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RESEARCH ON WEBSITE DESIGN SYSTEM OF TAN TRAO UNIVERSITY AND SPECIALIZED FACULTIES

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Abstract:

In the digital age, websites play a crucial role in education, serving as tools for information delivery, user interaction, and organizational branding. The current website of Tan Trao University exhibits several limitations in terms of interface, functionality, and scalability, particularly on mobile devices, which negatively impacts user experience. This study focuses on designing and developing a new website system for Tan Trao University and its academic departments to address these shortcomings.

The research analyzes the current state of the existing website, draws insights from similar educational website models, and applies modern web development methodologies to enhance user experience (UX) and user interface (UI). The result is a comprehensive website solution that improves communication efficiency and content management while contributing to the professional and reputable image of the university

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NGHIÊN CỨU THIẾT KẾ HỆ THỐNG WEBSITE TRƯỜNG ĐẠI HỌC TÂN TRÀO VÀ CÁC KHOA CHUYÊN MÔN

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Thông tin bài viết

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Từ khóa:

Directus CMS, MySQL, Next.js Tailwind CSS, UI/UX, Web design

Tóm tắt

Trong thời đại số hóa, website đóng vai trò quan trọng trong lĩnh vực giáo dục, là công cụ cung cấp thông tin, tương tác với người dùng và khẳng định thương hiệu của tổ chức. Website hiện tại của Trường Đại học Tân Trào còn nhiều hạn chế về giao diện, tính năng và khả năng mở rộng, đặc biệt là trên thiết bị di động, gây ảnh hưởng đến trải nghiệm người dùng. Nghiên cứu này tập trung vào việc thiết kế và phát triển hệ thống website mới cho Trường Đại học Tân Trào và các khoa chuyên môn nhằm khắc phục những hạn chế này.

Nghiên cứu này phân tích hiện trạng website hiện có, tham khảo các mô hình website giáo dục tương tự và áp dụng các phương pháp phát triển web hiện đại để cải thiện trải nghiệm người dùng (UX) và giao diện người dùng (UI). Kết quả mang lại một giải pháp website hoàn chỉnh, giúp nâng cao hiệu quả truyền thông và quản lý nội dung, góp phần xây dựng hình ảnh chuyên nghiệp và uy tín cho nhà trường

1. Introduction

In the era of Industry 4.0, the Internet and information technology have become inseparable factors in all fields, especially education. Websites are not only a tool for providing information but also an important bridge to help universities communicate and interact effectively with students, lecturers, parents and partners. A modern, professional website helps the school affirm its brand, improve communication efficiency and meet the need for information search quickly and conveniently.

Tan Trao University, with its mission of training high-quality human resources and meeting social needs, is facing many difficulties in transmitting information and promoting its image. The school's current website still has many limitations in terms of interface, features and scalability, failing to

meet user needs. In particular, the interface lacks modernity and is not friendly to mobile devices, reducing the user experience.

In the context of increasing competition between universities, building a new, modern and user-friendly website system is an urgent requirement. A well-designed website not only helps to convey information quickly, but also improves interaction and strengthens the connection between the school and students, parents and partners.

Therefore, the article "**Research on website design system of Tan Trao University and specialized faculties**" was selected to overcome current limitations, while taking advantage of opportunities that digital technology brings to improve the efficiency of school operations. This article not only solves technical problems but also aims to build a professional and prestigious image, contributing to enhancing access to information and promoting the brand of Tan Trao University.

2. Current status of the system

Currently, Tan Trao University has an official website to serve the communication and information transmission for students, lecturers and partners. However, although this website exists and has some basic features, its interface and user experience do not meet the requirements of aesthetics, friendliness and efficiency in information transmission.

Figure 1: Banner

The website's home page is not impressive and lacks clear guidance to users about important goals or information. Content that should be highlighted such as admission information, important events or study programs are not highlighted, easily leading to users not paying attention to them. Figure 1 the homepage banner intermittently fails to display.

Figure 2: Navigation menu bar

Furthermore, the website is not optimized for mobile devices. This is an extremely important factor in today's era when the majority of users access the Internet via mobile phones or tablets. Figure 2 shows that the navigation menu lacks responsive functionality, making for a poor user experience when used on devices other than desktops.

Moreover, the lack of dedicated pages for faculties may hinder effective communication between the university and students or external parties, reducing engagement and limiting opportunities to showcase the unique strengths and achievements of each faculty.

