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SIGMA-AI: Multimedia Engineering Technology Digital Gallery Platform with Artificial Intelligence

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ABSTRACT
The rapid expansion of digital creativity in higher education has increased the need for structured, secure, and intelligent platforms capable of managing large volumes of multimedia-based student work. SIGMA-AI was developed to address this challenge by integrating artificial intelligence into a digital gallery system specifically designed for the Multimedia Engineering Technology study program. Using the Rapid Application Development (RAD) methodology, the platform was built through iterative cycles of requirement analysis, system design, implementation, and testing. Key features include AI-driven auto-tagging, intelligent work recommendations, role-based validation, and an academic analytics dashboard. White-box testing demonstrates that the system's core processes login, artwork upload, and profile updatesoperate reliably across different scenarios. Comparative analysis shows that SIGMA-AI outperforms mainstream portfolio platforms such as Behance, Dribbble, and cloud repositories by offering structured academic workflows, automated metadata generation, and pedagogical insights unavailable in conventional systems. The findings indicate that SIGMA-AI is not only technically feasible but also strategically valuable for strengthening digital archiving, enhancing learning analytics, and supporting AI literacy in creative education environments.

Keywords: Digital Gallery**,** Rapid Application Development, SIGMA-AI.

ABSTRAK
Perkembangan karya digital di lingkungan pendidikan tinggi mendorong kebutuhan akan platform terstruktur yang mampu mengelola berbagai jenis konten multimedia secara aman, terpusat, dan dapat dianalisis. SIGMA-AI dikembangkan sebagai solusi untuk memenuhi kebutuhan tersebut melalui integrasi kecerdasan buatan ke dalam sistem galeri digital yang dirancang khusus bagi Program Studi Teknologi Rekayasa Multimedia. Penelitian ini menggunakan metode Rapid Application Development (RAD) yang meliputi tahap analisis kebutuhan, perancangan sistem, implementasi, serta pengujian. Fitur utama yang dihasilkan mencakup auto-tagging berbasis AI, rekomendasi karya otomatis, validasi berbasis peran, dan dashboard analitik akademik. Hasil pengujian white-box menunjukkan bahwa proses inti seperti login, unggah karya, dan pembaruan profil berjalan dengan konsisten pada berbagai skenario. Analisis komparatif juga menunjukkan bahwa SIGMA-AI memiliki keunggulan signifikan dibandingkan platform portofolio umum seperti Behance, Dribbble, maupun repositori berbasis cloud, terutama dalam hal alur akademik, otomatisasi metadata, dan dukungan analitik pembelajaran. Temuan ini menegaskan bahwa SIGMA-AI tidak hanya layak secara teknis, tetapi juga berpotensi menjadi sistem strategis dalam pengelolaan arsip digital, peningkatan literasi AI, serta penguatan proses evaluasi kompetensi dalam pendidikan kreatif.

Kata Kunci: Galeri Digital, Pengembangan Aplikasi Cepat, SIGMA-AI.

INTRODUCTION

The development of artificial intelligence technology has had a significant impact on various sectors, including the world of digital art and design, by enabling the automatic creation and manipulation of images through algorithms and machine learning (Liu, 2023). This transformation requires a balance between the automation of creative processes and the personalization of artwork, a challenge that can be overcome through innovative models that integrate generative adversarial networks, computer vision, and personalization technology (Zhao et al., 2023). The use of artificial intelligence in digital content creation has brought about major changes, particularly in the field of marketing, which is capable of generating personalized content based on user data, as well as segmenting customers according to detailed needs and characteristics (Nabila & Widaningsih, 2025). In this context, the use of artificial intelligence is not only limited to automation, but also to the ability to understand and replicate complex data structures to generate new information that is authentic and resembles human work (Luon et al., 2025). This is in line with research showing that the implementation of Generative AI in digital marketing can increase content production time efficiency, publication consistency, and audience engagement (Nabila & Widaningsih, 2025).

