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Developing a Digital Crowdfunding Platform for Student Empowerment in Higher Institutions: Insights from AE-FUNAI

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Abstract
Crowdfunding has emerged as a powerful tool for financing innovative ideas across various sectors. However, student-led initiatives, particularly within higher education institutions in Nigeria, often lack access to dedicated funding platforms tailored to their unique needs. This paper presents the design and implementation of a crowdfunding platform tailored to support student-led initiatives at Alex Ekwueme Federal University, Ndufu-Alike (AE-FUNAI). The platform addresses the financial challenges faced by students in securing resources for their projects, providing a structured and transparent way for students to raise funds, manage donations, and connect with supporters. Developed using agile principles and cutting-edge technologies such as Laravel 10, Vue.js, MySQL, Git, and Docker and Stripe API, the platform ensures user authentication, project management, and secure payment processing. Through data-driven insights and iterative development, the platform is positioned for long-term success, fostering an adaptable and user-centred design that evolves with the needs of AE-FUNAI students. This study demonstrates the potential of crowdfunding platforms to empower student innovation and entrepreneurship in higher education institutions.

Keywords: Crowd-funding, Wisdom of the Crowd, AE-FUNAI, Student-led Initiatives, Campaigns

Introduction

Crowdfunding also known as online fundraising has revolutionized the fundraising landscape by utilizing the internet to pool small contributions from a large number of individuals (Dambanemuya et al., 2022). This method, initially popularized in the arts and creative sectors, has rapidly expanded into diverse fields including technology, social causes, and education. The foundational concept of crowdfunding can be traced back to initiatives like the "Statue of Liberty" campaign in 1885, which successfully raised funds from over 160,000 donors through newspaper advertisements (Smith, 2018). In the digital age, platforms like Kickstarter and Indiegogo have popularized the concept, democratizing access to funding for a wide array of projects (Mollick, 2014). In the realm of higher education, crowdfunding provides a unique mechanism for supporting student led initiatives that may face difficulties in securing traditional funding sources (Belleflamme et al., 2014). These initiatives can encompass a wide range of activities, including academic research projects, community service endeavors, entrepreneurial ventures, and extracurricular activities (Agrawal et al., 2014). The flexibility and accessibility of crowdfunding platforms enable students to bring innovative ideas to life without the constraints of conventional funding pathways. Huang et al. (2021) and Dambanemuya et al. (2022) emphasize that credibility signals such as the quality of project descriptions or the endorsement of recognized figures can offset other perceived risks, a principle that should guide content and campaign verification processes on the AE-FUNAI platform. Dey et al. (2023) looked at crowdfunding from the legal domain as legal crowdfunding is gaining more momentum and viewed as a place where lawyers and individuals raise funds to fight legal actions. They studied how prospective donors can verify the credibility of legal campaigns as well as analyzed the conversations surrounding these campaigns on Facebook. While Kim et al. (2022) looked at crowdfunding from

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the medical view point by investigating various ways to re-design an entire website with a simulated medical crowdfunding interface as well as from the sense of community theory.

The potential of university-based crowdfunding platforms have been exemplified by several successful case studies. For instance, the University of California, Berkeley's crowdfunding platform has raised significant funds for various student and faculty projects. One notable campaign funded research into sustainable energy solutions, demonstrating the platform's capability to support cutting edge academic research. Similarly, the University of Oxford has leveraged crowdfunding to support student scholarships and research projects. A campaign to fund the Oxford Climate Society's educational activities successfully engaged a wide network of alumni and supporters, highlighting the potential for such platforms to enhance community engagement (OxReach: rewards-based crowdfunding platform, 2025). Crowdfunding in higher education is not just about raising funds; it also fosters a culture of innovation and entrepreneurship among students. According to Mollick (2014), crowdfunding allows for the testing of ideas and the validation of concepts by engaging a broad audience early in the development process. This democratization of finance supports a more diverse range of projects and initiatives, promoting inclusivity and creativity within the academic environment. The issue of web security is also very crucial in the academic environment (Anderson & Kocher, 2019).

The interactive nature of crowdfunding platforms enhances student engagement by involving them directly in the fundraising process (Gerber et al., 2012). Students learn valuable skills in project management, marketing, and communication as they develop and promote their campaigns. Moreover, these platforms build a robust community of supporters, including alumni, local businesses, and the general public, who contribute not just financially, but also with mentorship and networking opportunities (Burtch et al., 2013). Globally, universities are increasingly adopting crowdfunding as a strategic tool to supplement traditional funding sources. A study by Belleflamme et al. (2014) highlights that while crowdfunding offers numerous benefits, it also presents challenges such as maintaining donor trust, managing large numbers of small contributions, and ensuring the sustainability of funding efforts. Bagheri et al. (2019) research work was able to uncover donors' motivations and thinking process largely via interviews. Generally, crowdfunding presents a transformative opportunity for higher education institutions to support student-led initiatives. By exploring the power of the internet and engaging a broad community of supporters, universities will be able to foster innovation, enhance student engagement, and build a strong network of alumni and community partners. The success stories from institutions like UC Berkeley and Oxford demonstrate the potential of crowdfunding to not only provide financial support but also to create a dynamic and inclusive academic environment.

Students at AE-FUNAI often encounter significant barriers in securing funding for their initiatives. Traditional funding sources, such as grants and sponsorships, are limited and highly competitive, leaving many promising projects unfunded. This lack of financial support stifles innovation and entrepreneurial spirit among students. Additionally, there is currently no structured and transparent mechanism for students to raise funds, manage donations, and engage with potential backers. The absence of such a platform leads to missed opportunities for students to develop crucial project management and fundraising skills, as well as to connect with a broader network of supporters. The proposed crowdfunding platform is expected to significantly enhance the capacity of AE-FUNAI students to finance their projects, addressing the persistent challenge of limited funding. By providing an accessible and transparent funding mechanism, the platform will empower students to pursue innovative ideas and entrepreneurial ventures that might otherwise remain unrealized due to financial constraints. This initiative aligns with global trends in higher education, where crowdfunding has been recognized as a potent tool for fostering innovation and engagement among students (Belleflamme et al., 2015). The proposed platform will serve as a crucial enabler for student-led projects, ranging from academic research and community service to startup ventures and extracurricular activities. This empowerment is crucial in fostering a culture of innovation and entrepreneurship within the university. Studies have shown that crowdfunding platforms provide not only financial resources but also validation and feedback from a diverse group of backers, which can significantly enhance the development and execution of projects (Mollick, 2014). Implementing a crowdfunding platform at AE-FUNAI will also foster a culture of giving and community engagement. This aligns with findings from other universities where crowdfunding has been successfully implemented, resulting in increased participation from students, alumni, and community members (Agrawal et al., 2014). The platform will enable students to connect with a broader network of supporters, including alumni and local businesses, who can contribute not just financially but also through mentorship and networking opportunities. Crowdfunding platforms have been shown to effectively strengthen ties with alumni, many of whom are eager to support their alma mater in tangible ways. By proposing a transparent and structured

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mechanism for contributions, the platform can attract new supporters and donors, thereby expanding the university's network of benefactors. This enhanced engagement can lead to long-term relationships that benefit both the university and its stakeholders (Belleflamme & Lambert, 2016).

The successful implementation and operation of a crowdfunding platform will elevate AE-FUNAI's profile as a hub of innovation and excellence. High-profile, successful crowdfunding campaigns can generate positive publicity and highlight the university's commitment to fostering a dynamic and supportive environment for student initiatives. This can also attract prospective students, faculty, and partners who are looking for a progressive and resourceful academic institution (Gerber et al., 2012). From an academic perspective, this study will contribute valuable insights into the implementation and impact of crowdfunding platforms in educational settings. By documenting the process, challenges, and outcomes associated with the AE-FUNAI crowdfunding platform, this research will provide practical recommendations that can be utilized by other institutions considering similar initiatives (Lehner, 2013). Beyond financial support, this platform will serve as an experiential learning tool, allowing students to develop essential skills in project management, marketing, and fundraising. Engaging with the crowdfunding process requires students to articulate their project goals, create compelling pitches, and manage campaign logistics, thereby equipping them with skills that are highly valuable in their future careers (Burtch et al., 2013).

The proposed crowdfunding platform at AE-FUNAI holds the potential to transform the university's approach to funding student-led initiatives, fostering a more innovative, engaged, and supportive academic community as well as build a sustainable model future growth and success. The scope of this study encompasses the design, development, and initial implementation of the crowdfunding platform at AE-FUNAI. Thus, the study will not cover long term maintenance, extensive marketing strategies, or large scale commercialization aspects beyond the initial implementation phase.

This section provides a comprehensive review of the existing literature on crowd-funding, with a particular focus on its application in educational contexts. It explores the theoretical foundations of crowd-funding, examining the economic principles, social dynamics, and technological advancements that underpin this funding model. The review delves into the design and implementation of digital platforms, highlighting the critical factors that contribute to the success of crowdfunding initiatives, such as user interface design, community engagement, and platform governance. Crowdfunding has emerged as a transformative mechanism for financing projects and ventures by pooling resources from a broad audience, typically via online platforms. Over the past decade, it has revolutionized the way individuals, startups, and organizations access capital, democratizing the fundraising process and allowing creators to bypass traditional financial intermediaries. This method of financing has gained traction across various sectors, including education, where it presents a unique opportunity to support student-led initiatives that might otherwise struggle to secure funding through conventional channels. As educational institutions increasingly turn to innovative solutions to empower their students, the development of customized crowdfunding platforms tailored to the specific needs of academic communities has become a pressing concern. These platforms offer a means to not only raise funds but also engage the broader community, fostering a sense of ownership and participation among students, faculty, alumni, and other stakeholders. The AE-FUNAI Crowdfunding Platform, designed to support student-led initiatives, exemplifies this trend by aiming to create a sustainable, user-friendly, and effective tool for project funding within the university setting.

Crowdfunding has fundamentally transformed the landscape of entrepreneurial finance by harnessing the power of the internet to democratize access to funding. This method of raising capital allows entrepreneurs, and innovators to bypass traditional financial intermediaries and connect directly with a broad audience of potential backers. The evolution of crowdfunding reflects a broader trend towards more decentralized and participatory forms of economic activity, enabled by digital technologies. Agrawal et al. (2014) provide a foundational analysis of the economic principles underlying crowd-funding, arguing that this approach disrupts traditional financing models by reducing transaction costs and mitigating information asymmetry between entrepreneurs and investors. Traditionally, high transaction costs and the need for extensive due diligence have made it difficult for small-scale projects to secure funding through conventional channels such as banks or venture capital firms. Crowdfunding platforms address these challenges by offering a streamlined, user-friendly interface that lowers the barriers to entry for both project creators and backers. Besides, crowdfunding leverages the concept of the "wisdom of the crowd," wherein a large, diverse group of individuals is able to make more accurate and collectively beneficial campaign decisions and maximize the funding than a small group of experts (Song at al., 2022). Belleflamme et al. (2014) explore how crowdfunding taps into this phenomenon by

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matching projects with audiences that have a vested interest in their success. For the AE-FUNAI Crowdfunding Platform, this means curating campaigns that resonate with the values and interests of the university community, thereby increasing the likelihood of successful funding. The dynamics of crowdfunding platforms have been the subject of extensive research, particularly in terms of understanding what makes certain campaigns successful. Mollick (2014) offers an exploratory analysis that identifies several key factors contributing to crowdfunding success, including project quality, the strength of the project creator's social network, and the ability to tell a compelling narrative. Liu et al. (2022) systematically enhanced creator's disclosure scheme under a stylized two-contributor model. These findings suggest that for the AE-FUNAI platform, emphasis should be placed on helping students craft well-presented, high-quality campaigns that clearly communicate their goals and impact. Leveraging the university's social networks, both online and offline, could play a critical role in amplifying the reach and visibility of student-led initiatives. Gerber et al. (2012) further investigate the motivations behind why individuals choose to participate in crowd-funding, revealing that backers are often driven by a combination of altruism, the desire for rewards, and a sense of community support. For the AE-FUNAI crowdfunding platform, understanding these motivations is crucial for designing features that attract and retain backers. For example, offering meaningful rewards or recognition for contributions, creating a sense of involvement in the project's progress, and fostering a strong community around each campaign can enhance the overall experience for backers and increase the likelihood of campaign success. Hence, the evolution of crowdfunding is characterized by its ability to reduce traditional barriers to funding, engage a broad and diverse audience, and align the interests of project creators and backers. For the AE-FUNAI crowdfunding platform, these insights highlight the importance of designing a platform that is both user-friendly and effective in matching student projects with backers who share their vision and goals.

