INDONESIAN JOURNAL OF MULTIDISCIPLINARY SCIENCE

P-ISSN: 2808-5957
E-ISSN: 2808-6724
ijoms.internationaljournallabs.com

IMPLEMENTATION OF CROWDFUNDING WEB APPLICATION USING AWS AMPLIFY ARCHITECTURE WITH END-TO-END TESTING USING PLAYWRIGHT

Ary Utomo[1], Ganang Wijaya[2], Yanto Setiawan[3]
[1,2,3] *BINUS Online Learning, Bina Nusantara University, West Jakarta, DKI Jakarta, Indonesia*
[1] *ary.utomo@binus.ac.id* [2] *ganang.wijaya@binus.ac.id* [3] *yanto.setiawan@binus.ac.id*

ARTICLE INFO

Published: August 28th, 2023

Keywords: *Crowdfunding, AWS Amplify, Next.js, Playwright, Agile Scrum Methods*

This work is licensed under CC BY-SA 4.0

ABSTRACT

This research aims to address the challenges in fundraising processes, which often lack systematic and transparent approaches. To overcome these issues, a web-based crowdfunding application was developed using AWS Amplify as the cloud architecture, Next.js as the web application development framework, and Playwright as the automated end-to-end testing framework. Following the Agile Scrum methodology, the application was designed to provide a convenient and secure user experience for fundraising managers, donors, and potential beneficiaries. The evaluation results showed a high user satisfaction rate of 93.29%, indicating a significant improvement in fundraising effectiveness. Furthermore, the implementation of the web application resulted in a remarkable 210% increase in fundraising efficiency within a 19-day timeframe. The end-to-end automated testing, covering 11 test scenarios on various browsers such as Chromium, Firefox, and WebKit, demonstrated successful performance within a short testing time of 1.9 minutes. These findings validate the success and benefits of the developed web application, offering improved fundraising capabilities and high user satisfaction.

INTRODUCTION

Fundraising is the process of raising funds voluntarily in the form of money or other forms by collecting donations from individuals, companies, foundations, communities or government agencies. One alternative form of fundraising is through crowdfunding, which uses the internet as a medium to finance projects or campaigns (Rafi, 2018). These activities can provide benefits in terms of obtaining funding sources from various parties and increasing public awareness about the problem, issue, or purpose of a project or campaign. Crowdfunding has an important role in supporting campaigns, projects and programs that benefit the community. Donors perform donation transactions on the Kitabisa.com platform for a variety of reasons. Empathy altruistic motive, which originates from within the individual and inspires them to help each other, Religious motivation is also crucial, as religious teachings inspire people to donate to the crowdfunding approach (Sitanggang, 2018).

Currently, there is still a fundraising process that is carried out conventionally or manually. The conventional process takes the form of sending application letters, through physical events, or through personal networks and direct contact with potential individuals. This tends to lead to limited reach and potential fundraising, requiring greater time and effort, hampering efficiency and slowing down the fundraising process, and lack of transparency without an organized system to provide clear reports that can raise doubts from those who make donations. Due to the lack of resources, effort, and experience needed, small firms and individuals find it difficult to accomplish

this, in contrast to large enterprises. Additionally, physical fundraising efforts are typically restricted to particular regional locations (Li et al., 2020).

From these problems, the use of information technology in the form of websites can be an effective solution to facilitate the process of collecting funds more efficiently and widely. By implementing a crowdfunding platform as a web application, it can provide benefits such as delivering information about the goals and campaigns to be funded, accepting electronic donations, providing convenience for donors to participate and ensuring transparency in fund management, as well as increasing visibility and reaching a wider audience.

The website technology that can be used is the Next.js framework with TypeScript language, supported by cloud computing services AWS Amplify and GitHub, and hosted on the Vercel platform. Next.js is a powerful and flexible React.js (Sallaby & Kanedi, 2020) framework that enables fast and responsive web application development. Next.js is an open-source framework built on Node.js an interactive user interface, Next.js requires React.js as a JavaScript library (Famy, 2022). TypeScript can be utilized as a programming language based on JavaScript, providing classes, modules, and interfaces that enable developers to easily develop complex applications (Nugraha et al., 2020). AWS Amplify is a platform developed by Amazon Web Services (AWS) that helps developers build and manage mobile and web applications that provides tools and technologies to make application development easier, such as Backend as a Service (BaaS), frontend libraries, and monitoring tools (Erico et al., 2022). AWS Amplify supplies a declarative and user-friendly interface for several cloud operating categories. Any JavaScript-based front-end workflow work nicely with AWS Amplify (Neupane, 2022). Developers have been given a variety of serverless applications that they can deploy, customize, and even integrate (Kumar, 2019). The private repository service GitHub can be used to store application projects open-source (Rahardja, 2022) integrated with Vercel as a hosting platform for deployment (Slamet & Anistyasari, 2021).

In the development of applications using the Next.js framework with TypeScript language and cloud computing service AWS Amplify, as well as hosting on Vercel, it is important to conduct application testing to ensure optimal quality and functionality. The concept of serverless refers to heavily provisioned servers and infrastructure that users can access with high levels of credibility, reliability, availability, and disaster recovery in place without having to worry about how the services are managed on a back-end level (Neupane, 2022). One of the testing methods that can be used is User Acceptance Testing (UAT) and end-to-end testing using Playwright. End-to-end testing using Playwright, which is a modern open-source cross-browser automation testing tool developed by Microsoft, provides an API to control web browsers (Amalia & Cahyono, 2022) can be performed to ensure that all application components work as expected.