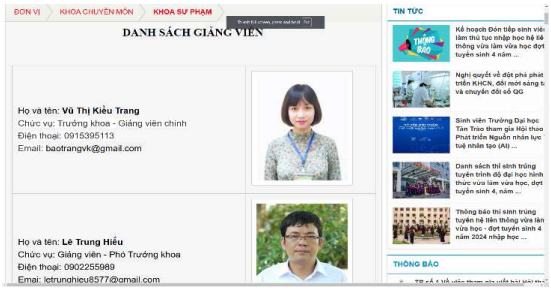

Figure 3: The page of Khoa Su Pham

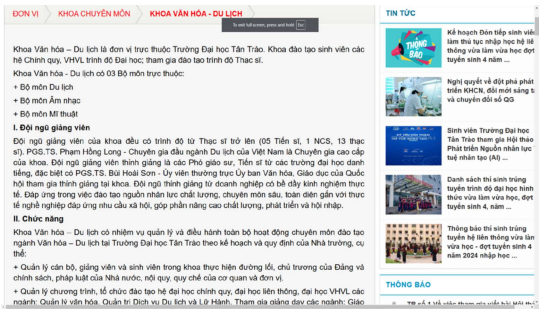

Figure 4: The page of Khoa Van Hoa - Du Lich

Figure 3 and Figure 4 illustrates that the Tan Trao University website currently does not have a separate page for each faculty, only a general introduction page about the mission and organizational structure. This can make it difficult for users to find out more detailed information such

as training programs, scientific research activities or special events of each faculty.

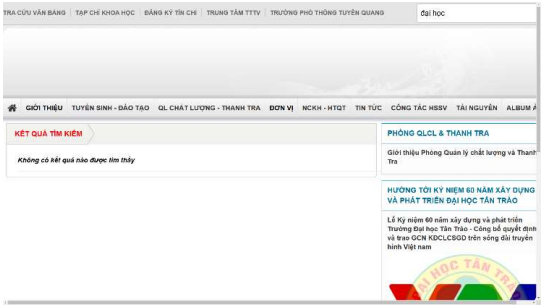

Figure 5: Search function

Figure 6: Breadcrumbs

Figure 5 shows that the current website's search function does not support Vietnamese with accents.

Figure 6 shows that breadcrumbs on some pages of the Tan Trao University website do not function properly.

3. Refer to similar models

When building a website for Tan Trao University, looking at website models from other universities will provide valuable lessons. Although each school has its own requirements and goals, these university websites share the common goal of providing information easily and quickly to students, lecturers, parents and partners.

Some modern university websites use a simple yet effective interface to attract users, thanks to

the clear arrangement of important information such as admissions, event announcements, training programs and information about faculties and departments. These websites often have a prominent search bar, allowing users to easily find the desired information without wasting much time. This is especially important for university websites, where the amount of information that needs to be updated and transmitted is very large. Improving the search bar, making it fast and accurate, is necessary to serve the increasing needs of users.

However, some current university websites still have some weaknesses, such as the interface is not lively and modern, reducing the user experience. Some websites have a dense layout design, making it difficult for users to look up information. In addition, many websites are not optimized for mobile devices, leading to poor access via smartphones or tablets, hindering users when they need to look up information quickly while on the go.

From the above advantages and disadvantages, it is possible to learn and improve in my project. In particular, it is necessary to pay attention to designing the interface to be intuitive, easy to use, and optimize the user experience on both computers and mobile devices. The interface of the website needs to reflect the university's brand but no less modern and attractive, with a reasonable arrangement between important content sections and other information sections such as the library, training programs, scholarship announcements, and academic events.

In addition, regular updates of news about events and programs are very important, because the university website is the main channel for communicating announcements, class schedules, seminars, events, and scholarship programs. Therefore, in this project, it is necessary to build an easy-to-use content management system that allows admin to update information quickly, accurately, and efficiently.

Search capabilities should also be considered, helping students and users quickly find the information they are interested in. A robust API system combined with an optimized database can help quickly handle these requests.

In general, current university websites have many positive features that need to be adopted, but there are also existing problems that need to be

improved. Focusing on modern interface design, optimizing user experience on all platforms and ensuring flexible news updates will help Tan Trao University's website become a useful and effective place to connect with the community of students, lecturers and partners. In addition, the combination of new technologies such as Server-Side Rendering (SSR), Static Site Generation (SSG) and building a powerful API system will contribute to creating a website that is not only beautiful but also extremely effective and easy to maintain.

4. Apply to project

Framework: Next.js (The React Framework for the Web, n.d.)

Supports Server-Side Rendering (SSR).

Increase page loading speed, make website friendly.

Static Site Generation (SSG).

Generate static content dynamically, reducing server load.

Incremental Static Regeneration (ISR).

Combines the benefits of SSR and SSG, allowing dynamic content updates on static pages.

Integrate API Routes.

Provides the ability to build simple BackEnd right in Next.js project.

Supports CSS/SCSS and CSS-in-JS libraries.

Easily customize the look and feel with tools like Tailwind CSS or Styled-Components.

Programming language: TypeScript (Microsoft, n.d.)

Early error detection.

Reduce runtime errors by detecting errors during programming.