The application of crowdfunding within educational contexts is a relatively new but rapidly growing area of interest. Educational institutions and students are increasingly turning to crowdfunding as a means to finance a wide range of projects, from research initiatives and creative endeavors to social impact programs and entrepreneurial ventures. Crowdfunding offers a unique opportunity to democratize funding access, particularly for students who may not have access to traditional funding sources. Lucas and Van Buren (2020) provide a comprehensive guide on how crowdfunding can be harnessed to support student-led initiatives, emphasizing that these platforms can serve as powerful tools for enabling students to bring their innovative ideas to life. They argued that crowdfunding can democratize access to capital by allowing students to pitch their ideas directly to a global audience, bypassing the often restrictive and competitive nature of traditional funding mechanisms. For the AE-FUNAI crowdfunding platform, this underscores the importance of designing a platform that is accessible to all students, regardless of their background or financial resources, thereby fostering an inclusive environment for innovation and creativity. McLellan & Sarangi (2021) examined the specific challenges and opportunities associated with student-led crowdfunding campaigns, noting that clear communication and alignment of campaign goals with the interests of potential backers are critical to success. They highlighted the importance of transparency in campaign messaging, as well as the need to build trust with potential backers by providing detailed information about how the funds will be used and the expected outcomes of the project. For the AE-FUNAI platform, this means providing students with the tools and guidance they need to create compelling, transparent campaigns that resonate with their target audience. Kohler and Gatzweiler (2021) proposed a framework for designing student-led crowdfunding platforms that maximize engagement, emphasizing the need for platforms to be intuitive, accessible, and supportive of collaborative learning environments. They argued that the design of the platform should facilitate easy interaction between students, backers, and the broader community, thereby creating a dynamic and supportive ecosystem for student projects. For the AE-FUNAI platform, this means incorporating features such as collaborative project spaces, mentorship opportunities, and integrated feedback mechanisms that allow backers to contribute ideas and support the development of projects. Ballesteros & Guitart (2020) further explored the determinants of success in student-led crowdfunding campaigns, with a particular focus on the role of social media in amplifying the reach and impact of these initiatives. They argued that social media platforms can serve as powerful tools for promoting campaigns, building community, and engaging with backers. For the AE-FUNAI platform, integrating social media functionality could significantly enhance the visibility of student projects, allowing them to reach a wider audience and attract more backers. Furthermore, embedding social media analytics could provide valuable insights into backer behavior and campaign performance, enabling students to refine their strategies and improve their chances of success. Purportedly, crowdfunding offers a promising avenue for supporting student-led initiatives within educational settings. By designing a platform that is accessible, transparent, and community-focused, the AE-FUNAI crowdfunding platform can empower students to bring their ideas to life, while also fostering a culture of innovation and collaboration within the university community.

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The design of a crowdfunding platform is a fundamental determinant of its success, especially within the educational sector where user experience and community engagement are paramount. A well-designed platform must balance functionality with accessibility, ensuring that all users from tech-savvy students to less experienced backers can navigate the platform with ease and confidence. Shneiderman (2010) underscores the importance of user interface (UI) design in creating effective and user-friendly platforms. He argues that an intuitive UI is not merely an aesthetic concern but a critical factor in user retention and satisfaction. For the AE-FUNAI crowdfunding platform, the UI must be tailored to the specific needs of its users, with features such as simple navigation, clear instructions, and accessible support services. The platform's design should minimize cognitive load, allowing users to focus on the content of campaigns rather than the mechanics of the platform itself. Brown & Venkatesh (2005) further explored how design influences the adoption of technology, particularly within households. Their insights can be extended to educational settings, where the success of a crowdfunding platform often hinges on its ability to appeal to a diverse user base. By incorporating familiar design elements and ensuring that the platform is responsive across different devices and operating systems, the AE-FUNAI crowdfunding platform will increase its adoption rate among students, faculty, and external stakeholders. The platform should also include features that cater to the specific needs of its users, such as easy access to payment options, personalized dashboards, and real-time project updates.

The role of community in crowdfunding is another critical design consideration. Hui et al. (2014) emphasized that community involvement can significantly boost the success of crowdfunding campaigns by providing social proof and fostering trust among backers. For the AE-FUNAI platform, this means designing features that encourage active community participation, such as discussion forums, social media integration, and opportunities for backers to provide feedback and support. Thus, by fostering a strong sense of community, the platform will be able to create a network of engaged users who are more likely to contribute to and promote campaigns. Community features will also include mechanisms for peer support, allowing experienced users to mentor newcomers, further strengthening the platform's community and enhancing user engagement. Burtch et al. (2013) examined the patterns of contribution in crowdfunding markets, noting that fostering a sense of ownership among contributors is crucial for encouraging repeat participation. For the AE-FUNAI platform, this could involve implementing features that recognize and reward backers, such as badges, leaderboards, or exclusive access to project updates and events. By making contributors feel valued and integral to the success of the platform, the AE-FUNAI platform will cultivate a loyal user base that is motivated to support multiple campaigns over time. The design of the AE-FUNAI crowdfunding platform will prioritize user experience, community engagement, and the creation of a supportive environment for both project creators and backers.

The successful implementation of a crowdfunding platform requires a strategic approach that considers both technical and social factors. A robust technical infrastructure, clear governance, and effective communication channels are essential components that ensure the platform operates smoothly and meets the needs of its users. Hemer (2011) provides a comprehensive overview of the challenges and opportunities associated with crowd-funding, emphasizing the need for a reliable and scalable technical infrastructure. For the AE-FUNAI crowdfunding platform, this means investing in secure and scalable servers, implementing user-friendly content management systems, and ensuring seamless integration with payment gateways and university systems. De Buysere et al. (2012) offer a framework for European crowdfunding that can be adapted to educational contexts, outlining best practices for platform governance, regulatory compliance, and community engagement. Their framework highlights the importance of establishing clear guidelines and policies that govern the platform's operations, including project approval processes, funding disbursement procedures, and user conduct standards. For the AE-FUNAI platform, adhering to these best practices will ensure that the platform operates transparently and fairly, thereby fostering trust and credibility among its users.

Furthermore, the platform must establish effective communication channels to facilitate interaction between project creators, backers, and platform administrators. This could include automated notifications, newsletters, and dedicated support teams that are readily available to assist users. Effective communication is not only vital for addressing user concerns but also for promoting the platform and its campaigns, helping to attract a wider audience and increase participation rates. The success factors of crowdfunding initiatives, focusing on platform features such as ease of use, transparency, and the availability of support services. For the AE-FUNAI crowdfunding platform, these features are particularly important given the educational context in which it operates. The platform must be designed to be intuitive and accessible, with clear instructions and guidance available at every step of the process. Transparency is also key, with users needing to see how funds are

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allocated and used, as well as the impact of their contributions on the success of projects. The implementation of the AE-FUNAI crowdfunding platform will also include a focus on continuous improvement, with regular updates and enhancements based on user feedback and evolving technological trends. Technology is at the heart of modern crowdfunding platforms, driving both their functionality and their capacity to engage and connect with potential backers. The rapid evolution of digital tools and platforms has significantly enhanced the crowdfunding experience, making it more accessible, efficient, and capable of supporting diverse projects. For the AE-FUNAI crowdfunding platform, leveraging the latest technological advancements will be crucial to its success, enabling it to meet the specific needs of students and stakeholders while also pushing the boundaries of what is possible within the crowdfunding space.

Lin and Viswanathan (2016) delved into the concept of home bias in online investments, where investors tend to favor local projects over those based in distant locations. They argued that technology can be a powerful tool in overcoming these biases, helping to bridge geographic and social gaps that might otherwise limit the reach of crowdfunding campaigns. The AE-FUNAI Crowdfunding platform will effectively target a wider audience, both within and beyond the university's immediate community as it uses advanced geolocation and social networking technologies. This approach can increase the potential pool of backers and ensure that worthy projects receive the support they need, regardless of their geographic origin. Boudreau & Lakhani (2013) highlighted the role of the crowd as an innovation partner in the crowdfunding ecosystem. They suggested that technology facilitates collaboration and co-creation, enabling backers to contribute not just financially but also intellectually and creatively to the projects they support. For the AE-FUNAI platform, this means integrating interactive features that allow backers to provide feedback, share ideas, and participate in project development. Such features could include forums, virtual brainstorming sessions, and collaborative tools that enable students and backers to work together in real-time. This level of engagement not only enhances the project's development but also fosters a sense of ownership and community among backers, increasing their commitment to the project's success. The integration of artificial intelligence (AI) and data analytics into crowdfunding platforms represents a significant leap forward in enhancing platform performance and user experience. The double-edged sword effect of large crowds in crowdfunding, where the sheer volume of projects can overwhelm backers, making it difficult for them to identify and support initiatives that align with their interests. Data analytics can be used to monitor and evaluate the performance of the platform and the campaigns it hosts. By tracking key metrics such as funding progress, user engagement, and social media activity, the platform can continuously optimize its operations and user interface, ensuring that it remains responsive to the needs of both project creators and backers. This data-driven approach also allows for the identification of emerging trends and potential areas for innovation, enabling the platform to stay ahead of the curve in the rapidly evolving crowdfunding landscape. In addition to AI and data analytics, the use of blockchain technology offers another avenue for innovation in crowdfunding. For the AE-FUNAI platform, integrating blockchain could mean offering smart contracts that automatically release funds when certain conditions are met, reducing the risk of fraud and increasing backer confidence. This might be looked at in the future research. The role of technology in crowdfunding extends beyond the platform itself to include the tools and devices that users employ to interact with the platform. Mobile technology, for example, has become increasingly important as more users access crowdfunding platforms via smartphones and tablets. The AE-FUNAI crowdfunding platform will need to be fully optimized for mobile use, with responsive design, mobile-friendly interfaces, and seamless integration with social media apps to facilitate easy sharing and engagement on the go.

