A Web-Based Design Knowledge Hub for Reusable Engineering Education

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***Abstract*—Engineering education increasingly requires learning resources that are not only readable but also reusable and extensible for design-oriented practice. This paper presents a web-based design knowledge hub that structures engineering design knowledge using a Markdown-centered architecture deployed as a static portal. The proposed hub integrates hierarchical documentation, equations, figures, and code fragments to support both human learning and future AI-assisted reuse. A case study based on an implemented portal demonstrates how the proposed structure enables cross-domain reuse of engineering knowledge. The results indicate that the design knowledge hub provides a practical and scalable infrastructure for reusable engineering education.**

***Index Terms*—engineering education, design knowledge, reusable learning resources, web-based platform, documentation architecture**

I. Introduction

Engineering knowledge used in design practice is often scattered across textbooks, slides, personal notes, and software repositories, making systematic reuse difficult. While many educational platforms focus on content delivery, fewer address how design knowledge itself should be structured for reuse, extension, and long-term maintenance.

Recent discussions on engineering education emphasize the importance of reusable and well-structured learning resources that support both conceptual understanding and practical application [1]. At the same time, lightweight documentation formats such as Markdown have gained wide acceptance due to their readability, portability, and compatibility with modern version control systems [2].

This paper addresses this gap by proposing a web-based design knowledge hub that emphasizes structural reusability rather than content volume.

II. Related Work

Learning management systems, digital textbooks, and wiki-based platforms are widely used in engineering education. These systems are effective for dissemination but often treat learning materials as static documents.

Educational research has highlighted the need for active learning and reusable instructional design in STEM education [1]. In parallel, the adoption of lightweight markup languages such as Markdown has enabled more flexible and maintainable documentation workflows in technical domains [2].

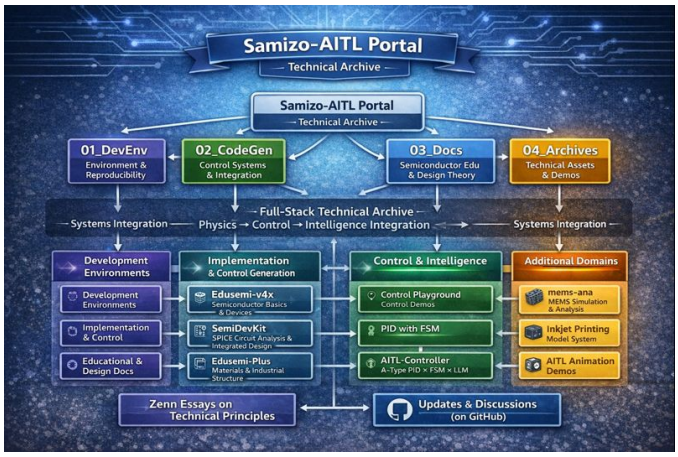

Fig. 1. Overall structure of the proposed design knowledge hub. The portal integrates development environments, code generation, documentation, and archives to support reusable engineering education.

However, few existing platforms integrate these approaches into a unified framework specifically aimed at reusable engineering design knowledge.[2], [1], [3], [4]

III. System Overview

The proposed system is a web-based design knowledge hub that organizes engineering design knowledge in a reusable and extensible manner. The hub is implemented as a static web portal generated from Markdown sources, allowing all materials to be version-controlled and easily maintained.

Figure 1 provides an overview of the portal architecture and its knowledge organization.

IV. Knowledge Structuring Method

Markdown is adopted as the primary documentation format to balance human readability and machine interpretability. Its simplicity lowers the barrier for educators and engineers to contribute content, while its text-based nature enables long-term maintainability.

A hierarchical directory structure separates domains, topics, and abstraction levels. Lightweight metadata enable indexing and future automation. Equations, design rationale, and code fragments are colocated to preserve design intent and support reuse across educational and practical design contexts.

V. Case Study

The design knowledge hub has been implemented as a publicly accessible portal covering multiple engineering domains, including semiconductor technology and control systems. In particular, the portal includes materials on high-voltage device integration, process technology, and system-level design considerations.

Materials are cross-referenced across domains, allowing learners to navigate from fundamental concepts to applied design examples. This case study demonstrates that the same structural framework can accommodate diverse topics without modification to the underlying platform.

VI. Discussion

The primary advantage of the proposed approach lies in its reusability and extensibility. Because all materials are version-controlled and structurally consistent, knowledge can be updated incrementally without disrupting the overall organization.

From an educational perspective, this approach aligns with established principles of effective STEM instruction, emphasizing clarity, modularity, and reuse [1]. At the same time, the use of Markdown enables sustainable documentation practices that support long-term evolution of engineering knowledge bases [2].

A limitation of the current work is the lack of quantitative assessment of learning outcomes, which is left for future study.

VII. Conclusion

This paper presented a web-based design knowledge hub aimed at reusable engineering education. By focusing on the structural organization of design knowledge, the proposed approach bridges the gap between educational materials and practical design reuse. The implementation demonstrates that lightweight, open technologies can support scalable and maintainable engineering education infrastructures.

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Author Biography

Shinichi Samizo received the M.S. degree in Electrical and Electronic Engineering from Shinshu University, Japan. He worked at Seiko Epson Corporation on semiconductor memory devices, high-voltage device integration, and inkjet MEMS actuator technologies. He is currently an independent semiconductor researcher focusing on semiconductor process and device education, control systems, and AI-assisted system integration.