With the development of this fundraising application, it is expected that the fundraising and crowdfunding process can be easier, more effective and efficient, and successful in achieving the goals desired by organizations or individuals engaged in fundraising activities for their desired projects or campaigns. To enhance the quality, similar to applications like KitaBisa.com, the focus can be directed towards aspects such as interface design and user experience. Enhancements to the

website's look will pique user attention and boost their enjoyment of using it (Khofifah et al., 2021).

In a related study, Sasmito and Fauzan (2020) implemented the Scrum framework to develop fundraising mobile applications, completing the project in just 35 days. Their findings demonstrate the feasibility of utilizing the Scrum framework to meet tight development deadlines. By involving all Scrum components, the study achieved streamlined data integration and accelerated application completion. The fundraising application enables effortless dissemination, real-time user notifications, and simplified donation processes. Furthermore, funds recording and collection are efficiently conducted in real-time, as evidenced by usability testing with a SUS score of 82.1% (Sasmito & Fauzan, 2020).

In a study by Husni et al. (2021) titled "Web-Based Fundraising Information System: 'Let's Donate'," the researchers utilized the SDLC (System Development Life Cycle) comprising planning, analysis, design, and implementation stages. "Let's Donate" is a user-friendly crowdfunding platform managed by the social institution Areta, aimed at facilitating fundraising for humanitarian programs. It offers various payment methods to simplify the donation process, eliminating the need to physically visit donation centers. The system underwent tests and evaluations, demonstrating smooth functionality without any errors (Husni et al., 2021).

Finally, another relevant study on the topic is "Fundraising and Donation Application System" by Tesa Muliawati and Fajar Masya in 2019. The authors focused on utilizing crowdfunding sites, categorizing them into three main categories: creative, social, and event projects. The research employed observation, data collection, information gathering, references, and requirement analysis for crowdfunding system development. The findings indicate successful fundraising and donations through crowdfunding by implementing a system that offers creative, social, and events categories with their respective sub- categories (Muliawati & Masya, 2019).

This research differs from previous relevant studies in terms of its research objectives. The main objective of this research is to implement an effective web application for fundraising activities by incorporating innovative features which allows users to create their own fundraising or crowdfunding campaigns and invite others to donate. Additionally, the utilization of AWS Amplify cloud architecture streamlines web application development, and the adoption of Playwright tools facilitates automated testing during development. These innovations aim to enhance community participation in fundraising, improve application development efficiency, and enhance the quality and reliability of the website. Furthermore, the research involves the development of a web-based fundraising application system using AWS Amplify cloud architecture that supports a complete set of product development lifecycle in an agile project, along with the utilization of playwright web testing automation features to enhance the accuracy and reliability of tests (Amalia & Cahyono, 2022). In order to solve the issues with manual testing, automation testing has been created (Hanna et al., 2018). To make component testing and scenario testing easier for developers to perform, several automation testing frameworks have been created (Thooriqoh et al., 2021).

Based on the statements, the researcher then wanted to study the implementation of crowdfunding web application using AWS Amplify Architecture with end-to-end testing using Playwright. It is expected to be a new source for experts in the field or those interested in the issue discussed. Furthermore, it is hoped that this study will provide foundation for future research in the area.

METHOD

In this research, the methodology used is an experimental study with a quantitative approach. This approach is used to test the effectiveness of applications in achieving fundraising and crowdfunding goals. The testing is conducted by collecting data on gathered donations, successful campaigns, and user satisfaction through feedback from users which can be measured by a Likert scale (Setyawan & Atapukan, 2018) from the results of the User Acceptance Test (UAT). Testing of the web application was also conducted using the automated end-to-end testing method with Playwright. The data was divided into an experimental group (using the app) and a control group (not using the app). Automation intends to reduce the amount of test cases that must be executed manually rather than to completely replace manual testing (Thooriqoh et al., 2021).

Observations and measurements are made before and after the fundraising period. The data is analyzed to test the effectiveness of the application and used for conclusions and recommendations for further development. The data collection process included gathering written documentation and utilizing questionnaires to identify system requirements that would contribute to user satisfaction. The stages of research carried out are shown in Figure 1.

In the early stages of planning a fundraising web application, a needs analysis is performed to understand the goals to be achieved. Data is collected from users and literature studies to find suitable solutions for implementation. Then, at the application development stage, the required functionality is identified in the Product Backlog. The product backlog aims to list the features and functionality of the software that you want to develop based on user needs. The scrum methodology demands that the development team concentrate on how to complete the most valuable component of the program in the shortest amount of time (Yu, 2018).

The development process follows the Agile Scrum methodology with Sprints lasting 2-3 weeks. Scrum is a component of the agile project management movement, which developed in reaction to the limitations of earlier software development approaches like waterfall management (Nowosielski, 2018).

The Sprint Planning stage is carried out to plan work, including tasks, stories, and time estimates. Furthermore, the Sprint Backlog is used to carry out the work as planned. Daily Scrum is a daily discussion of application progress and job reports. The Sprint Review stage, conducted in week 3, involves reviewing work results with users, while the retrospective stage evaluates the development process and seeks improvement solutions. Feedback from these stages can result in changes in the Product Backlog or review of features already developed (Aklani & Lim, 2020). In Sprint 1, the flow of application features and the creation of user interface mockups were carried out. In Sprint 2, the mockups were sliced and transformed into a web user interface using Next.js.