Crowdfunding, while primarily viewed as a means of raising capital, has evolved into a powerful tool for fostering social and educational advancements. The ability to pool resources from a broad audience empowers not only financial growth but also community development and educational enhancement. For institutions like AE-FUNAI, which focus on nurturing student-led initiatives, the potential of crowdfunding extends far beyond financial contributions to include the promotion of social responsibility, educational enrichment, and community engagement. Dong and Clifton (2020) provide a compelling analysis of how crowdfunding can serve as a catalyst for community-based sustainable development, especially in developing countries. Their research highlights how crowdfunding platforms can be tailored to support initiatives that address local challenges, thereby fostering a sense of community ownership and accountability. This approach is particularly relevant for the AE-FUNAI crowdfunding platform, which seeks to empower students to take an active role in addressing both campus and local community issues. By facilitating projects that align with sustainable development goals, the platform can help students develop a deeper connection to their community while contributing to meaningful social change. The AE-FUNAI crowdfunding platform is designed not just to support individual projects but to build a culture of collaboration and social responsibility within the university. Projects that focus on community

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improvement, environmental sustainability, and social equity are particularly encouraged. By prioritizing such projects, the platform aligns with broader global goals, such as those outlined by the United Nations Sustainable Development Goals (SDGs). This alignment enhances the platform's appeal to socially conscious backers who are motivated by the desire to make a positive impact on society. Lehner (2013) expands on this by exploring the potential of crowdfunding for social ventures, suggesting that platforms with a focus on social impact can attract a unique type of backer. These backers are often driven by a commitment to the common good rather than purely financial returns. For the AE-FUNAI platform, this means targeting backers who are not just looking to support a project but are also interested in the social or educational value it offers. This could include alumni, faculty members, local businesses, and philanthropic organizations that share the university's mission and values. In their paper, Shao et al. (2024) presented a crowdfunding model considering both the creator's optimal pricing as well as information-disclosure approaches. Their analysis shows that the contributors' prior belief on the fraction of high-valuation contributors is critical in the creator's strategic information disclosure.

Aim and Objectives of the study

The aim of this study is to design and implement a crowdfunding platform at AE-FUNAI to support student-led initiatives. The objectives are as follows:

i. To design a user-friendly crowdfunding platform tailored to the needs of AE-FUNAI students and stakeholders.
ii. To implement the crowdfunding platform and ensure that all the critical functionalities (e.g., student authentication and payment processing) are operational.

To provide data-driven recommendations for the platform's continuous improvement and sustainability, with a target to increase user.

Methodology

This section outlines the research methodology, system analysis, and design approach employed in building the AE-FUNAI crowdfunding platform, with a strong emphasis on agile principles. Adopting an agile methodology facilitated iterative development, continuous feedback, and adaptive planning, which are crucial for responding to the dynamic nature of user needs and technological advancements (*Fig. 1*). Agile methodology prioritizes collaboration and flexibility, allowing teams to work closely with stakeholders throughout the development process. The research employed a blend of qualitative and quantitative techniques. Qualitative methods, such as user interviews and focus groups, provided rich insights into user experiences and preferences, while quantitative methods, including surveys and usage metrics, delivered valuable data for informed decision-making. This comprehensive understanding of user needs ensured that the platform was designed with the end-user in mind. The selection of Laravel 10 as the development framework was strategic, leveraging its robust architecture, scalability, and compatibility with modern web technologies. Laravel 10 supports secure and rapid development, making it an ideal choice for agile projects. The agile approach, combined with the strategic choice of Laravel 10, not only enhances the development process but also positions the FUNAI crowdfunding platform for long-term success by fostering a user-centered design and ensuring responsiveness to evolving user needs.

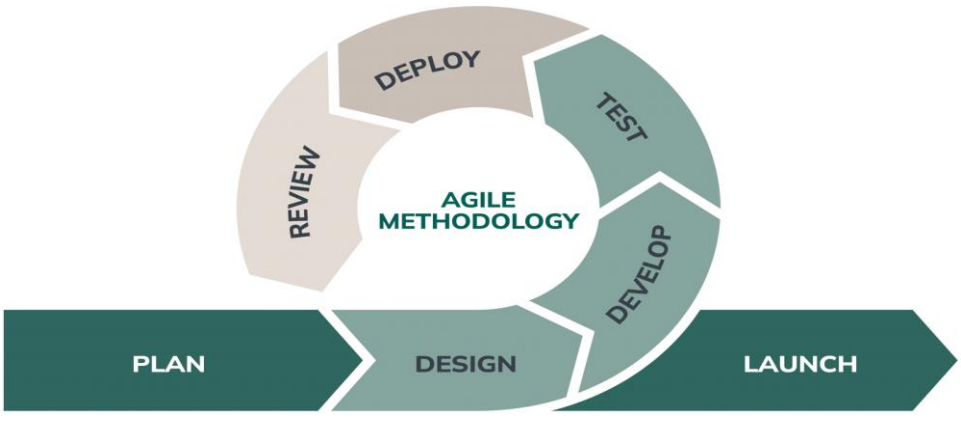

Figure 1: Agile Software Development Process

The following technologies are integrated into the Laravel 10 platform:

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i. Payment Gateways: Integration with PayPal and Stripe to provide users with secure and flexible payment options for donations.
ii. Social Media Platforms: Connecting with platforms like Facebook, Twitter, and Instagram to facilitate easy sharing of fundraising campaigns, enhancing the platform's visibility and reach.

System analysis

The system analysis aimed at understanding the existing landscape of crowdfunding platforms and pinpointing key limitations and gaps. This analysis serves as the foundation for developing an optimized and innovative solution that addresses the specific needs of students at AE-FUNAI. Key components of the system analysis included:

i. Assessment of Current Crow-funding Platforms: This involved a comparative review of popular platforms such as GoFUNAI, GoFUNDme, Kickstarter, and Indiegogo to identify their strengths and weaknesses in areas like ease of use, payment integration, security, and user engagement.
ii. Identification of Limitations: Many existing platforms were found to lack features that cater specifically to student-led initiatives, such as tailored user support, direct integration with university systems, and localized marketing tools.

Data gathering technique

To develop the AE-FUNAI crowdfunding platform, the following data-gathering techniques were used:

i. Interviews: Conducted with potential users and administrators to gather insights on the needs and challenges associated with crowdfunding platforms.
ii. Document Review: Existing crowdfunding platforms were reviewed to understand the strengths and limitations of current offerings.

Analysis of the existing system

Existing crowdfunding platforms, such as GoFUNAI, GoFUNDme, and Kickstarter, offer essential fundraising functionalities, but they lack certain features that cater specifically to volunteer-based community fundraising or student-led initiatives. While they are designed for a wide range of fundraising efforts, these platforms often prioritize campaigns for personal needs, business ventures, or creative projects, leaving gaps in supporting smaller, localized, or community-driven efforts. The followings were limitations identified:

i. Current platforms provide minimal control to campaign administrators, particularly in managing volunteer efforts, campaign visibility, and donations in a detailed, customizable way.
ii. Most platforms do not integrate with educational institutions or community organizations, which limits their effectiveness in supporting school-based fundraising or localized campaigns.
iii. Volunteers and organizers often lack the flexibility to manage campaigns dynamically, such as assigning different roles or tracking specific performance metrics related to engagement, donations, or volunteer participation.

These gaps point to the need for a platform that provides more targeted tools for volunteer-driven initiatives and allows for better administrative oversight, offering a solution tailored to the specific needs of the AE-FUNAI community.

Advantages of the existing system

Despite the identified limitations, existing crowdfunding platforms like GoFUNAI and Kickstarter still provide several key advantages, which can be built upon or modified in the development of the AE-FUNAI crowdfunding platform:

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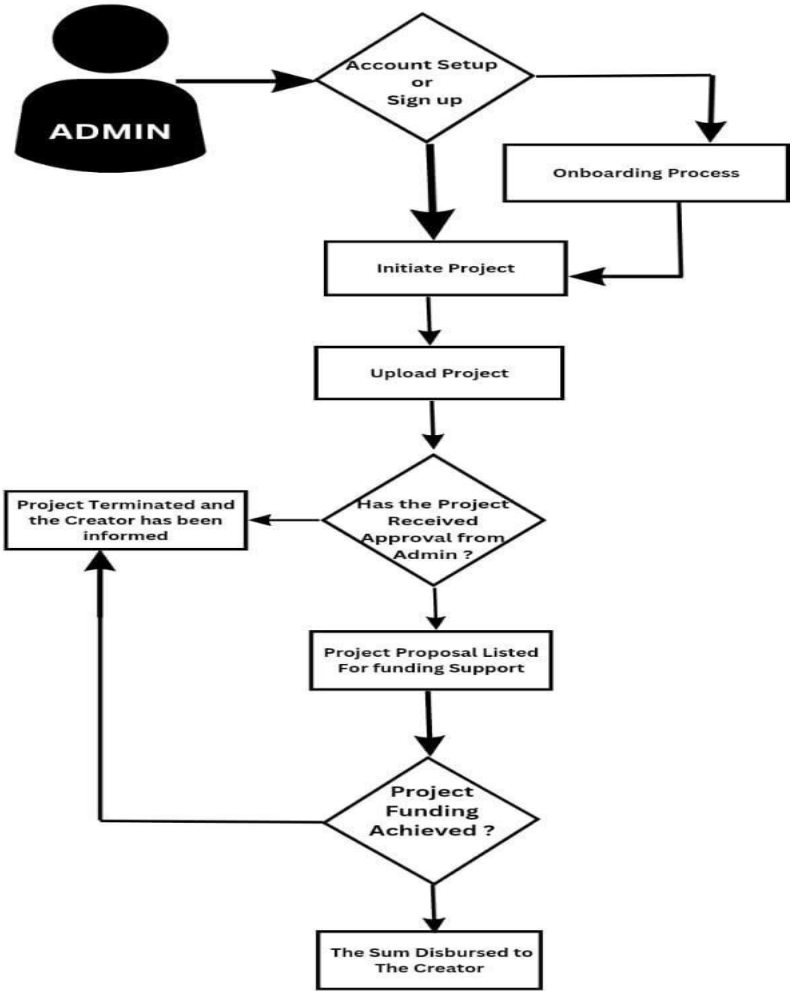

Figure 2: Flowchart of AE-FUNAI Crowdfunding

a. **Established infrastructure**: These platforms have well-established infrastructure, including robust servers and secure payment gateways such as PayPal and Stripe. This infrastructure is crucial in ensuring the reliability and security of the crowdfunding process. Leveraging similar infrastructure in the AE-FUNAI crowdfunding platform would ensure smooth and secure payment processing, which is crucial for gaining user trust.
b. **Ease of use**: Platforms like GoFUNAI and Kickstarter offer intuitive user interfaces, making it easy for users with little to no technical experience to create and manage campaigns. The process is streamlined, from setting up a campaign to withdrawing funds. The AE-FUNAI crowdfunding platform can replicate this ease of use by adopting user-friendly interfaces and simplified workflows to lower the barrier for students and volunteers to set up and manage campaigns.
c. **Global reach**: Popular crowdfunding platforms provide global access, allowing fundraisers to tap into a large and diverse audience. This global reach can significantly increase the chances of successful fundraising by attracting donors from around the world. While the primary focus of the AE-FUNAI platform is on AE-FUNAI student-led initiatives, the ability to extend campaigns beyond the local community through global outreach could open new avenues for support, such as from alumni or international donors.