Enhanced source code maintenance.

Readable, extensible source code, suitable for long-term projects.

Strong community support.

TypeScript integrates well with frameworks like React, Next.js, and modern libraries.

Tailwind CSS (Labs, n.d.)

Fast growth rate.

Get a great look without writing custom CSS.

Flexible customization.

Easily change theme, color, and size as required.

Support Responsive Design.

Integrate classes to support display on multiple devices.

Database: MySQL (Corporation, n.d.)

Easy integration with BackEnd via API.

Support to manage information, events, faculties, users, training programs effectively.

5. System analysis and design

5.1. System requirements analysis

System functional requirements:

Login: Allows the admin to log in to the system.

Logout: Allows the admin to log out of the system.

Account Management: Allows admin to view account information, update personal information.

Manage posts: Allows admin to manage posts.

Information management: Allows admin to manage information including: Organizational structure, General introduction, etc.

Authorization: Allows admin to authorize each account type.

System Account Management: Allows admin to view the list of system accounts and perform search, add, update information, lock and activate Admin accounts.

BackUp: Allows admin to Export and Import data.

API: Create APIs for data stored in the system, allowing external applications to easily retrieve and interact with the data.

Multimedia Management: Provides the ability to manage multimedia files such as images, videos, etc.

Customize Interface: Customize the admin interface.

Workflow Management: Supports the management of workflows in content review and approval, helping admin and departments within the organization work more efficiently.

Non-functional requirements of the system

Beautiful, simple, user-friendly interface.

The size of the database must be large enough.

The website interface is simple and easy to use.

Fast page response speed.

The system is highly reliable.

Runs well on browsers: Chrome, Firefox, etc.

Protect user information and internal data.

5.2. System design

4-storey structure:

Client Layer: Is an intuitive interface for users to interact with the system through a web browser or mobile device.

FrontEnd Layer: FrontEnd is built using Next.js App Router to manage routing and render flexible interface.

BackEnd Layer: Implemented with Directus (Directus, n.d.), a headless CMS, that simplifies data management.

Database Layer: Use MySQL to store and manage relational data. Data is organized in the form of tables with clear relationships, ensuring data integrity.

Request Flow:

The user sends a request from the browser to the system.

Next.js Middleware checks credentials and access rights.

The request is forwarded to API Routes, which handles the basic logic before calling the endpoints.

Directus performs tasks like fetching data from MySQL database, processing business logic and returning results to FrontEnd.

FrontEnd renders content based on the received results and returns the interface to the user.

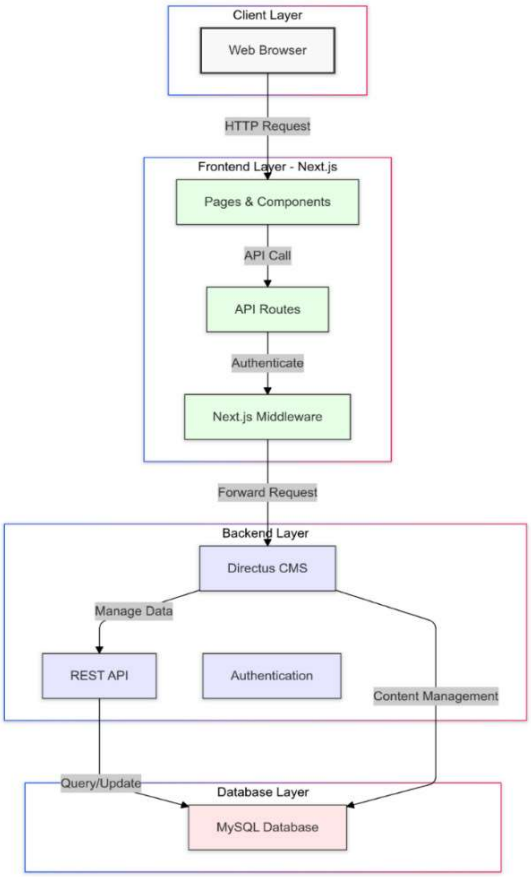

Figure 7: System Architecture Flow

Content Management Flow:

Admin access the Directus management interface to perform operations such as adding, editing, deleting posts or updating information.

Changes are logged directly to MySQL and trigger cache invalidation mechanisms on the FrontEnd to ensure the displayed data is always up to date.

Advantages of architecture

Scalability:

Each floor can be expanded or replaced without affecting the entire system.

Can integrate new services or support more different types of devices.

High performance:

Use caching strategies at both FrontEnd and BackEnd to reduce load on the database.

Integrate static generation for pages that change little, helping to increase loading speed.

Security:

JWT ensures secure user authentication.

BackEnd layer and database are protected behind firewalls and strict access control mechanisms.

Easy to maintain:

Clear separation between layers makes debugging and upgrading easy.

Directus supports intuitive management, minimizing manual work.