Sprint 3 focused on developing the backend using AWS Amplify. Sprint 4 involved integrating the frontend and backend. Finally, in Sprint 5, user feedback was addressed by adding features such as email notifications and social media integration.

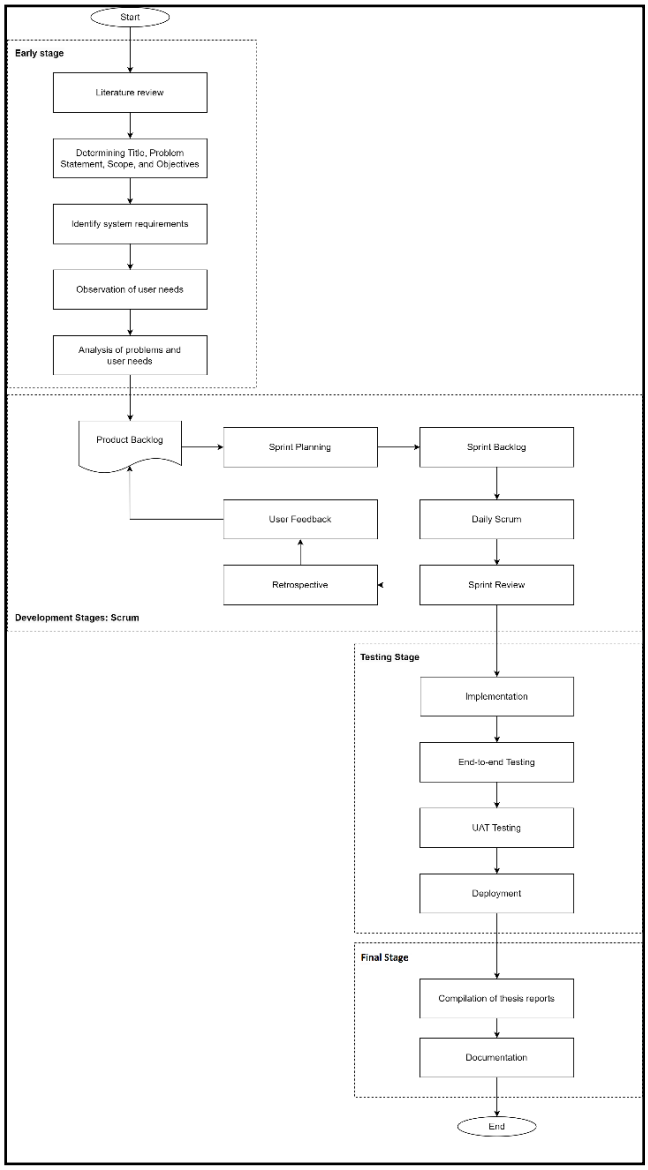

Figure 1. Flowchart of Research Stages

At the testing stage of the application that has been developed, end-to-end testing is carried out using Playwright to test the functionality of the features that have been developed. In addition, UAT is also carried out to ensure that the user requirements and needs that have been set are met in the application and the level of user satisfaction with applications with Likert scale. Finally, the final stage is in the form of preparing reports and documentation of applications that have been developed.

System modeling and design can be described with use case diagrams that aim to describe the interaction relationships between application systems with actors involved in the built system. As a tool for system design visualization, UML is a development modeling language used in the field of software engineering (Sitio et al., 2023). The functional specifications of the software are described in the use case diagram (Fauzan et al., 2021). This fundraising application system has 3 actors involved, namely Admin, User, and Contributor. The use case diagram can be seen in Figure 2.

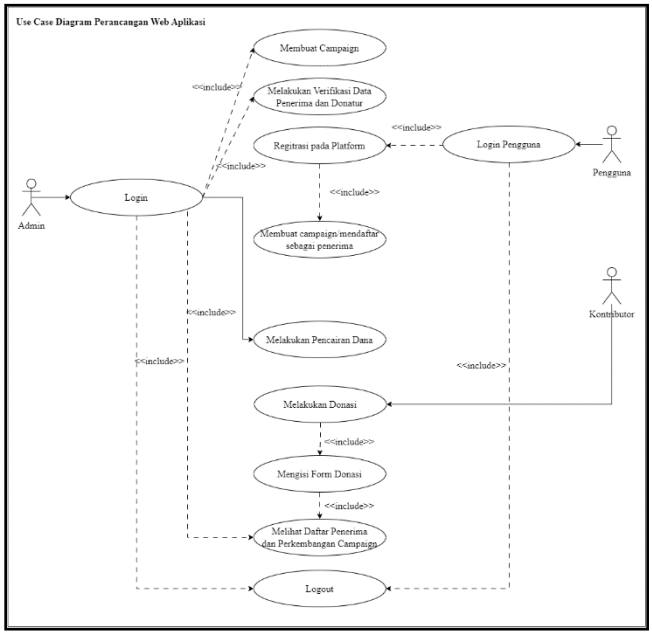

Figure 2. Case Diagram of Web Designing Application

This fundraising application system was created using the AWS Amplify website architecture and cloud computing architecture. The system architecture diagram created can be seen in Figure 3. AWS Amplify offers a declarative and user-friendly interface for several cloud operating categories. Any JavaScript based frontend workflow and React Native for mobile developers work nicely with AWS Amplify (Neupane, 2022).

