieco, I., Ciancamerla, M., Rafaiani, C., Tamburrini, M., Ciardiello, M. A., & Mari, A. (2019). Isolation of cypress gibberellin-regulated protein: Analysis of its structural features and IgE binding competition with homologous allergens. *Molecular Immunology*, 114, 189–195. https://doi.org/10.1016/j.molimm.2019.07.023

Walker, J. T. (2020). Software Test Automation with Robot Framework. *International Journal of Computer Applications*, 175(25), 8–14. https://doi.org/10.5120/ijca2020920784

Yu, T., Dai, J., & Wang, C. (2023). Adoption of blended learning: Chinese university students' perspectives. *Humanities and Social Sciences Communications*, 10(1), 390. https://doi.org/10.1057/s41599-023-01904-7

Yuliansyah, Y., Rammal, H. G., Maryani, M., Mohamed Jais, I. R., & Mohd-Sanusi, Z. (2021). Organizational learning, innovativeness and performance of financial service firms in an emerging market: examining the mediation effects of customer-focused strategy. *Business Process Management Journal*, 27(4), 1126–1141. https://doi.org/10.1108/BPMJ-10-2020-0454

Zhang, G., Pan, P., Yang, Z., Niu, H., Liu, J., Zhang, C., Meng, J., Song, Y., Bao, Q., Wei, J., Li, G., & Liao, Z. (2020). Rapid synthesis of cypress-like CuO nanomaterials and CuO/MWCNTs composites for ultra-high sensitivity electrochemical sensing of nitrite. *Microchemical Journal*, *159*, 105439. https://doi.org/10.1016/j.microc.2020.105439

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