Disadvantages of the existing system

i. Most platforms focus solely on individual fundraising rather than community-driven causes.
ii. Many platforms do not allow administrators to add or manage volunteers efficiently.

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iii. Users are often limited in how they can customize their campaigns and user profiles.

High-level model of the proposed system

The proposed AE-FUNAI crowdfunding platform takes a community-driven approach, addressing the limitations of existing platforms by focusing on volunteer-based initiatives (*Fig. 2*). The system enables administrators to add and manage volunteers, allowing for more efficient and collaborative campaign management. In the proposed system, the following are the key features (see *Fig. 3* for the use case):

i. The administrators assign roles to volunteers, who in turn can create and manage multiple campaigns.
ii. The platform allows users to raise funds for both local and global causes, supporting a wide range of community initiatives.
iii. Integration with PayPal, Stripe, and manual bank transfers provides users with secure and diverse payment methods for donations.
iv. Users have the ability to customize campaign pages and user profiles to better align with their unique causes and engage donors effectively.

Analysis of the proposed system

Figure 3: AE-FUNAI Crowdfunding Use Case

The AE-FUNAI crowdfunding platform addresses the gaps identified in the existing system by offering by carrying out the following:

i. Volunteers can create and manage unlimited campaigns.
ii. Support for PayPal, Stripe, and manual bank transfers, giving users multiple payment options.
iii. Members can manage their profiles, including updating avatars, email addresses, and passwords.
iv. Built-in protections like Cross-Site Scripting (XSS), Bcrypt password hashing, and General Data Protection Regulation (GDPR) compliance ensure data security and privacy.

Justification of the proposed system

The platform's design and features cater to the specific requirements of community-based initiatives, offering a versatile solution that aligns with the institutional goals of AE-FUNAI, The AE-FUNAI crowdfunding platform is justified by its ability to offer a comprehensive, community-focused crowdfunding experience that directly

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addresses the needs of both fundraisers and administrators. Unlike existing systems, this platform is specifically designed to empower community-driven fundraising efforts, such as student-led initiatives at AE-FUNAI, by providing enhanced user control, secure payment processing, and robust administrative tools. The key justifications are as follow:

i. The platform allows users to fully manage their profiles and campaigns, offering customization options that improve the overall user experience.
ii. The platform is equipped to handle donations in various currencies, broadening its appeal and accessibility to both local and international donors.
iii. With built-in security features such as XSS protection, Bcrypt password hashing, and GDPR compliance, the platform ensures a high level of data protection and user privacy, addressing the growing concern for online security in crowd-funding.
iv. Fundraisers and administrators can receive real-time notifications and updates on campaign performance, helping them make timely decisions and engage with donors effectively.

System design

The system design focuses on creating a user-friendly, secure, and scalable crowdfunding platform. The design ensures that both users and administrators can efficiently manage campaigns, monitor donations, and engage volunteers, while maintaining secure payment systems and providing flexibility for future enhancements. The core functionalities integrated into the system design include:

i. Users can easily create, update, and track their campaigns, ensuring transparency and ease of use throughout the fundraising process.
ii. Payment integrations such as secure and flexible payment methods, such as PayPal and Stripe.
iii. Administrators have enhanced control over managing campaigns, volunteers, and donations, ensuring effective oversight and scalability.

Algorithm

The core algorithms of the AE-FUNAI crowdfunding platform are essential to the system's ability to manage campaigns efficiently, process donations in real-time, and ensure secure user interactions. Each algorithm is designed to address key operational requirements, improving the platform's functionality and scalability.

a. Campaign management algorithm (CMA)

The CMA is responsible for the creation, updating, and deletion of campaigns. It enables both volunteers and administrators to manage their campaigns with ease. The algorithm follows a structured process where the user inputs campaign details, which are then validated to ensure that all required fields (such as title, goal amount, and campaign description) are complete. Once validated, the algorithm assigns a unique identifier to the campaign, which is stored in the system's database for tracking and updates.

***Algorithm 1**: Pseudo-code for Campaign Management Algorithm*

```
//Create Campaign
1. IF campaign creator submits campaign details THEN
2. Validate campaign details (title, goal, deadline, etc.)
3. IF validation succeeds THEN
4. Create campaign record in database
5. Notify campaign creator of creation
6. ELSE
7. Display error message to campaign creator
//Update Campaign
8. IF authorized user submits update request THEN
9. Check campaign status (allows updates)
10. IF campaign status allows updates THEN
11. Update campaign record in database
12. Notify backers of update
13. ELSE
14. Display error message to user
//Delete Campaign
15. IF authorized user submits deletion request THEN
16. Check campaign status (allows deletion)
17. IF campaign status allows deletion THEN
18. Delete campaign record from database
19. Notify backers of deletion
20. Refund contributions (if applicable)
21. ELSE
22. Display error message to user
```

Algorithm 1 uses if-then statements to control the flow of the program and can be translated into a programming language like Java, or JavaScript. A simple code snippet to demonstrate *Algorithm 1* is shown in *Algorithm 2*.

b. Donation tracking algorithm (DTA)

The Donation Tracking Algorithm monitors donations in real-time and updates the corresponding campaign's progress as soon as a donation is received. The process begins when a user initiates a donation. The system checks if the transaction is valid through integrated payment gateways (e.g., PayPal or Stripe) and confirms the success of the payment before updating the campaign's fundraising status.

***Algorithm 2**: A Simple Code Snippet for CMA*

```
//Create Campaign
def create_campaign(…):
    if validate_details(…):
        # Create campaign record in database
        notify_creator("Campaign created successfully")
    else:
        display_error("Invalid campaign details")

def update_campaign(campaign_id, updates):
    if authorized_user():
        if campaign_status_allows_updates(campaign_id):
            # Update campaign record in database
            notify_backers("Campaign updated")
        else:
            display_error("Campaign status does not allow updates")
    else:
        display_error("Unauthorized user")

def delete_campaign(campaign_id):
    if authorized_user():
        if campaign_status_allows_deletion(campaign_id):
            # Delete campaign record from database
            notify_backers("Campaign deleted")
            refund_contributions()
        else:
            display_error("Campaign status does not allow deletion")
    else:
        display_error("Unauthorized user")
```

A donation tracking algorithm (DTA) for AE-FUNAI crowdfunding platform is shown in *Algorithm 3* as a pseudo-code and in *Algorithm 4* as a code snippet.

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***Algorithm 3**: Pseudo-code for DTA*

```
//Record Donation
1. IF donor submits donation details THEN
2. Validate donation details (amount, campaign ID, etc.)
3. IF validation succeeds THEN
4. Record donation in database (donor ID, campaign ID, amount, timestamp)
5. Update campaign funding progress (total amount raised)
6. Notify campaign creator and donor of successful donation
7. ELSE
8. Display error message to donor
//Update Donation
9. IF authorized user submits update request THEN
10. Validate update details (new amount, etc.)
11. IF validation succeeds THEN
12. Update donation record in database
13. Update campaign funding progress (total amount raised)
14. Notify campaign creator and donor of update
15. ELSE
16. Display error message to user
//Refund Donation
17. IF campaign creator or authorized user submits refund request THEN
18. Validate refund request (campaign status, etc.)
19. IF validation succeeds THEN
20. Process refund to donor
21. Update donation record in database (refund status)
22. Notify donor of refund
23. ELSE
24. Display error message to user
```

Algorithm 3 captures the essential steps for tracking donations on a crowdfunding platform. A simple code snippet to demonstrate *algorithm 3* is shown in *Algorithm 4*.

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***Algorithm 4**: A Simple Code Snippet for DTA*

```
def record_donation(donation_details):
    if validate_donation_details(donation_details):
        # Record donation in database
        update_campaign_funding_progress(donation_details['campaign_id'])
        notify_creator_and_donor("Donation successful")
    else:
        display_error("Invalid donation details")

def update_donation(donation_id, updates):
    if authorized_user():
        if validate_update_details(updates):
            # Update donation record in database
            update_campaign_funding_progress(updates['campaign_id'])
            notify_creator_and_donor("Donation updated")
        else:
            display_error("Invalid update details")
    else:
        display_error("Unauthorized user")

def refund_donation(donation_id):
    if authorized_user():
        if validate_refund_request(donation_id):
            # Process refund to donor
            update_donation_record(donation_id, "refunded")
            notify_donor("Refund processed")
        else:
            display_error("Invalid refund request")
```

Algorithm 4 is the code snippet that demonstrates the basic logic of the *Algorithm 3*.

c. Authentication and security algorithm (ASA)

User authentication is managed by a robust Authentication and Security Algorithm, designed to ensure that users' credentials and sensitive information are securely stored and processed. The system utilizes Bcrypt hashing for password storage, ensuring that no plaintext passwords are stored. The algorithm supports features like two-factor authentication (2FA) for enhanced security. An ASA for a crowdfunding platform is shown in *Algorithm 5*. *Algorithm 5* captures the essential steps for authenticating and securing users on a crowdfunding platform. A simple code snippet to demonstrate Algorithm 5 is shown in *Algorithm 6*.

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***Algorithm 5**: Pseudo-code for ASA*

```
//User Registration
1. IF user submits registration details THEN
2. Validate registration details (username, email, password, etc.)
3. IF validation succeeds THEN
4. Hash and store password securely
5. Create user account in database
6. Send verification email to user
7. ELSE
8. Display error message to user
//User Login
9. IF user submits login credentials THEN
10. Validate login credentials (username, password)
11. IF validation succeeds THEN
12. Authenticate user using hashed password
13. Generate session token or JWT for authenticated user
14. Grant access to platform features
15. ELSE
16. Display error message to user
//Password Recovery
17. IF user submits password recovery request THEN
18. Validate user email or username
19. IF validation succeeds THEN
20. Send password reset link to user's email
21. Allow user to reset password
22. ELSE
23. Display error message to user
```

***Algorithm 6**: A Simple Code Snippet for ASA*

```
1. import bcrypt
2. import jwt
3.
4. def register_user(user_details):
5.     if validate_user_details(user_details):
6.         hashed_password = bcrypt.hashpw(user_details['password'].encode('utf-8'), bcrypt.gensalt())
7.         # Create user account in database
8.         send_verification_email(user_details['email'])
9.     else:
10.         display_error("Invalid user details")
11.
12. def login_user(login_credentials):
13.     if validate_login_credentials(login_credentials):
14.         user = authenticate_user(login_credentials['username'], login_credentials['password'])
15.         if user:
16.             session_token = jwt.encode({'user_id': user['id']}, secret_key, algorithm='HS256')
17.             # Grant access to platform features
18.         else:
19.             display_error("Invalid login credentials")
20.     else:
21.         display_error("Invalid login credentials")
22.
23. def password_recovery(email):
24.     if validate_email(email):
25.         # Send password reset link to user's email
26.         pass
27.     else:
28.         display_error("Invalid email")
29. ….
```

System architecture

The AE-FUNAI crowdfunding platform adopts the Model-View-Controller (MVC) architecture, a software design pattern that separates the application's logic into three interconnected components: Model, View, and Controller. This separation enhances the system's maintainability, scalability, and flexibility. This architectural design not only improves the platform's scalability but also simplifies future enhancements and troubleshooting efforts (*Fig. 4*).