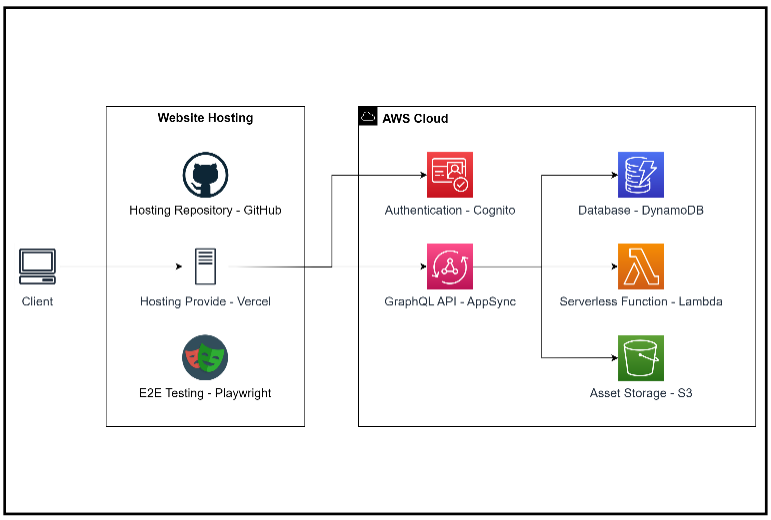

Figure 3. System Architecture

Database design on the system using DynamoDB, a NoSQL database service from AWS. This database follows a key-value-based data model with a structure of tables, rows, and columns. Database models are designed using the GraphQL schema by adding and creating the necessary objects or data models. GraphQL is a query language that is becoming a new way to manage data distribution (Firdausi et al., 2021). GraphQL helps the system decide what data to retrieve based on available queries from the backend. Database design is done by identifying the types of entities and relationships that the system needs to further determine the data type of attributes to be used as a schema for GraphQL.

RESULT AND DISCUSSION

Implementation of interfaces on websites developed using Typescript using the Next.js framework built and implemented in the Visual Studio Code work environment. To create an interactive user interface, the front-end framework Next.js requires React JS as a JavaScript library.

The landing page serves as the introductory page of the website, providing essential information regarding the website and its upcoming activities. It offers a brief overview of the website's purpose and the activities it will host. Additionally, the landing page includes a section dedicated to frequently asked questions (FAQs) and their corresponding answers. This aims to address common inquiries and provide users with quick access to relevant information. The developed website interface utilizes two themes: dark mode and light mode. The landing page can be seen in Figure 4.

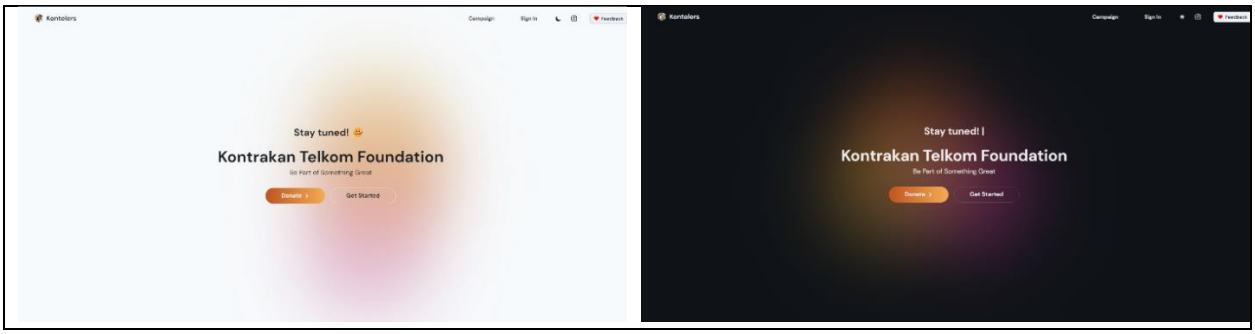

Figure 1. Landing Page

On the sign-in page, the page displays the sign in form for users who have registered in the web application. The form includes fields for email and password to allow user to access to the dashboard page. The sign-in page can be seen in Figure 5.

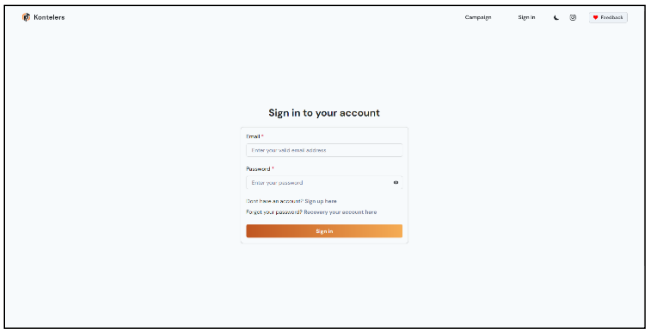

Figure 2. Sign-In Page

On the sign-up page displays a form that users need to fill out when registering to participate in the website. Some forms that must be filled out include email, password, confirm password, full name, phone number, and bio to create an account to allow user access the dashboard. The sign-up page can be seen in Figure 6.