Challenge:

Ensures performance with large amounts of data.

Synchronize data between FrontEnd and BackEnd.

Handle real-time or near real-time requests.

Solution:

Integrate caching and use CDN to optimize content loading.

Apply lazy loading and infinite scrolling techniques to reduce load.

Use WebSockets or similar solutions to support real-time data updates.

Database Design

Content management (Figure 8):

User management: authorization, authentication, group management.

Content management: articles/news, static pages, training programs, announcements, events, research and projects.

Media management: images, videos, documents.

API Management: REST and GraphQL API.

BackEnd:

Provides an admin interface for data entry and content management. Provides an API for the FrontEnd to retrieve and display data.

User management and authorization.

Media resource management.

User interface (Figure 9):

Home

Introduce.

Training: news, activities, timetables, exam schedules, course outlines.

Research: research topics, scientific publications, projects, international cooperation.

Admissions: admission information, application, tuition & scholarships.

News & Events.

Students: student portal, student activities, clubs, alumni.

Contact.

FrontEnd:

Get data from Directus API.

Display content according to the designed interface.

Handle user interactions.

Optimize SEO and user experience.

5.3. Software Development

BackEnd Deployment

Install the necessary tools like nvm, npm and yarn to manage packages and dependencies.

Directus CMS: I use Directus CMS, a headless content management tool.

API and Authentication: Configure RESTful API endpoints (Adeel Ehsan,Mohammed Ahmad

M. E. Abuhaliqa,Cagatay Catal and Deepti Mishra, 26 April 2022) and authentication systems to protect critical parts of your website like admin and user permissions.

The tools are all installed and configured by docker (Bui, Tue, 13 Jan 2015) on a Debian GNU/Linux 12 server.

FrontEnd Deployment

Building project structure

Create pages and components

Using Next.js App Router

Design interface with Tailwind CSS and ShadcnUI library

Entity Relationship Diagram

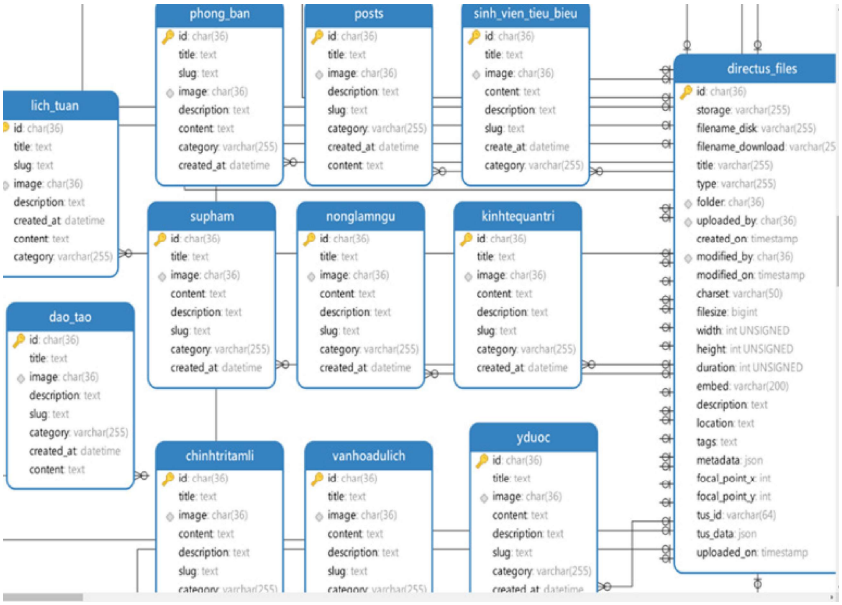

Figure 8: Illustration of the Directus system table

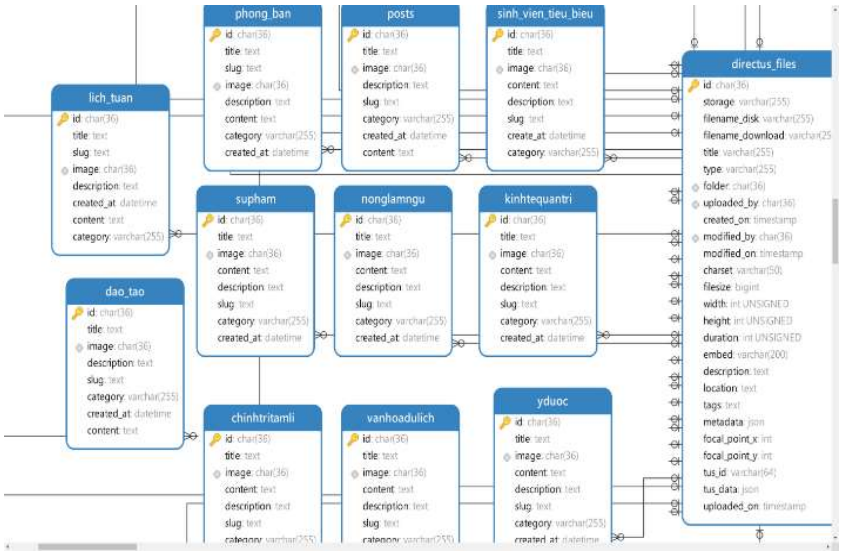

Figure 9: Illustration of a database diagram focused on content management with specialized tables.