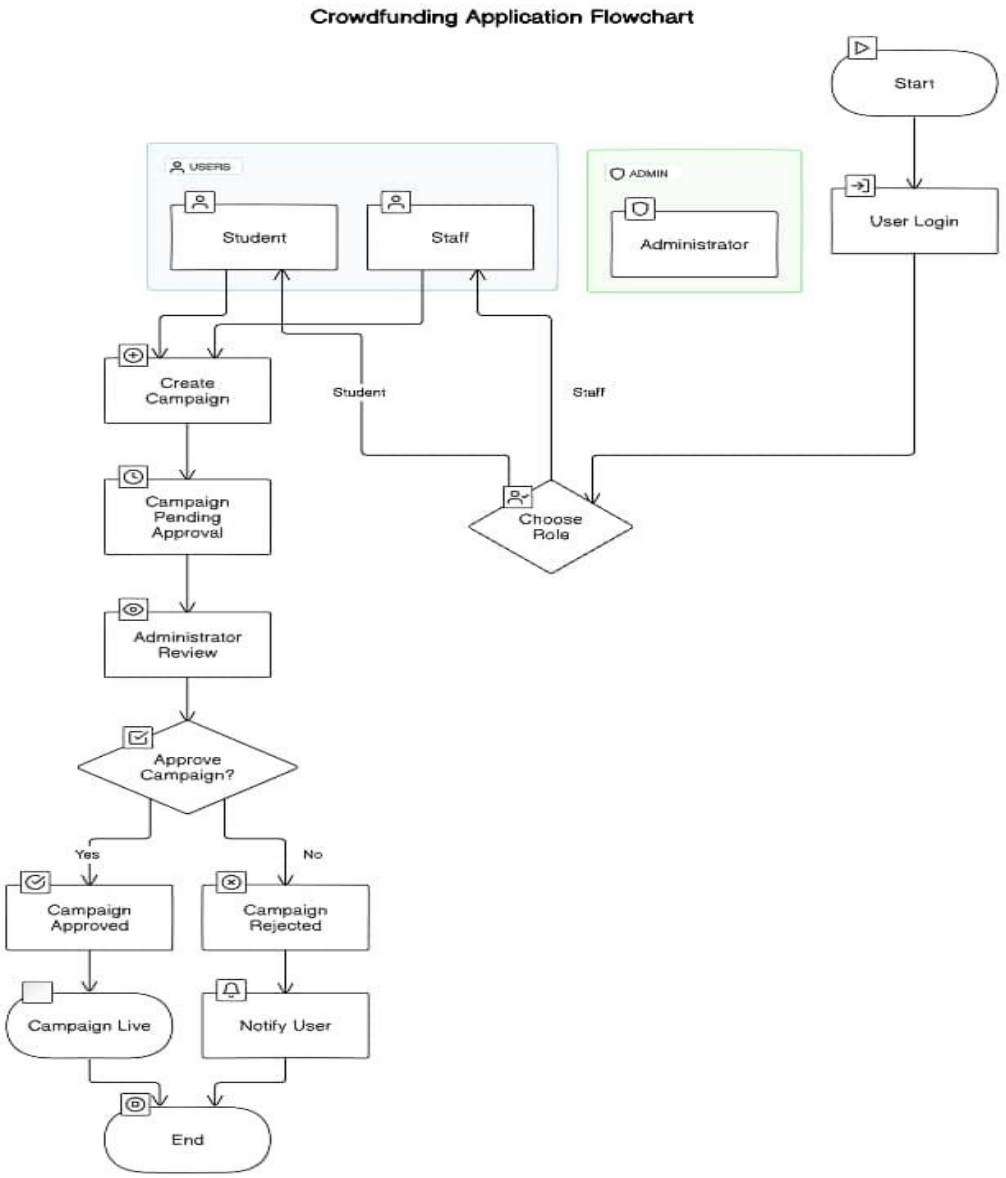

Figure 4: AE-FUNAI Crowdfunding Application Flowchart

i. **Model**: The Model component handles data-related logic, such as interacting with the database to manage user profiles, campaigns, donations, and transaction records. The system uses Eloquent ORM, an object-relational mapping tool, to streamline database operations, allowing developers to work with database records using active records without complex SQL queries.

ii. **View**: The View is responsible for presenting the data to the users. Using Bootstrap 5, the platform's user interface was designed to be fully responsive, ensuring compatibility across

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different devices. Vue.js was integrated into the front end for dynamic components, such as real-time donation progress bars and campaign filters.

iii. **Controller**: The Controller manages the logic behind user interactions, such as form submissions and API calls. It processes incoming requests, applies necessary business rules, and communicates between the Model and View components. For instance, when a user donates, the controller validates the input, checks for successful payment, and updates the campaign's progress.

Main menu design

The Main Menu of the AE-FUNAI crowdfunding platform was designed to be intuitive and user-friendly, giving users quick access to the platform's core functionalities (*Fig. 5*).

i. Home: The Home section displays featured campaigns, recent donations, and platform statistics (e.g., total funds raised, number of active campaigns).

ii. ii. Campaigns: The Campaigns section lists all active campaigns, with filters for users to sort by category, location, or funding status (such as, fully funded, urgent, or ongoing).

iii. iii. Login/Register: The Login/Register section allows users to log in or create an account. The system supports social login via Facebook or Google for ease of access, while providing a secure email/password option with password reset functionality.

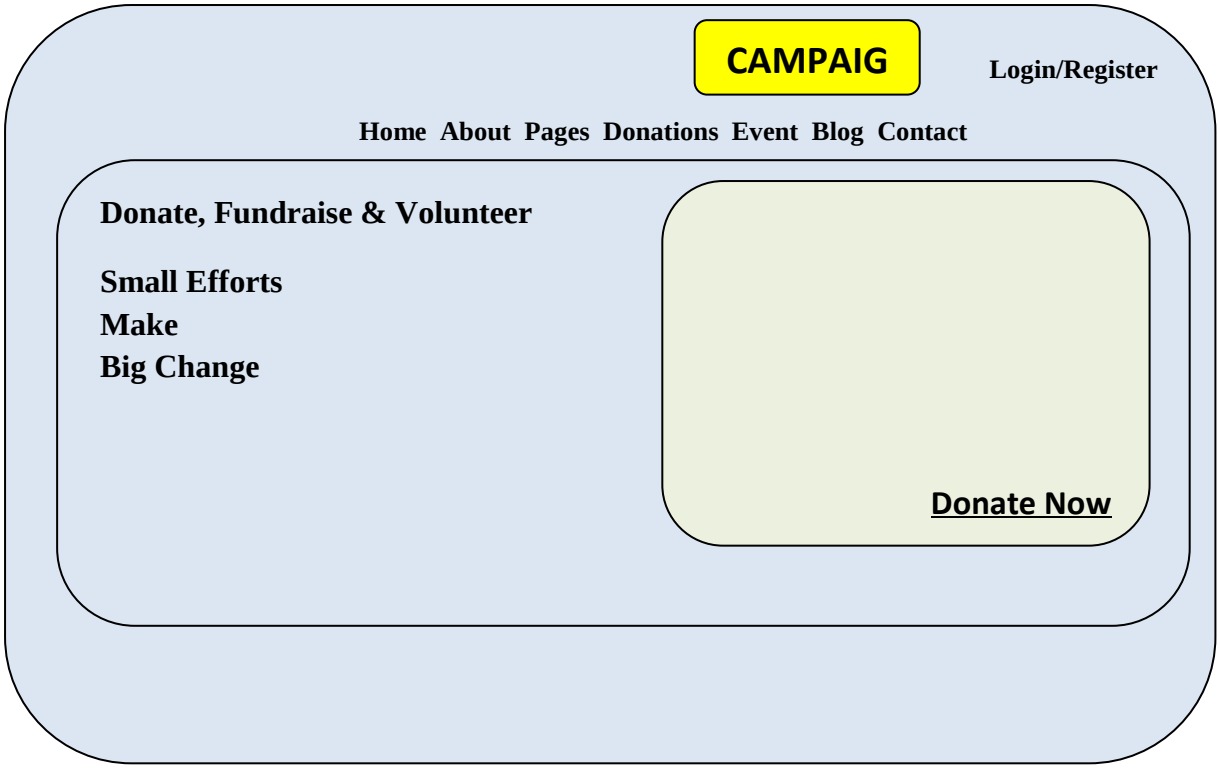

Figure 5: Main Menu Design

iv. My Account: The My Account section enables users to manage their profiles, including updating their personal information, changing passwords, or viewing their donation history. For volunteers, this section also includes options to manage their campaigns, allowing them to update, edit, or delete campaigns as necessary.

Sub menu design

The Sub Menu Design of the AE-FUNAI crowdfunding platform is developed to provide additional navigation options within major sections, enhancing user experience and promoting seamless interaction (*Fig. 6*). The submenus are context-sensitive, offering users tailored options based on their current activity, such as managing a campaign or browsing donations.

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i. The submenus allow users to navigate deeper into specific functionalities with ease. For example, within the "Campaigns" menu, submenus include options like "My Campaigns," "Create New Campaign," and "Campaign Categories."
ii. The submenus are dynamic and change based on the user's role (admin, volunteer, or donor). For instance, administrators will have access to tools like user management and system analytics, while donors will have shortcuts to donation history and bookmarked campaigns.

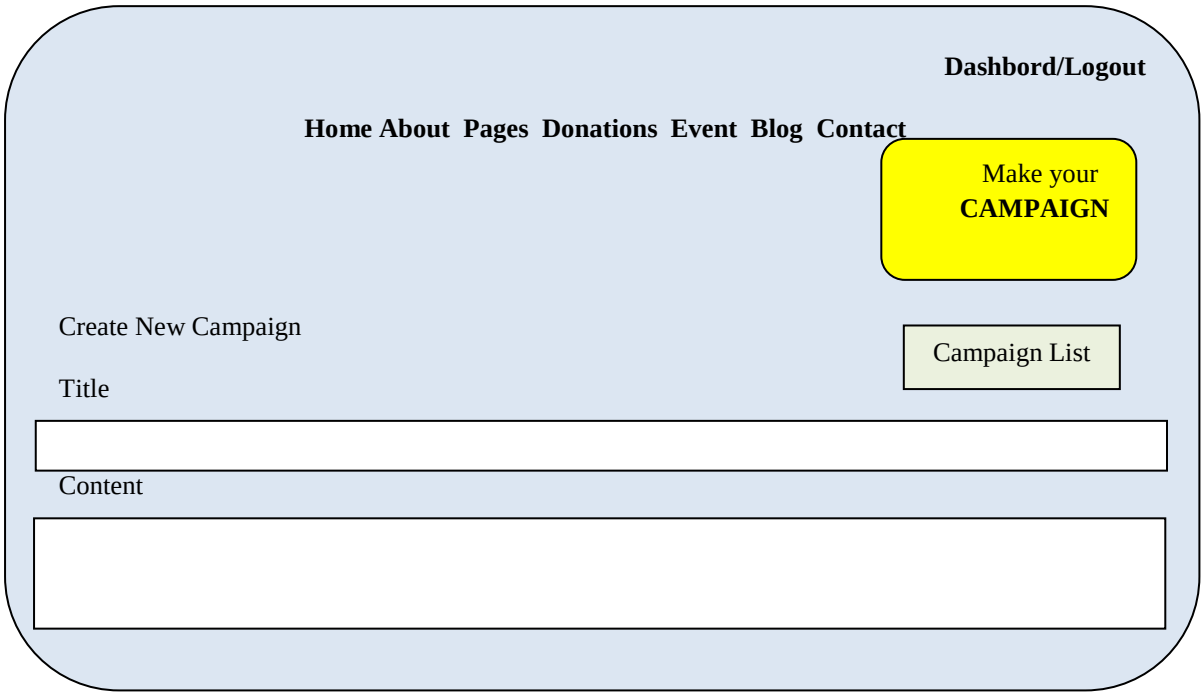

Figure 6: Sub-Menu for Campaign Design

Program module design

Program modules are the building blocks of the AE-FUNAI crowdfunding platform, each responsible for handling specific tasks. Two important modules are the Campaign Management Module (CMM) and the User Authentication Module (UAM).

a. The CMM allows volunteers and administrators to manage active and completed campaigns. It provides users with a form to submit new campaign details; enables users to edit existing campaigns, with real-time updates reflected on the public platform; allows administrators to delete campaigns, with confirmation prompts to avoid accidental deletions. This module communicates with the database via Eloquent ORM, ensuring efficient data handling and consistency.
b. The UAM manages user access and secures the platform. It handles new user signups, including email verification and password hashing via Bcrypt. It also authenticates users by comparing hashed passwords and generating secure session tokens as well as it provides users with the option to reset their password through a secure, email-based recovery process.

