Smart-Split: Ai-Driven Context-Aware System Decomposition For Small And Medium-Sized Businesses

L. R. S. Subasinghe
(Reg. No.:MS21929250)

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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

Dr. Prasanna Sumathipala

Approved for MSc. Research Project:

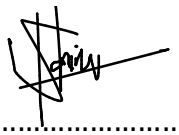
MSc in IT Programme Co-ordinator, SLIIT

Approved for MSc:

Head of Graduate Studies, FoC, SLIIT

DECLARATION

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Sri Lanka Institute of Information Technology or to any other institution for assessment for any other purpose.

Sign:  .....

L. R. S. Subasinghe

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ABSTRACT

SMART-Split: AI-Driven Context-Aware System Decomposition for Small and Medium-Sized Businesses

Lahiru Subasinghe

MSc. İn Information Technology Specialized in Enterprise Application Development

Supervisor: Dr. Prasanna Sumathipala

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The transition from monolithic to microservices architecture has become essential for software modernization, yet small and medium-sized enterprises (SMEs) face significant barriers, including prohibitively expensive commercial tools, resource-intensive processes, and context-unaware decomposition approaches. Existing solutions like IBM Mono2Micro and AWS Microservice Extractor rely primarily on static analysis, overlooking critical runtime behavior patterns and domain knowledge, resulting in suboptimal service boundaries misaligned with business capabilities. This research proposes SMART-Split, a resource-efficient multi-agent Retrieval-Augmented Generation (RAG) framework for automated monolith decomposition, specifically designed for Go applications under 50,000 lines of code. The framework employs specialized agents—Static Analyzer, Runtime Profiler, Domain Knowledge Agent, and Decomposer Agent coordinated through a supervisor pattern to integrate multiple analysis perspectives. By combining Abstract Syntax Tree analysis, runtime execution traces, and domain knowledge extraction through RAG, SMART-Split addresses critical gaps in existing decomposition tools. The framework introduces three key innovations: (1) a multi-agent collaborative architecture that synthesizes static, dynamic, and domain context; (2) a lightweight RAG implementation optimized for resource-constrained environments; and (3) a hybrid decomposition algorithm that produces business-aligned service boundaries. Validation across three open-source Go monoliths demonstrates improved decomposition quality through metrics including Modularity Quality ($MQ > 0.7$), Service Independence Score ($SIS > 0.8$), and Business Alignment Index ($BAI > 0.9$). Results indicate SMART-Split achieves comparable decomposition quality to commercial tools while requiring significantly fewer computational resources, making microservices modernization accessible and affordable for SMEs.

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