The use of artificial intelligence, particularly Generative AI, enables the creation of text, images, and various other forms of media by learning patterns and structures from training data to generate new data with similar characteristics (Sengar et al., 2024). This capability not only speeds up the content production process but also enables deeper personalization, such as in optimizing the production of interactive videos that are relevant to the audience, as well as increasing consumer engagement on

social media (Orak & Turan, 2024). (Haryanto, 2024). AI has the ability to analyze audience preferences based on previous interactions, such as viewing duration, preferred content types, and responses to specific visual elements, enabling the design of more personalized and aesthetically pleasing video narratives (Orak & Turan, 2024). This research is expected to make a significant contribution to advancing the understanding of the practical application of artificial intelligence in the field of digital art and design, while presenting innovative solutions to emerging challenges (Garcia, 2024). The development of this AI-based digital gallery platform has the potential to increase digital literacy and interdisciplinary learning among users, equipping them with important skills in an era dominated by artificial intelligence (Zahirah et al., 2025). In this study, the Multimedia Engineering Technology study program requires a digital gallery platform for the student's Final Project database. This research will utilize AI technology to automatically generate user experiences through recommendations based on preferences and previous interactions.

METHOD

The Rapid Application Development method is a software development approach that emphasizes a rapid development cycle through repeated iterations and continuous user feedback. This approach is designed to accelerate the application development process by reducing the time between conceptualization and implementation, often involving intensive collaboration between developers and end users (Albert & Voutama, 2025). System development in this study will use the Rapid Application Development methodology, which emphasizes a rapid development cycle through repeated iterations and continuous feedback from users. This method was chosen to accommodate the adaptive and flexible needs in developing an AI-based digital gallery platform, ensuring that the system can efficiently integrate innovative features and respond to changing user needs (Rožman et al., 2023). Through this RAD approach, it is hoped that the digital gallery platform can be developed efficiently, adaptively, and capable of delivering an innovative user experience that is responsive to the dynamics of AI technology (Setiawan & Lubis, 2022).

System Requirements Analysis

This system requirements analysis stage involves gathering detailed information about the desired functionality, including AI-based visual search features, gallery content personalization, and user interaction mechanisms, through discussions and interviews with potential users and domain experts (Aziezah et al., 2023). The user requirements analysis stage was conducted through direct observation of TRM program activities and interviews with potential users. This aimed to identify their specific needs related to the digital gallery platform, such as media upload features, content curation, and social interaction. The results of this analysis were then used to formulate functional and non-functional specifications that would form the basis of the system design (Fawwas et al., 2023).

System Design

In the system design stage, the collected requirements analysis will be visualized in the form of Data Flow Diagrams and Entity Relationship Diagrams to model data flow and database structure (Gunawan et al., 2021). In addition, the user interface will also be designed, which involves determining the layout, UI components, and content, as described in a prototype that combines UML diagrams such as sequence diagrams to illustrate the dynamics of UI elements (Djaber & Ismail, 2023). The technology used to design the systems includes shadcdn for the frontend, laravel 12 for the backend, postgresql for the database, supabase for the storage.

Key Features of the Platform

1. Authentication and Authorization: Student/faculty login & registration; and Role-based access control
2. Student Work Management: Upload files (images, videos, animations, designs, etc.); Description & tagging of work; and Preview work
3. Digital Gallery: Works displayed publicly; and Filter and search by category, student name, or tag.
4. AI Features (Artificial Intelligence): *Auto Tagging*: the system automatically detects the type of work (such as websites, mobile applications, AR VR, etc.); and *Work Recommendations*: displays related works based on content/tag similarities.
5. Instructor/Administrator Dashboard: Validate works before they appear in the public gallery; and Work statistics per student/cohort; and Manage categories and users.

System Implementation

This module will integrate AI algorithms for features such as object recognition, personalized content recommendations, and automatic image quality enhancement, using deep learning models trained on relevant image datasets (Wang et al., 2025). This digital gallery platform is still under development and will be used in the even semester next year.