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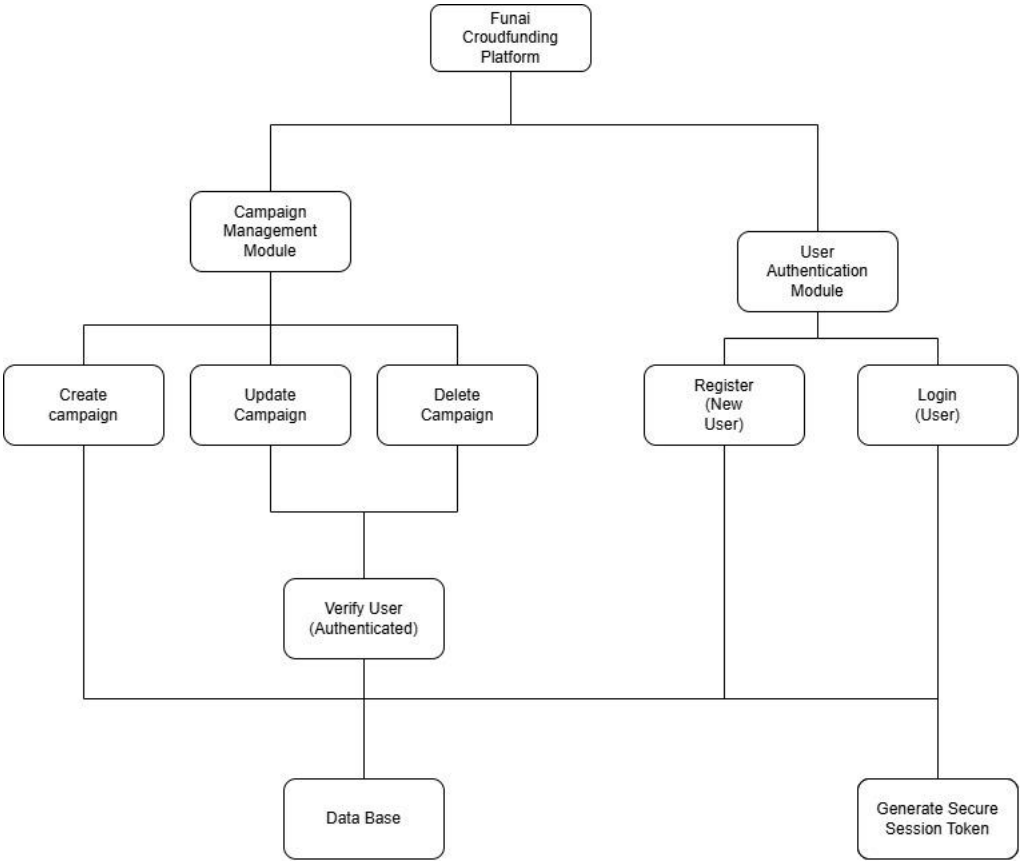

Figure 7: Program Module Design

Database development tool

The database for the AE-FUNAI crowdfunding platform was developed using MySQL. MySQL was chosen for its robustness, scalability, and compatibility with the Laravel 10 framework.

Data dictionary

A Data dictionary is a crucial part of database design, defining the structure and relationships of data. The data dictionary for the AE-FUNAI crowdfunding platform includes key entities such as Users (*Table 1*), Campaigns (*Table 2*), and Donations (*Table 3*). The data dictionary defines relationships between these tables, ensuring referential integrity within the database.

i. Users: *Table 1* stores information about platform users, including their ID, name, email, role (admin, volunteer, donor), and hashed password. The Users table is the cornerstone of the database, storing all information about individuals interacting with the platform. This table connects to the Campaigns table (for organizers) and the Donations table (for donors), enabling role-specific functionalities such as campaign management and donation tracking.

Table 1: User/Admin Table

Field name	Description	Data type	Constraint
UserID	Unique identifier for each user	INT	Primary Key, Auto-increment
Name	Full name of the user	VARCHAR(100)	Not Null
Email	User's email address	VARCHAR(100)	Not Null, Unique
Role	Role of the user (admin, volunteer, donor)	ENUM	Not Null
Hashed Password	Encrypted password for account security	VARCHAR(255)	Not Null

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ii. Campaigns: *Table 2* stores details about each campaign, such as campaign ID, title, description, goal amount, and start/end dates. This table captures information related to each fundraising campaign, including details such as the title, description, financial goal, start/end dates, and organizer information. The Campaigns table is linked to the Users table through the organizer_id foreign key, ensuring that every campaign is associated with a verified platform user.

Table 2: Campaigns Table

Field name	Description	Data type	Constraints
CampaignID	Unique identifier for each campaign	INT	Primary key, auto-increment
Title	Title of the campaign	VARCHAR(150)	Not Null
Description	Brief description of the campaign purpose	TEXT	Not Null
GoalAmount	Financial goal for the campaign	DECIMAL	Not Null
StartDate	Date and time when the campaign starts	DATETIME	Not Null
EndDate	Date and time when the campaign ends	DATETIME	Not Null

iii. Donations: *Table 3* tracks individual donations, including the donation ID, amount, donor ID, and campaign ID. The Donations table records each donation transaction made on the platform, connecting donors (via donor_id) with the campaigns they support (via campaign_id). Each donation entry includes details such as the donation amount and timestamp. By linking back to the Users table and Campaigns table, the Donations table ensures that only valid donations from registered users are recorded and attributed to active campaigns, preserving the integrity of donation data.

Table 3: Donations Table

Field name	Description	Data type	Constraints
DonationID	Unique identifier for each donation	INT	Primary key, Auto-increment
Amount	Amount donated	DECIMAL	Not Null
DonorID	References the ID of the donor in Users table	INT	Foreign Key (UserID)
CampaignID	References the ID of the campaign in Campaigns table	INT	Foreign Key (CampaignID)

Database design and structure

The database design for the AE-FUNAI crowdfunding platform follows a relational model, focusing on effective data organization, optimized access, and strong referential integrity. This section outlines the design choices, data relationships, and structural organization that ensure the platform can handle a large volume of users, campaigns, and donations while maintaining high performance and data consistency.

i. Database design approach: The database design uses a relational model, with three primary tables (Users, Campaigns, and Donations), each dedicated to a core entity of the platform. This approach was structured to allow each table to serve a specific purpose, with relationships managed via foreign keys. These relationships are critical for maintaining data linkage, ensuring that every donation and campaign was accurately connected to a verified user and that campaigns are organized by registered platform users. The relational model's use of primary keys, foreign keys, and constraints helps enforce data integrity, ensuring that orphan records or invalid references are minimized.

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ii. **Database structure:** The platform's database contains three main tables: Users, Campaigns, and Donations which interact through foreign keys to establish relationships. Each table is designed to handle specific information, and their interconnections are carefully structured to support the platform's goals.

A Data Dictionary is a foundational element in database design that precisely defines the structure, attributes, constraints, and relationships between the data entities in the system (Table 4). For the AE-FUNAI crowdfunding platform, the data dictionary covers the core tables necessary for managing users, campaigns, donations, and their relationships. By establishing a robust data dictionary, we ensure data consistency, integrity, and seamless integration across the platform's operations. The key entities:

a. Users table: This table manages data related to all users of the platform, including administrators, volunteers, and donors. Each user is assigned a unique ID to ensure accurate association with their activities on the platform.

Attributes: `user_id`: Unique identifier for each user; `surname`: The user's last name; `first_name`: The user's first name; `other_names`: Additional names of the user (if applicable); `email`: The user's contact email, which must be unique for login and notifications; `role`: Specifies the user's role, categorized as 'admin,' 'volunteer,' or 'donor' for access control; `hashed_password`: Encrypted password for secure login.

Relationships: Linked to `Campaigns` as creators or organizers (if volunteer); Linked to `Donations` as donors, to track contributions.

b. Campaigns table: This table stores information on individual fundraising campaigns initiated on the platform, outlining the goals, timelines, and organizing users.

Attributes: `campaign_id`: Unique identifier for each campaign; `title`: Brief title describing the campaign; `description`: Detailed information about the campaign purpose and goals; `goal_amount`: Financial target for the campaign; `start_date`: Date the campaign starts; `end_date`: Date the campaign ends; `organizer_id`: Foreign key linking to `Users` (specifically a volunteer or admin) who manages the campaign.

Relationships: Linked to `Users` table via `organizer_id` to assign ownership; Linked to `Donations` table via `campaign_id` to track all contributions made towards the campaign.

c. Donations table: This table records all individual donations, allowing the platform to track the contribution amounts, donor details, and the specific campaign each donation supports.

Attributes: `donation_id`: Unique identifier for each donation; `amount`: Amount donated by the user; `donor_id`: Foreign key linking to the `Users` table (specifically a donor); `campaign_id`: Foreign key linking to the `Campaigns` table to associate the donation with a particular campaign; `date`: Timestamp indicating when the donation was made.

Relationships: Connected to `Users` table to identify the donor; Connected to `Campaigns` table to identify which campaign the donation supports.

d. **Table relationships and referential integrity**: The database is designed with a relational model, utilizing primary and foreign keys to link records across the `Users`, `Campaigns`, and `Donations` tables. The referential integrity are denoted by the three key identifiers:

i. Each `donor_id` in the `Donations` table references a `user_id` in the `Users` table to ensure that every recorded donation has an associated, existing user.
ii. Each `campaign_id` in the `Donations` table references a `campaign_id` in the `Campaigns` table to confirm that donations are only linked to valid, active campaigns.
iii. The `organizer_id` in the `Campaigns` table must match a `user_id` in the `Users` table, ensuring that only existing users can organize campaigns.