After the user completes the registration process and their account is verified, they can proceed to sign in on the website. Upon successful sign-in, the website will redirect them to the dashboard page. The dashboard page provides information such as total donations, total campaigns created, total registered admissions, donation list, and cash flow. The dashboard page view can be seen in Figure 7.

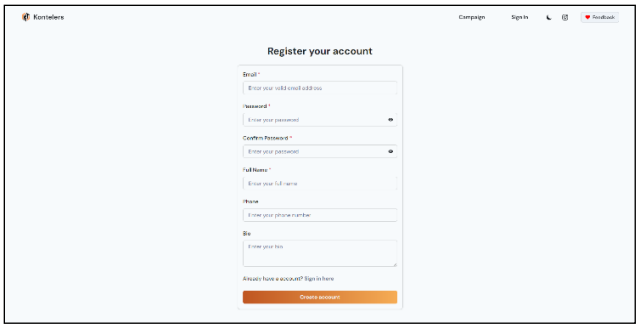

Figure 3. Sign-Up Page

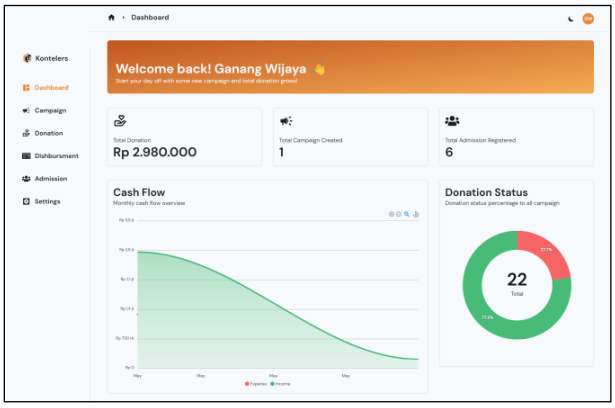

Figure 4. Dashboard Page

On the campaign page, there are various information of created campaigns. These campaigns are divided into two categories: campaigns created by the users themselves and campaigns created by other users. The campaign page can be seen in Figure 8.

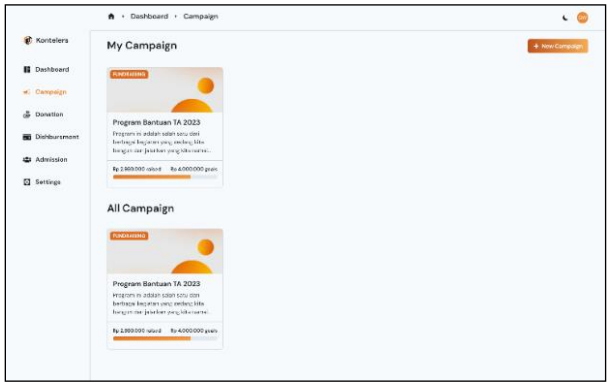

Figure 5. Campaign Page

There is a "Create Campaign" button that allows users to create a new campaign. Create campaign page includes several forms that need to be filled out, such as the campaign name, funds needed (goals), campaign type, duration, and campaign description that can be seen in Figure 9.

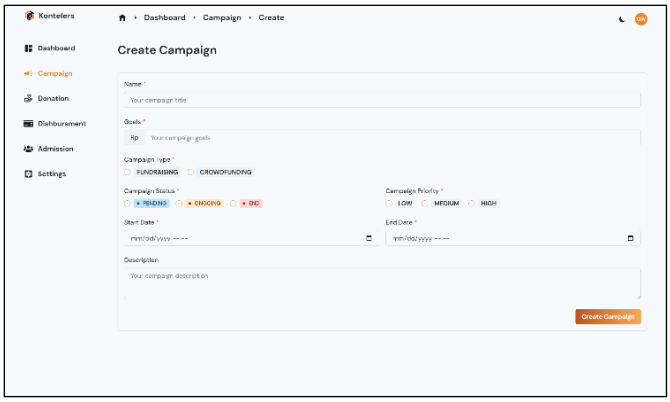

Figure 6. Create Campaign Page

The donation page displays information about users who have made donations to the selected campaign. It includes details such as the name of the selected campaign, user name, total donation, and donation status. The donation page is shown in Figure 10.

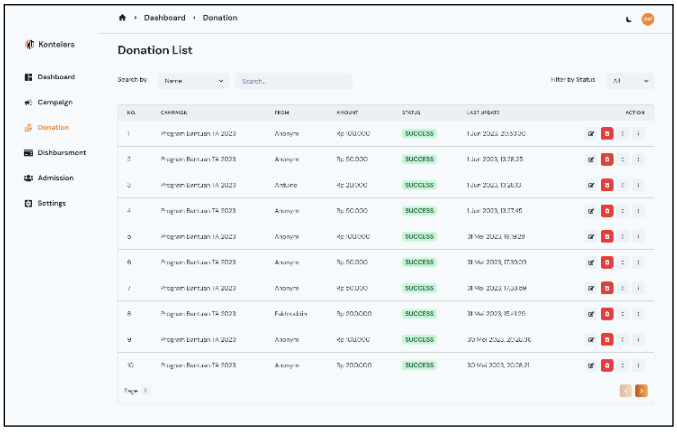

Figure 7. Donation Page

The disbursement page contains information of a list of disbursements of funds for campaigns that have been successfully implemented, with a function that admin can manages the disbursement of funds from each existing campaign. Some information related to fund disbursement on the disbursement page includes the campaign name, target users, and the total amount disbursed. The disbursement page view can be seen in Figure 11.