System Testing

This testing is important to ensure that the digital gallery platform can handle surges in users or data without experiencing a significant decline in performance (Nabila & Widaningsih, 2025). User acceptance evaluation will involve collecting feedback from end users through surveys and interviews to assess their satisfaction with the interface, functionality, and AI features implemented. The results of this evaluation will form the basis for further iteration and refinement, ensuring that the platform not only functions technically but also optimally meets user

expectations and needs (Albert & Voutama, 2025). In this study, the author used system testing with whitebox testing.

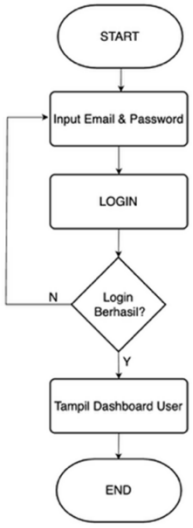

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Figure 1
Login Flowchart Diagram

Figure 1 illustrates the logical sequence of the user authentication process in the SIGMA-AI system. The diagram shows the stages starting from credential input, system verification, decision points for valid or invalid data, and the transition to the user dashboard upon successful authentication. This flow ensures controlled access and system security.

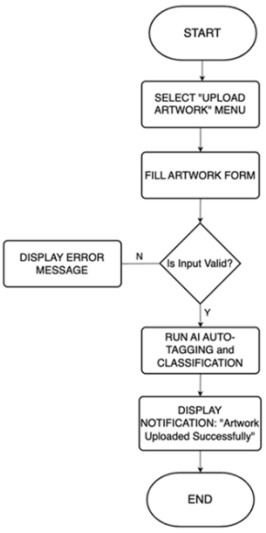

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Figure 2
Artwork Upload Flowchart Diagram

Figure 2 describes the procedural flow of uploading student artwork into the digital gallery. It outlines menu selection, form completion, input validation, execution of AI-based auto-tagging, and successful data storage. The diagram emphasizes the integration of artificial intelligence within the submission workflow.

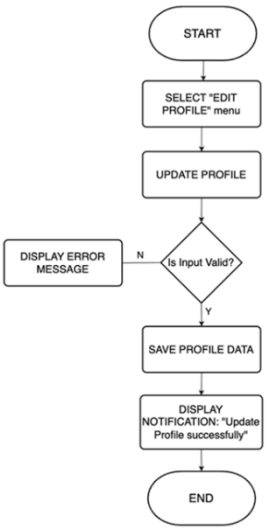

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Figure 3
Profile Update Flowchart Diagram

Figure 3 presents the process of updating user profile information. The flow highlights validation mechanisms that handle both correct and incorrect inputs, ensuring data accuracy before changes are saved to the system database.

RESULT

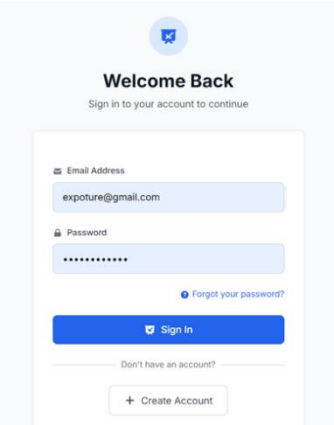

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Figure 4
Login Menu Display

Figure 4 shows the visual interface of the login page. This display represents the initial interaction point between users and the system, designed to provide a simple and intuitive authentication experience.

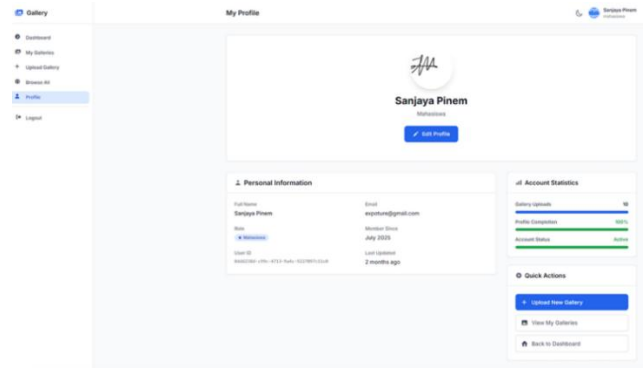

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Figure 5
Student Main Page Display

Figure 5 depicts the main dashboard interface accessed after successful login. The page functions as a central navigation hub, allowing students to manage profiles, upload artwork, and access gallery features efficiently.