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Table 4: Data Dictionary Table

Table	Field	Data type	Description	Constraints
Users	user_id	INT	Unique ID for each user	Primary Key, AutoIncrement
	surname	VARCHAR (50)	User's last name	Not Null
	first_name	VARCHAR (50)	User's first name	Not Null
	other_names	VARCHAR (50)	Additional names if applicable	Nullable
	email	VARCHAR(100)	User's unique email address	Unique, Not Null
	role	ENUM('admin', 'volunteer', 'donor')	Defines the role type	Not Null
	hashed_password	VARCHAR(255)	Encrypted password for secure access	Not Null
Campaigns	campaign_id	INT	Unique ID for each campaign	Primary Key, Auto Increment
	title	VARCHAR(100)	Title of the campaign	Not Null
	description	TEXT	Detailed campaign description	Not Null
	goal_amount	DECIMAL(10,2)	Financial goal for the campaign	Not Null
	start_date	DATE	Start date of the campaign	Not Null
	end_date	DATE	End date of the campaign	Not Null
	organizer_id	INT	Links to user_id in Users (organizer of campaign)	Foreign Key Not Null
Donations	donation_id	INT	Unique ID for each donation	Primary Key, Auto Increment
	amount	DECIMAL(10,2)	Amount donated	Not Null
	donor_id	INT	Links to user_id in Users (donor of the amount)	Foreign Key, Not Null
	campaign_id	INT	Links to campaign_id in Campaigns	Foreign Key, Not Null
	date	TIMESTAMP	Date and time of donation	Default current timestamp

This structure enhances the AE-FUNAI's crowdfunding platform's functionality by enabling comprehensive tracking and analytics, allowing the platform to support both complex queries and robust reporting capabilities, ensuring scalability, security, and data integrity. The entity relationship diagram (ERD) is shown in *Fig. 7* which shows the relationship amongst various components.

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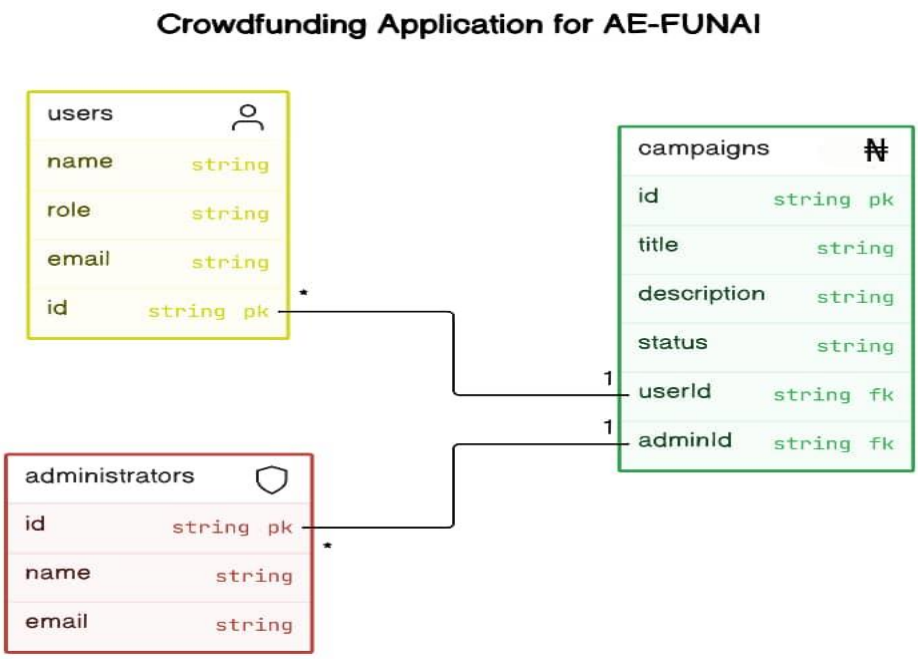

Figure 7: Entity Relationship Diagram

System implementation

This sub section details the implementation of the AE-FUNAI crowdfunding platform, outlines the hardware and software requirements, and discusses the program development process. The system implementation phase involved translating the system design into actual functional components using appropriate hardware, software, and programming tools. To effectively implement and deploy the AE-FUNAI crowdfunding platform, the following hardware requirements are necessary: (i) Processor: Intel Core i5 or higher. (ii) RAM: 8 GB or more. (iii) Storage: 500 GB SSD or higher (for database storage and media). (iv) Network: Broadband internet connection for server connectivity and hosting. (v) Server: A cloud or dedicated server with a minimum of 4 cores, 16 GB RAM, and 100 GB SSD storage. The platform development requires the following software components:

i. Operating System: Windows 10 or Ubuntu 20.04 LTS for development; Linux-based OS for deployment.
ii. Development Framework: Laravel 10 (PHP framework).
iii. Database: MySQL 8.0 for database management.
iv. Web Server: Apache or Nginx for hosting.
v. Version Control: Git for source code management.
vi. Payment Gateway APIs: PayPal and Stripe SDKs for handling payments.
vii. Integrated Development Environment (IDE): Visual Studio Code or PHPStorm for coding.

Program development involved choosing the appropriate programming languages and tools to build a responsive, secure, and user-friendly platform. We highlight the chosen language, the justification for its use, and the implementation of key components. PHP (Laravel): Laravel, a PHP-based framework, was chosen as the primary backend language for building the AE-FUNAI crowdfunding Platform. PHP was chosen for its integration with modern web frameworks like Laravel, known for its scalability, security features, and robust community support. Laravel 10 provides MVC architecture, built-in security features, and seamless integration with payment gateways, making it ideal for a crowdfunding platform. JavaScript was used for frontend interactivity, along with libraries like jQuery. JavaScript enhances user experience with real-time interaction, including updating campaign progress without refreshing the page. HTML5/CSS3 was used for structuring and styling the user interface. MySQL was used for managing database queries and relationships, providing strong querying capabilities and data consistency.

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Main menu implementation

The main menu was implemented using Blade Templates (a Laravel templating engine), providing dynamic content updates without reloading the entire page. The main menu includes links to:

i. Home (*Fig. 8*).

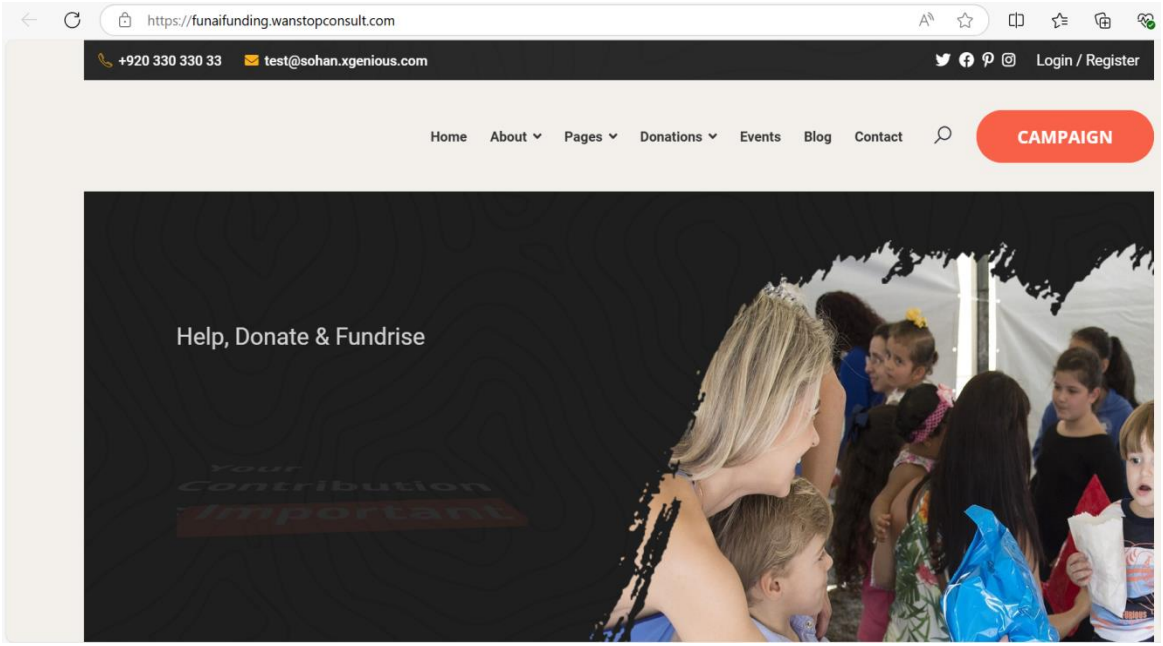

Fig 8: Main Menu

Figure 8: Home Page for AE-FUNAI Crowdfunding Platform

ii. Campaigns (view, create, or manage campaigns (*Fig. 9*)).

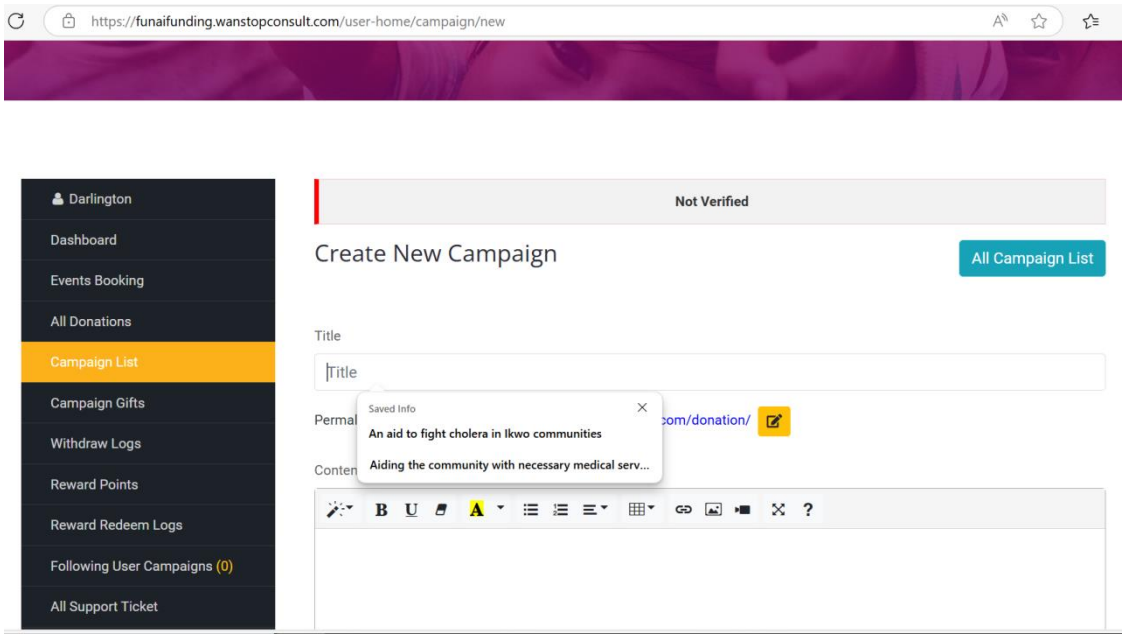

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Figure 9: Campaign menu

iii. Login/Signup (user authentication (*Figs. 10 a &10 b*))