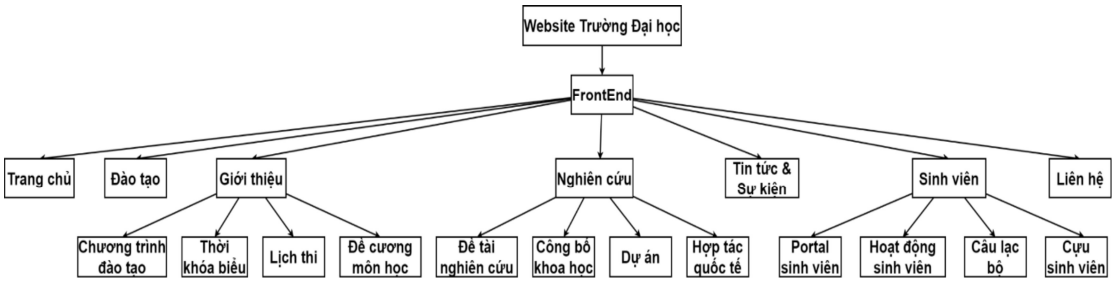

Figure 10: Content management system

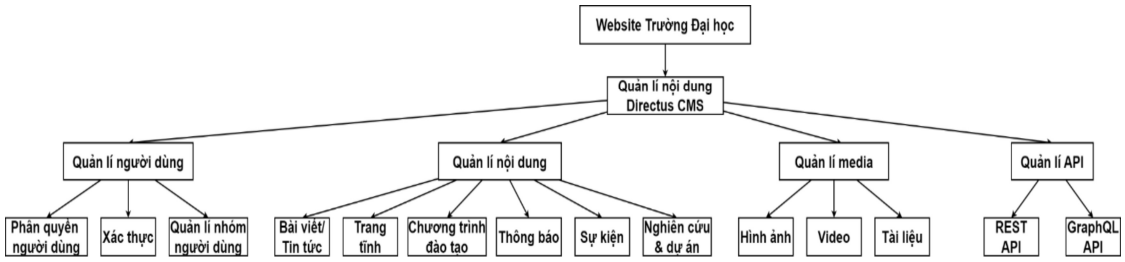

Figure 11: User interface

Automated deployment with GitHub Actions Vercel

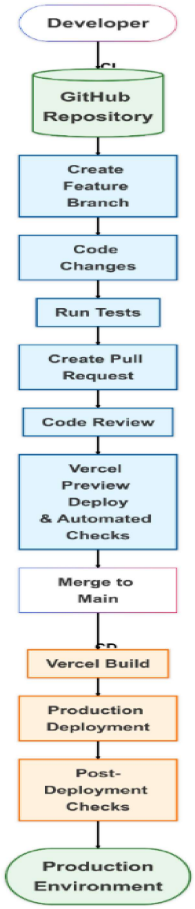

Figure 12: Github Vercel CI/CD Pipeline.

Benefit:

Automation: No manual deployment required, saving time and ensuring consistency.

Easy integration: Works seamlessly with GitHub repositories and Vercel.

Fast Response: Every time a code update is pushed, the system automatically builds and deploys the new version.

Environment management: GitHub Actions supports secrets management, helping to secure API tokens when communicating with Vercel.

Figure 12 This pipeline demonstrates the integration between GitHub and Vercel for continuous integration and deployment (CI/CD). Changes pushed to the GitHub repository are automatically built and deployed to the Vercel platform, ensuring efficient and seamless updates to the application:

Step 1: Developer creates feature branch from main branch

Step 2: Push code and create Pull Request

Step 3: Vercel automatically creates a preview deployment

Step 4: After reviewing and merging into main

Step 5: Vercel automatically builds

Step 6: Deploy to production

Step 7: Test post-deployment

5.4 System testing

Unit Testing (Ermira Daka; Gordon Fraser, 15 December 2014): Testing individual components and modules to ensure that parts of the system function correctly independently.

Integration Testing (H.K.N. Leung, L. White, 06 August 2002)**:** Test the interaction between system components, ensuring that the API, FrontEnd and BackEnd work smoothly when connected together.

System Testing (Briand, L., Labiche, Y. A, 2002): Testing the entire system to ensure all functions are working correctly, including performance and security testing.

Functional Testing (Moxley, RT, 01 Jan 1990): Make sure features like login, document download, search are working properly.