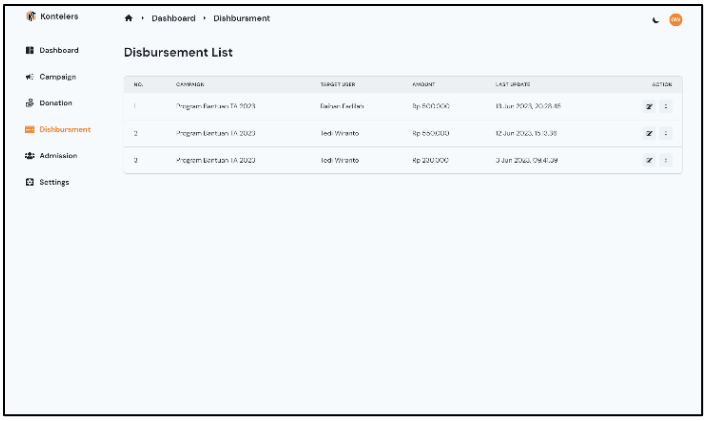

Figure 8. Disbursement Page

On the admission list page, there are some information regarding the users who have registered as beneficiaries for a campaign. The page provides information such as the name of the prospective recipient, the chosen campaign, acceptance status, and document requirement status. Additionally, there are buttons available to edit the data for each entry. The admission list page can be seen in Figure 12.

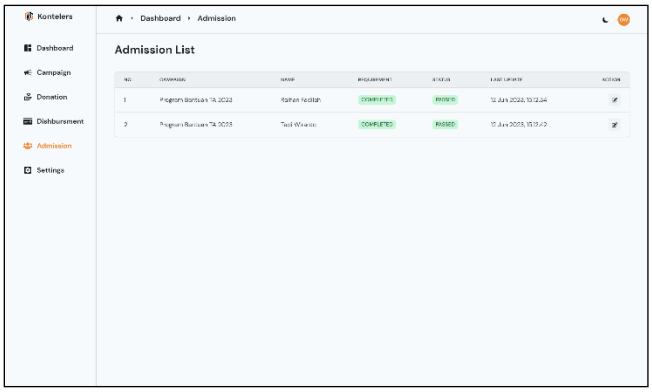

Figure 12. Admission Page

The settings page contains information related to the account settings of registered user with functions for editing profile data. The settings page can be seen in Figure 13.

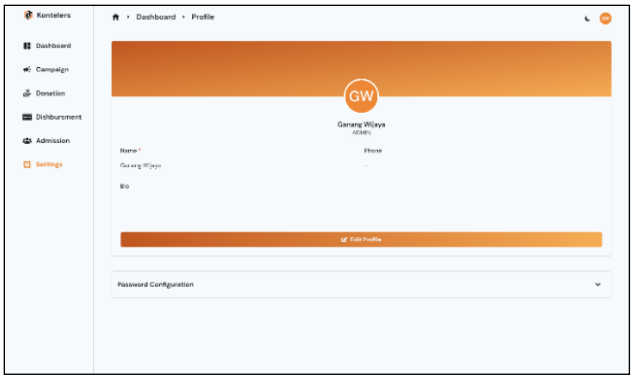

Figure 13. Settings Page

After the completion of the web application development, the subsequent crucial step is the comprehensive system evaluation process. The system evaluation in this study includes the functional evaluation of the website application and the usability evaluation by users. By conducting these evaluations, the research ensures that the system operates effectively and efficiently, aligning with the intended requirements and meeting the expectations of the end-users.

End-to-end testing is conducted to ensure that the system functions well overall and there are no errors in the business processes or main features executed by the application. This testing is performed in the development environment using Playwright version 1.33.0. The results of the testing execution process, as shown in Figure 14, indicate that all 11 test cases have passed with a total time of 1.9 minutes or 114 seconds can be seen in Figure 14.

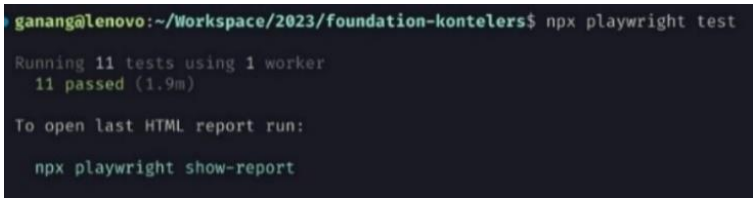

Figure 14. Test Execution Process with Playwright

UAT is conducted on the web application involving contributors who have used the application. A questionnaire is used to measure several indicators, including user- friendliness, alignment with the application's concept and goals, with the aim of evaluating the effectiveness of the developed application and user satisfaction. The questions in the questionnaire are used to obtain respondents' feedback on the application.

UAT testing is carried out on web applications by involving contributors who have used the application. The questionnaire is used to measure several indicators, including ease of use of the application, alignment with the application's concept and goals, with the aim of evaluating the effectiveness of the developed application and user satisfaction. The questions in the questionnaire are used to obtain respondents' feedback on the application. The weights of question answers are described in Table 1.