Figure 10 a: Login Page

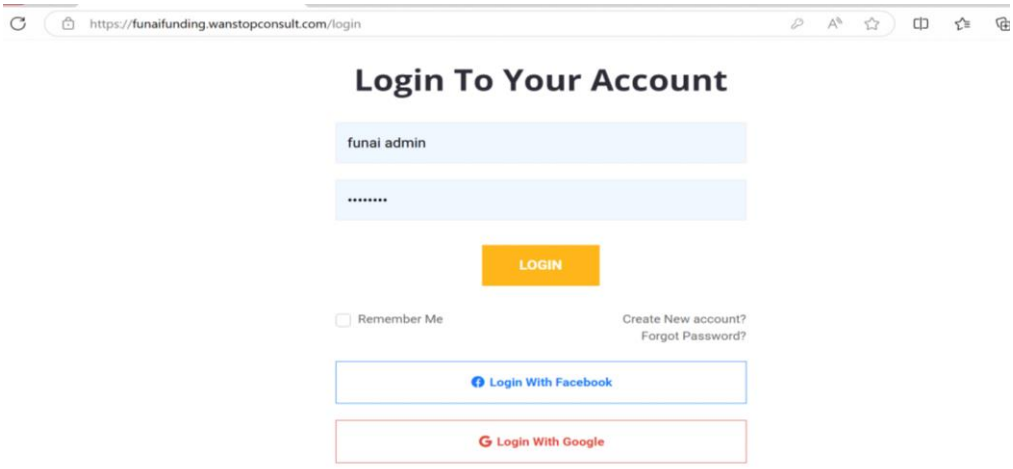

Figure 10 b: Login Page

iv. My Account (personalized dashboard for managing user profiles (*Fig. 11*))

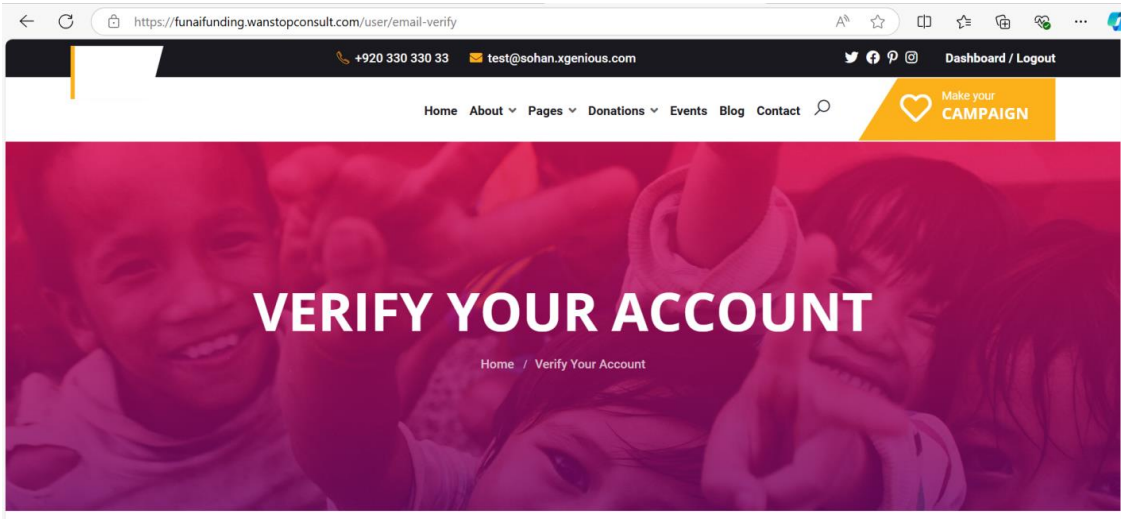

Figure 11: User Dashboard for New Account

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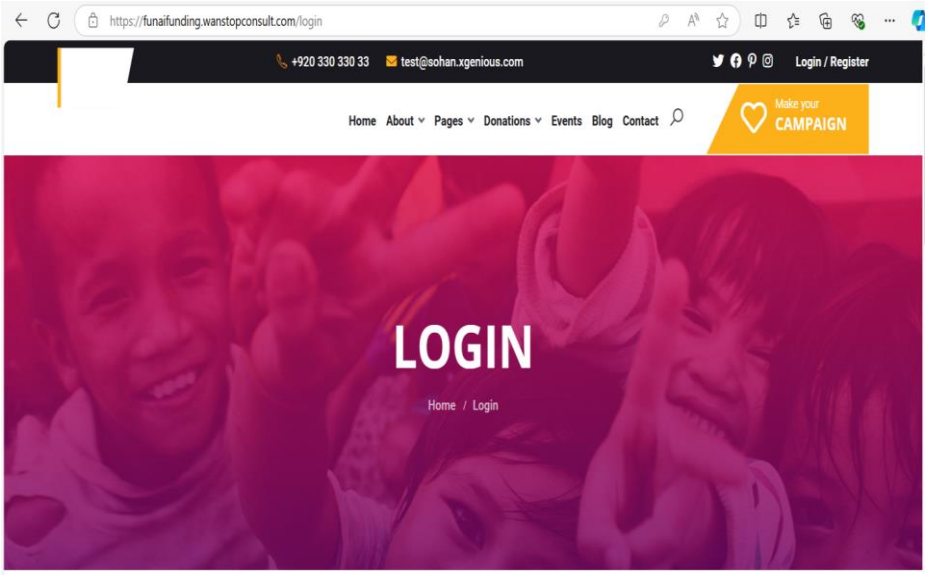

Results

System testing is crucial to ensuring that the platform works as intended and meets all functional requirements. This section outlines the test plan, test data, and results obtained during system testing. The testing process followed these steps:

i. Unit Testing: Each module (e.g., Campaign Management, User Authentication) was tested independently to ensure they perform correctly in isolation.
ii. Integration Testing: The interactions between different modules were tested, particularly focusing on payment processing and campaign updates.
iii. System Testing: The platform as a whole was tested in a controlled environment to ensure all components work together seamlessly.
iv. User Acceptance Testing (UAT): Selected users tested the platform's usability, including campaign creation and donation processes.

The following test data were used:

i. Sample Campaigns: Test campaigns with varying goals and durations were created to evaluate campaign management functionality.
ii. Sample Users: Different user roles (admin, volunteer, donor) were created to ensure that role-based features work correctly.
iii. Sample Transactions: Test donations were made using PayPal and Stripe in sandbox environments to verify payment processing.
iv. Campaign Management: All expected functions (create, update, delete) worked as intended, with real-time updates reflected in the UI. No discrepancies were found.
v. Payment Processing: PayPal and Stripe integration worked seamlessly, with transactions being processed in real time. Expected and actual results were consistent.
vi. User Authentication: Secure login and registration worked as expected. Password hashing and token generation passed all security checks.

The system was tested for performance evaluation under various conditions:

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i. Load Testing: The platform handled up to 100 concurrent users without significant performance degradation.
ii. Response Time: The average response time for creating a campaign was 1.2 seconds, within the acceptable threshold for a dynamic platform.

Despite the successful implementation, the following limitations were identified:
i. Payment Options: Although PayPal and Stripe work effectively, additional local payment gateways may be required to serve a broader audience.
ii. Scalability: While the system performed well during testing, scalability beyond 1,000 concurrent users has not been extensively tested.

Discussion

The testing results indicate that the AE-FUNAI crowdfunding platform meets the specified functional requirements as can be seen in Figures 8 - 11, including secure user management, flexible campaign creation, and real-time donation tracking. While limitations exist in terms of scalability and local payment integrations, the system is robust and ready for deployment in a university context. The platform includes several security measures:
i. CSRF Protection: Ensures that forms are protected from cross-site request forgery (CSRF) attacks.
ii. Password Encryption: All user passwords are stored securely using Bcrypt hashing.
iii. SSL Encryption: All communications between users and the platform are encrypted using SSL, ensuring secure data transmission.

System integration involved linking the backend modules with frontend interfaces, ensuring smooth interaction between the MySQL database, Laravel Controllers, and Blade Views. The integration of third-party payment gateways was also crucial, using APIs for secure and efficient payment processing. The results from testing indicated that the system performs as expected, with efficient campaign management, seamless payment integration, and secure user authentication. While limitations were identified in scalability and local payment gateway support, the system was deemed suitable for its intended environment. The successful implementation of the AE-FUNAI crowdfunding platform demonstrates that a focused, community-driven solution can address the gaps present in existing crowdfunding platforms, particularly in educational and volunteer-driven contexts.

Conclusion

The development of the AE-FUNAI crowdfunding platform has made a meaningful contribution to the field of crowd-funding, particularly in academic and community-based environments. This research set out to create a tailored solution for student-led initiatives at AE-FUNAI, addressing the gaps present in existing crowdfunding platforms. One of the platform's most significant achievements is its community-driven framework, which allows for the active involvement of volunteers and administrators in managing campaigns. This feature addresses a notable deficiency in popular crowdfunding platforms that focus primarily on individual fundraising, often overlooking the importance of community and collaboration. By enabling administrators to manage volunteers and campaigns directly, the platform fosters greater engagement and accountability in fundraising efforts. The platform's customizable features make it particularly suited for educational institutions. Unlike conventional crowdfunding platforms, the AE-FUNAI crowdfunding platform was designed to meet the specific needs of universities, offering tools that allow users to customize campaigns, manage funds, and interact with a wide range of stakeholders. This flexibility supports not only student-led initiatives but also broader community-driven causes, ensuring that a variety of projects can thrive on the platform.

A key technical accomplishment of this project is the integration of secure payment processing and user authentication through Laravel's MVC framework. The system successfully combines modern web technologies with secure, efficient, and user-friendly design principles, ensuring that users can safely contribute to campaigns without compromising their personal data. Features such as Bcrypt password hashing and GDPR compliance demonstrate the platform's commitment to security and privacy. Moreover, this platform serves as a powerful tool for educational empowerment. By providing students with an accessible and secure means of raising funds, it encourages innovation and collaboration on projects that might otherwise lack financial support. This empowers students to turn ideas into reality, fostering creativity and a sense of community within the academic environment. Finally, the platform sets the stage for future research into the role of crowdfunding within educational institutions. As one of the first crowdfunding platforms specifically tailored for a university setting,

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it opens new avenues for exploring how technology can support student-led projects, community engagement, and volunteer-driven initiatives. This project establishes a model that can be expanded upon by other researchers, contributing to the ongoing development of crowdfunding in academic contexts.

Recommendations

The development of the AE-FUNAI crowdfunding platform has laid the foundation for a functional and effective fundraising tool. However, to improve the platform's utility and reach, the following recommendations are proposed:

i. As the platform grows, performance optimization measures, such as load balancing and caching mechanisms, should be implemented to ensure it can handle a larger number of concurrent users.
ii. While the integration with PayPal and Stripe provides global payment options, the inclusion of local payment processors, such as Flutterwave or Paystack, would make the platform more accessible to local users which would facilitate easier donations in local currencies, enhancing user experience for domestic campaigns.
iii. Given the increasing use of mobile devices, developing a mobile-friendly version of the platform or a dedicated mobile app would greatly enhance accessibility and user engagement.
iv. Incorporating advanced analytics features into the platform would provide administrators and campaign managers with detailed insights into campaign performance. Metrics such as donation trends, user engagement, and campaign reach could help optimize future campaigns.
v. The platform should explore partnerships with AE-FUNAI alumni and corporate sponsors to increase visibility and attract more donations. Incentives such as recognition and tax benefits for corporate donors could be incorporated into the system.

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