Performance Testing (E.J. Weyuker; F.I. Vokolos): Measures the system's load-bearing capacity when multiple users access it at the same time.

Security Testing (B. Potter; G. McGraw, 08 October 2004): Check for system security vulnerabilities, such as SQL Injection, XSS.

User Interface Testing (Yanfi Yanfia, Pualam Dipa Nusantaraa, 2023): Ensure that the user interface meets all aesthetic and usability requirements.

5.5 Deployment and maintenance

Prepare deployment environment:

Make sure the server environment meets the hardware and software requirements: Docker configuration, MySQL configuration, Node.js installation for Next.js).

Install the system into the server

Directus and MySQL Deployment

Put Docker containers for Directus CMS and MySQL on the server. Use Docker Compose to manage and deploy the entire system.

Deploy Next.js application:

Deploy Next.js application using Vercel and Docker tools to deploy to server. Ensure the application can run stably in production environment.

Configure domain name and SSL certificate.

Set up a domain name for the system and configure HTTPS with SSL certificate to protect user data.

Figure 13 page helps developers track and manage deployment environments, monitor the success or failure of each deployment, and review detailed deployment history, which is useful for debugging and maintaining a continuous integration pipeline.

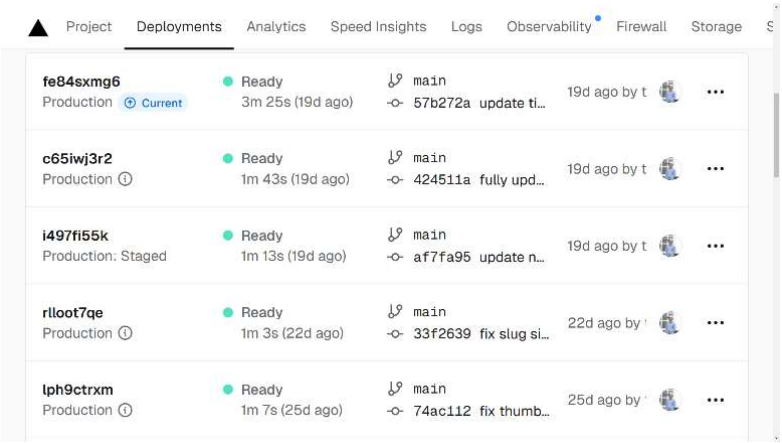

Figure 13: Vercel branch management system

6. Results

After the implementation and testing process, the website system for Tan Trao University has been completed and operates as expected at 2 addresses FrontEnd [1]and BackEnd [2].

User Interface: The website has a simple, easy-to-use interface that adapts well to all types of devices, from desktops to mobile phones. The interface is optimized thanks to Tailwind CSS, making the page load speed fast and smooth. Combined with dark mode to enhance the user experience.

User Experience: The website meets the basic needs of students, parents and teachers with updated information on training programs, school activities, and related activities. The interface is easy to navigate and features for searching and classifying information are integrated.

Performance Evaluation

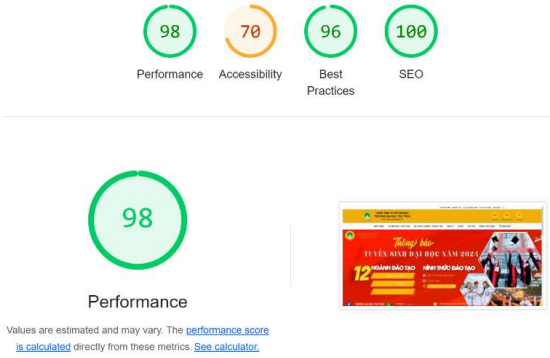

Figure 14: Website score by Google Lighthouse.

Performance: Reflects the speed and smoothness when users access the website. A score of 98/100 shows that the website is well optimized for loading speed, display experience.

Accessibility: Assesses the level of support for users, including people with disabilities (users of assistive devices). A score of 70/100 indicates that there is room for improvement to make the site more user-friendly for all users.

Best Practices: Reflects the level of compliance with modern standards for web security and implementation. A score of 96/100 indicates that the site meets the technical standards requirements.

SEO Optimization: Evaluates search engine optimization capabilities, ensuring the website is easily found by users.

About BackEnd:

Figure 15: System login page

Figure 15 The system is strongly secured with the use of JWT for user authentication and authorization. Ensure that user data is always protected during the use of the website. After the user enters correct information, the system requires a second authentication step via OTP code sent via authentication applications (Google Authenticator, Microsoft Authenticator, Authy, 1Password, ...). This mechanism helps to enhance account security, minimizing the risk of being attacked due to password disclosure.