Table 1. User Acceptance Test scoring table

Score	Information
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

To calculate the interval index, each assessment's total score is multiplied by 100 and then divided by the highest possible total score. This formula ensures that the resulting index falls within a specific interval. The equation for calculating the interval index, referred to as Equation 1, provides a clear and standardized method for obtaining the index value. The formula for calculating the interval index can be seen in Equation 1:

$$\text{Index interval} = \frac{Total\ questionnaire\ score}{Maximum\ questionnaire\ score} \times 100\% \quad (1)$$

The interval index calculation result plays a crucial role in determining the score for the User Acceptance Testing (UAT). In order to accurately calculate the interval index for the Likert scale, weighting is applied. Weighting assigns specific values to each interval of the Likert scale index assessment, ensuring the scores reflect the relative importance of each interval. The specific weights assigned to the Likert scale index intervals can be seen in Table 2, providing a clear reference for the weighting process.

Table 2. Weight of index interval value

Value (%)	Information
80-100	Strongly Agree
60-80	Agree
40-60	Neutral
20-40	Disagree
1-20	Strongly Disagree

The list of questions on the questionnaire asked to respondents can be seen in Table 3. These questions are intended to obtain answers to measure the effectiveness of the application in solving problems experienced by users and user satisfaction with the application.

Table 3. List of Questionnaire Questions

No	Question	Answer				
		SA	**A**	**N**	**D**	**SD**
1	In my opinion, this website already uses features that are easy to understand.	17	6			
2	In my opinion, it is easier and more efficient to make donations using this website compared to conventional methods.	12	11			
3	In my opinion, this website has made the donation process easier.	14	9			
4	In my opinion, it iseasy to make donations on the website.	13	9	1		
5	In my opinion, it iseasier to monitor ongoing campaigns through the website.	17	6			
6	In my opinion, conducting fundraising or crowdfunding process can be carried out more transparent.	16	7			
7	In my opinion, overall, this websitecan help and facilitate the fundraising or Crowdfunding process.	19	4			

Based on the data obtained from the questionnaire distributed to 23 respondents, calculations were performed using the Likert scale according to the answer weights in Table 3, resulting in calculations using Equation 1.

$$\text{Index interval} = \frac{Total\ questionnaire\ score}{Maximum\ questionnaire\ score} \times 100\%$$

$$\text{Index interval} = \frac{540+208+3}{805} \times 100\%$$

$$\text{Index interval} = \frac{751}{805} \times 100\%$$

$$\text{Index interval} = 93.29\ \%$$

Based on the data obtained from the distributed questionnaires, calculations were performed using the Likertscale. The calculation result using Equation 1 is 93.29%, indicating a "Strongly Agree" rating. This result suggests that users strongly agree with the implementation of the web application to address their problems. Referring to Table 10,the UAT results can be concluded that potential users strongly agree with the developed web application.

CONCLUSION

Based on the testing and evaluation conducted on the development of this web application, it can be concluded that the implemented web application has fulfilled the functional requirements through the UAT testing phase and obtained results from the distributed questionnaires to the stakeholders, including the administrators and contributors. The results from 23 respondents indicate a user satisfaction level of 93.29% with a "Strongly Agree" rating, indicating that the fundraising activities have become more effective and users are satisfied when using the developed web application. The web application has had a significant impact on increasing donation collection. Prior to the development of the application, self-recorded donations amounted to only Rp960,000 between January 8, 2023, and March 8, 2023. However, after the development of the web application, fundraising was conducted through the application between May 14, 2023, and June 1, 2023, resulting in a 210% increase in the total collected donations, reaching Rp2,980,000. This demonstrates that the presence of the fundraising web application has provided a significant positive impact, increased the participation of contributors and streamlined the donation process compared to conventional methods.

Finally, the developed web application has successfully passed the testing phase with satisfactory results based on automated end-to-end testing using Playwright. In this testing, a total of 11 scenarios or test cases were executed, and all of them passed within a time frame of 1.9 minutes. The testing was conducted using Chromium, Firefox, and WebKit as the browsers used. The results of this testing indicate that the application functions well across different browsers and meets the expected functionality.

In this research, there are still limitations and potential areas that can be further developed in the web application. To improve its quality and functionality, some suggestions can be given. Firstly, implementing features to creating a mobile application version to make it usable with Android and IOS operating systems would be beneficial. Additionally, it is important to integrate a payment gateway feature that supports various payment methods, such as bank transfers, credit cards, and e-wallets, to facilitate payment validation processes. By implementing these suggestions, it is expected that the web application can become better and provide an enhanced user experience.

REFERENCE

Aklani, S. A., & Lim, D. (2022). Aplikasi Donasi Berbasis mobile Menggunakan Metode Scrum. *Jurnal Edik Informatika Penelitian Bidang Komputer Sains dan Pendidikan Informatika*, *8*(2), 135-144.

Amalia, A., & Cahyono, A. B. (2022). Analisis Pemanfaatan Playwright untuk Automasi Pengujian Aplikasi Berbasis Web (Studi Kasus: Sistem Manajemen Jaringan). *AUTOMATA*, *3*(1).

Erico, E., Wijaya, S., Tambela, B. H., Pardosi, I. A., & Winardi, S. (2022). Pengembangan Sistem Monitor dan Laporan Mesin PT. Numalos Abadi Menggunakan Amazon Web Services. *Jurnal SIFO Mikroskil*, *23*(2), 111-120.

Famy, S. (2022). *Rancang Bangun Sistem Informasi Manajemen Berbasis Web Menggunakan NextJS di CV. Sanjaya Abadi Baru*. [Doctoral dissertation, UP Batam].