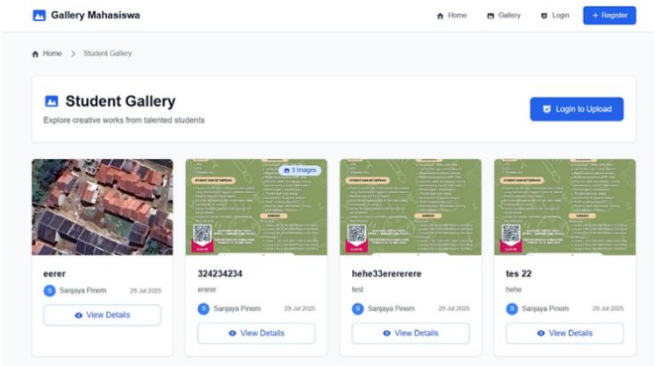

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Figure 6
Student Gallery Page Display

Figure 6 illustrates the gallery interface where student works are displayed. The layout supports browsing, filtering, and visual exploration of multimedia content, reinforcing the platform's role as an academic digital archive.

White Box Testing

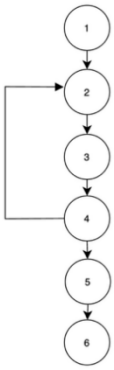

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Figure 7
Login Flowgraph

Figure 7 represents the control flow graph of the login module used in white-box testing. It visualizes nodes and paths that describe system execution logic, forming the basis for identifying independent execution paths.

Table 1
Testing Login Flowgraph

Path	**1**
Track	1-2-3-4-5-6
Scenario	1. Start 2. Enter email & password 3. Login 4. Login successful 5. User dashboard 6. end
Result	success
Path	2
Track	1-2-3-4-2-3-4-5-6
Scenario	1. Start 2. Enter email & password 3. Login 4. Login failed 5. Enter email & password 6. Login successful 7. User dashboard 8. End

source: processed data

Table 1 summarizes the results of white-box testing for the login process. Each path describes a different execution scenario, including successful and failed login attempts, demonstrating that the authentication logic functions correctly across alternative control paths.

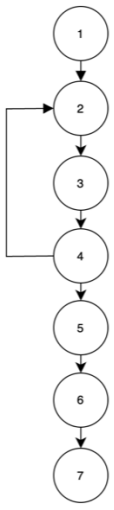

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Figure 8
Flowchart Artwork Upload

Figure 8 shows the control flow used for white-box testing of the artwork upload module. The diagram focuses on decision points related to input validation and AI auto-tagging execution.

Table 2
Testing Artwork Upload

Path	**1**
Track	1-2-3-4-5-6-7
Scenario	1. start 2. select upload artwork menu 3. fill out artwork form 4. valid input 5. Run AI auto-tagging 6. artwork uploaded successfully 7. end
Result	Success
Path	2
Track	1-2-3-4-2-3-4-5-6
Scenario	1. start 2. select the upload artwork menu 3. fill out artwork form 4. Input failed 5. Upload artwork menu 6. Fill in the artwork form 7. Input valid 8. Run AI autotagging 9. artwork uploaded successfully 10. end

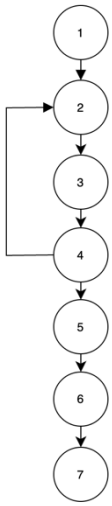
source: processed data

Table 3
Testing Login Profile Update

Path	**1**
Track	1-2-3-4-5-6-7
Scenario	1. start 2. select edit profile 3. update profile 4. input valid 5. save profile data 6. Profile updated successfully 7. end
Result	Success
Path	2
Track	1-2-3-4-2-3-4-5-6
Scenario	1. start 2. select edit profile 3. update profile 4. Invalid input 5. select edit profile 6. Update profile 7. Valid input 8. save profile data 9. Profile updated successfully 10. End

source: processed data

Table 2 presents the testing outcomes for the artwork upload process. The table confirms that the system consistently handles both invalid and valid inputs, successfully completing uploads after corrective actions when errors occur.



source: processed data

Figure 9
Flowgraph Profile Update

Figure 9 illustrates the flowgraph for the profile update feature. It maps the execution paths required to validate user input and store updated data, serving as a reference for structural testing.