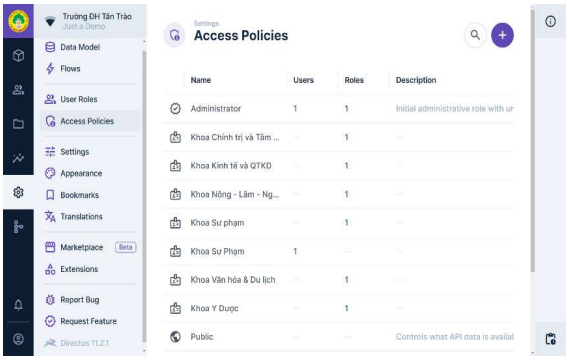

Figure 16: Managing access through roles

1 https://tqu-demo.vercel.app/.*[Accessed 21 12 2024]*

2 https://tqu-demo.directus.app/.*[Accessed 21 12 2024]*

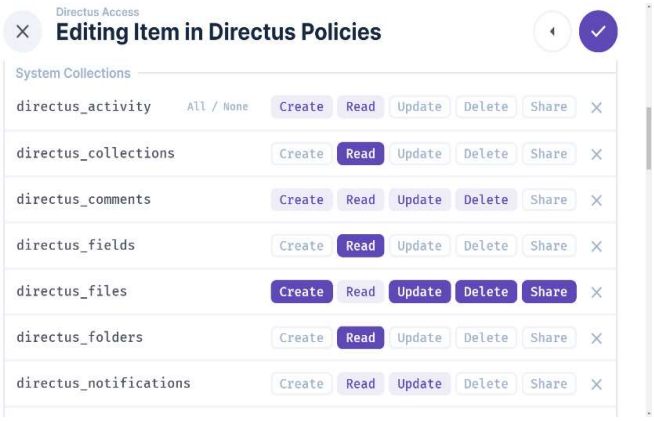

Figure 17: Assign access rights to roles

Figure 16 and Figure 17 Admin can easily manage access role, user authorization and system account management.

Figure 18 Each department is organized and categorized into individual folders, making it easier to manage and access specific information related to each department. This structure helps streamline the process of locating relevant documents, ensuring better organization and efficiency across various departments.

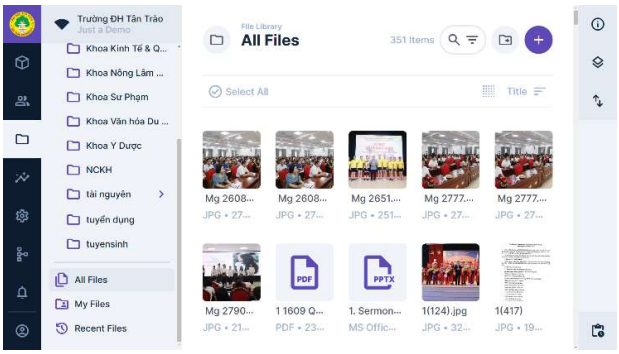

Figure 18: File management system

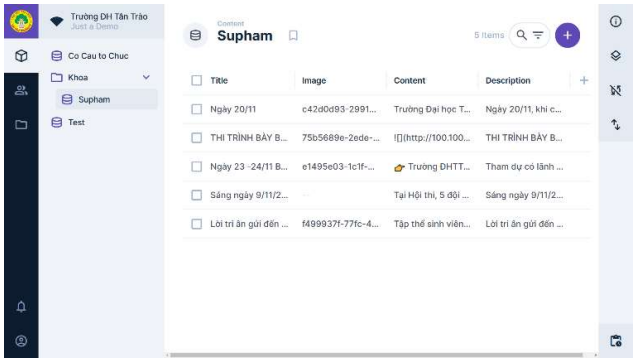

Figure 19: Illustration of department account

Comprehensive website monitoring capabilities support the management and tracking of changes to ensure transparency and effective governance. This is an important part of the design and operation of the school and departmental website system. Figure 19 shows that when logging into the “Khoa Su Pham” account, you can only manage posts of the Khoa Su Pham.

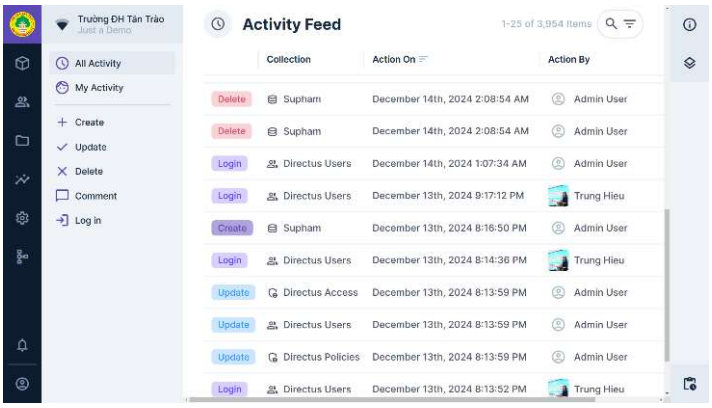

Figure 20: Activity Feed interface

Figure 20 shows the Activity Feed table from the Directus system, recording the activities performed on the database. The activities include “Create”, “Update”, “Delete”, and “Login”, sorted by time. The “Action By” column shows who performed the action.