Fauzan, R., Siahaan, D., Rochimah, S., & Triandini, E. (2021). A Different Approach on Automated Use Case Diagram Semantic Assessment. *International Journal of Intelligent Engineering and Systems*, *14*(1), 496–505. https://doi.org/10.22266/IJIES2021.0228.46

Firdausi, A. T., Hormansyah, D. S., & Ervansyah, F. (2021). Implementasi GraphQL Untuk Mengatasi Under-Fetching pada Pengembangan Sistem Informasi Pelacakan Alumni Politeknik Negeri. *Jurnal Informatika Polinema, 7*(4), 73-80.

Hanna, M., Aboutabl, A. E., & Mostafa, M.-S. M. (2018). Automated Software Testing Framework for Web Applications. *International Journal of Applied Engineering Research*, *13*(11), 9758–9767.

Husni, H., Putro, S. S., Negara, Y. D. P., Yuana, N. U., & Herawati, S. (2021). Development of a Web-Based "Let's Donate" Fundraising Information System. In *E3S Web of Conferences* (Vol. 328, p. 04014). EDP Sciences. https://doi.org/10.1051/e3sconf/202132804014

Khofifah, S., Theresiawati, & Widi, I. W. (2021). Analisis Pengaruh Kualitas Website Crowd Funding. *Matrik*, *23*(2), 168–181.

Kumar, M. (2019). Serverless Architectures Review, Future Trend and the Solutions to Open Problems. *American Journal of Software Engineering*, *6*(1), 1–10. https://doi.org/10.12691/ajse-6-1-1

Li, Y. M., Wu, J. D., Hsieh, C. Y., & Liou, J. H. (2020). A social fundraising mechanism for charity crowdfunding. *Decision Support Systems*, *129*, 113170. https://doi.org/10.1016/j.dss.2019.113170

Muliawati, T., & Masya, F. (2019). Fund Raising and Donation Application system. *International Research Journal of Computer Science Issue 06*, *6*(06), 639–653. www.irjcs.com

Neupane, K. R. (2022). *Serverless full-stack web application development guidelines with AWS Amplify framework.*

Nowosielski, K. (2018). *Benefits of utilising Agile Scrum Management in Web Development projects A case study at Mirum Agency*. https://www.theseus.fi/handle/10024/158005%0Ahttps://www.theseus.fi/bitstream/handle/10024/158005/Kacper-Nowosielski_Scrum_thesis_final.pdf?sequence=1

Nugraha, I. G. B. E., Bayupati, I. P. A., & Dharmaadi, I. P. A. (2020). Sistem Penjadwalan Dinas Pegawai Divisi Terminal Service PT. Angkasa Pura Logistik Kantor Cabang Bali. *JITTER (Jurnal Ilmiah Teknologi Dan Komputer), 1*(2).

Rafi, M. I. A. (2018). Rangan Bangun Aplikasi Sistem Penggalangan Dana Berbasis Web Dengan Menerapkan Konsep Crowdfunding Pada Startup Peduly. *Angewandte Chemie International Edition, 6(11), 951–952.*, 10–27.

Rahardja, U. (2022). Meningkatkan Kualitas Sumber Daya Manusia Dengan Sistem Pengembangan Fundamental Agile. *ADI Bisnis Digital Interdisiplin Jurnal*, *3*(1), 63–68. https://doi.org/10.34306/abdi.v3i1.760

Sallaby, A. F., & Kanedi, I. (2020). Perancangan Sistem Informasi Jadwal Dokter Menggunakan Framework Codeigniter. *Jurnal Media Infotama*, *16*(1), 48–53. https://doi.org/10.37676/jmi.v16i1.1121

Sasmito, G. W., & Fauzan, A. (2020). The implementation of scrum framework for developing fundraising mobile applications. *International Journal of Advanced Science and Technology*, *29*(1), 1654–1663.

Setyawan, R. A., & Atapukan, W. F. (2018). Pengukuran Usability Website E-Commerce Sambal Nyoss Menggunakan Metode Skala Likert. *Compiler*, *7*(1), 54–61. https://doi.org/10.28989/compiler.v7i1.254

Sitanggang, M. H. A. (2018). Memahami mekanisme crowdfunding dan motivasi berpartisipasi dalam platform Kitabisa.com. *E Journal UNDIP*, *6*(3), 1–11.

Sitio, H. J. S., Christovita, I., Ahmad, R. K., & Setiawan, Y. (2023). Web-Based Application Development for Training Data Management Using REACTJS. *Indonesian Journal of Multidisciplinary Science*, *2*(6), 2573-2588.

Slamet, J., & Anistyasari, Y. (2021). Pengembangan NiceRoom Sebagai Online Integrated Development Environment Tools untuk Meningkatkan Hasil Belajar Siswa pada Pembelajaran Python Programming di SMKN 1 Cerme. *Jurnal IT-EDU*, *6*, 128–138.

Thooriqoh, H. A., Annisa, T. N., & Yuhana, U. L. (2021). Selenium Framework for Web Automation Testing: A Systematic Literature Review. *JUTI: Jurnal Ilmiah Teknologi Informasi*, *19*(2), 65–76.

Yu, J. (2018). Design and Implementation of Subject-based Learning Website Based on Scrum. *MATEC Web of Conferences*, *232*. https://doi.org/10.1051/matecconf/201823201018