Table 3 reports the white-box testing results of the profile update process. The scenarios show that the system reliably manages repeated input attempts until valid data is provided, ensuring robustness and data integrity.

SIGMA-AI demonstrates several competitive advantages compared with widely used creative portfolio platforms such as Behance, Dribbble, and cloud-based repositories like Google Drive (Gunawan & Indrawan, 2021). While mainstream platforms primarily function as public showcases for creative work, SIGMA-AI is purpose-built as an academic digital gallery designed to consolidate, preserve, and analyze student final projects (Fytrou, 2025). This gives it a structural advantage because academic repositories require long-term data integrity, standardized metadata, and curated validation procedures that generic platforms do not offer. The integration of artificial intelligence further strengthens its capabilities through automatic tagging and content recognition, enabling consistent classification of multimedia outputs without relying on manual input. Previous studies show that AI-generated metadata significantly improves retrieval accuracy and reduces curatorial workload in multimedia archives, making SIGMA-AI more efficient for institutions that produce large volumes of animation, video, AR/VR content, and graphic design projects (Sengar et al., 2025).

Another advantage of SIGMA-AI lies in its intelligent recommendation engine, which identifies similarities between works to support learning analytics and personalized exploration. Unlike public portfolio platforms that only display creative outputs, SIGMA-AI provides pedagogical value by helping lecturers track

thematic patterns, assess skill progression, and map student competencies across cohorts. Research shows that AI-based recommendation systems enhance engagement and learning outcomes in digital learning environments, reinforcing the relevance of SIGMA-AI's approach in academic settings (Wang et al., 2025). Furthermore, SIGMA-AI incorporates a role-based validation workflow in which lecturers and administrators review submissions before they become publicly accessible. This mechanism ensures academic quality assurance and alignment with curriculum outcomes, addressing a critical gap found in platforms like Behance, Dribbble, or Google Drive that lack built-in academic oversight (Aziezah et al., 2023).

From a technological perspective, SIGMA-AI is designed to handle multimedia-heavy educational outputs with scalable architecture using Laravel, PostgreSQL, and Supabase. This makes it more suitable for academic programs that routinely manage high-resolution files, animation sequences, or interactive media. Studies indicate that domain-specific digital systems perform better than general-use platforms when managing large, complex educational multimedia datasets (Rožman et al., 2023). Additionally, SIGMA-AI provides dashboard-based analytics that present statistics for students and cohorts, enabling data-driven curriculum evaluation. Such features are unsupported by public creative platforms yet essential for outcome-based education, aligning with findings on the importance of analytics-enhanced systems in improving academic decision-making (Albert & Voutama, 2025). Overall, SIGMA-AI offers a more comprehensive, academically aligned, and AI-driven solution compared with existing portfolio platforms, combining curation, automation, analysis, and scalability in a single integrated system tailored for higher education.

CONCLUSION

The development of SIGMA-AI successfully delivers an integrated digital gallery platform capable of addressing the complex needs of multimedia-based academic environments. By combining AI-powered auto-tagging, recommendation algorithms, and role-based content validation, the system provides functionalities beyond those of traditional creative platforms. The use of the RAD model ensures that the platform evolves in alignment with user expectations, while white-box testing confirms the reliability of its core operational flows. Compared with public portfolio services such as Behance, Dribbble, and Google Drive repositories, SIGMA-AI demonstrates clear advantages in academic curation, metadata consistency, scalability for multimedia content, and analytics-driven educational support. These strengths position the platform as a robust solution for managing final project repositories and enhancing academic quality assurance. As digital creativity continues to grow, SIGMA-AI has the potential to become a foundational tool for improving digital literacy, fostering innovation, and supporting data-informed curriculum development within creative media higher education programs.

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