Figure 21: News approval function.

Figure 21 posts can be easily added, edited, or deleted through the Directus admin interface; however, the user’s permissions can only save posts in draft mode. In this mode, posts can only be viewed and edited by the author and users with corresponding permissions. Posts will only be publicly displayed on the website when an administrator with sufficient authority approves publishing.

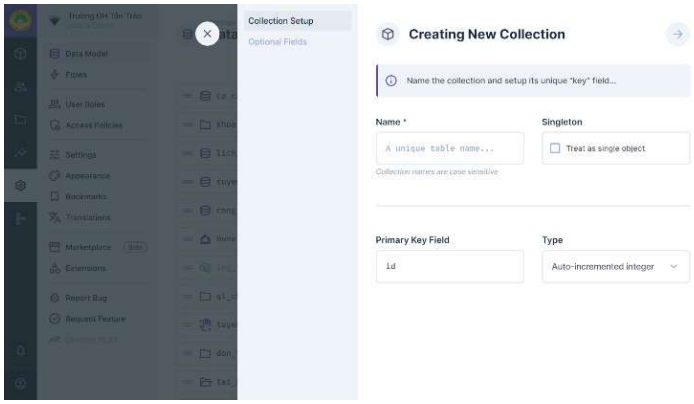

Figure 22: Data model

Figure 22 The layered system architecture makes the system easily extensible in the future. New functions can be added without affecting the existing components of the system.

Some improved functions of the website:

Figure 23: Illustration of the page system of departments

Figure 23 shows the home page of the specialized departments with the department name and clear navigation menu bar. The content is configured specifically for each department.

Figure 24: Illustration of search results for the term "đại học tân trào"

Figure 24 users can search for information quickly and accurately thanks to the article search function. Search results are displayed immediately. While, the current website does not support the Vietnamese language.

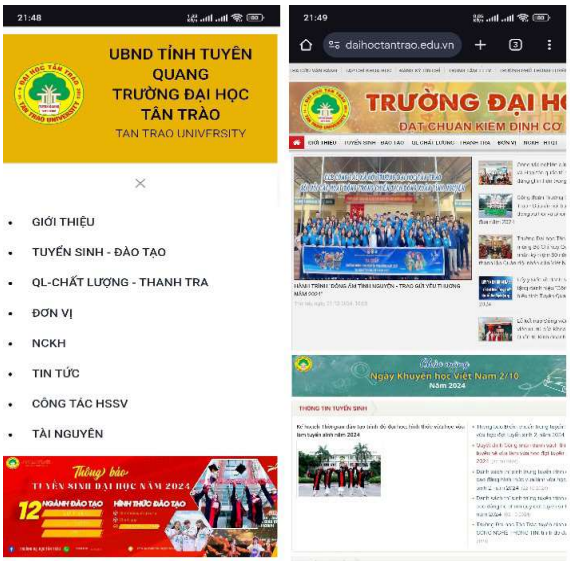

Figure 25: Mobile mode of 2 websites

Figure 25 Left: new responsive website. Right: old non-responsive website.

Figure 26: Dark mode

Figure 26 websites support dark mode to improve user experience and optimize energy efficiency. When used, users will experience less eye strain, especially when surfing the web at night or in low-light environments, thanks to reduced screen glare. Because of these benefits, many websites and applications today integrate dark mode as a standard feature to meet the diverse needs of users.

7. Conclusion

The website development project for Tan Trao University has been completed with features that meet the needs of information transmission and data management. The system uses advanced technologies such as Next.js, TypeScript, Tailwind CSS and Directus CMS, providing scalability and performance optimization.

Although the system has been deployed and is operating well, there are still some potential directions for further development to enhance the value of the website in the future:

Incorporating online learning tools: Incorporating additional features to support remote learning, including course and classroom management, will help the system better meet learning needs in the current digital era.

Artificial Intelligence (AI) Application: Use AI technology to provide personalized experiences for users, support students in looking up information easily through chatbots or virtual assistants, and provide solutions to course-related problems.

Linking with other internal systems: Synchronizing the website with student management, financial, and academic records systems will create a synchronous and comprehensive information ecosystem, enhancing management efficiency.

Mobile App Development: While the current interface is optimized for mobile devices, building a dedicated app for the school will make it easier for students and faculty to access information, while optimizing the experience on mobile devices.

Enhanced Security: Maintaining and improving security capabilities to protect personal information and critical data is essential. Regularly testing and updating systems will ensure compliance with current security standards and effective response to potential threats.

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