【Grant-in-Aid for Scientific Research (S)】

Broad Section J

Title of Project： Fundamental and Innovative Technologies for Next-Generation Software Ecosystems

MATSUMOTO Kenichi

(Nara Institute of Science and Technology, Graduate School of Science and Technology, Professor)

Research Project Number: 20H05706 Researcher Number：70219492

Keyword：Software Reuse, Microservices, AI Applications, Blockchain Technology

【Purpose and Background of the Research】

Advances in new digital technologies such as IoT and AI increase the importance and diversity of software. Further technological innovation is required to accumulate, share and circulate higher quality software to society.

This research aims to solve today's technical problems in software development and operation by active utilization and linking of latest digital technologies such as AI, natural language processing, SaaS, and blockchain. Specifically, we analyze technical issues, such as “the increase in technical debt,” “lack of human resources,” and “diversification of technical information,” to develop and deploy technological solutions. The research goal is to achieve a high level of economy and sustainability by eliminating wastefulness, and output highly creative results that facilitate innovation for new technological systems.

【Research Methods】

Technical issues of software development and operation are highlighted in the following three Research Questions (RQs), with answers that require through research based on original ideas and approaches such as “upcycling,” “competency,” and “linkage with external technical information.” (See Figure 1)

RQ1: Is it possible to upcycle software products like code?
Is it possible to convert a program code into a valuable software asset (e.g., microservices) by analyzing aspect and feature of the technical debt in the code?

RQ2: Is it possible to solve the human resource shortage by putting person and AI chatbots in the right places?
Is it possible to achieve competency evaluation of humans and AI in development and operations through clarification of human resource patterns to improve productivity, operations and encourage person to acquire new skills for modern development and operations?

RQ3: Is it possible to have robust and sustainable quality control, also linked to external technical information?
Is it possible to restrain and reduce technical debt by linking external technical information obtained through software community knowledge and academic journals, and maintain in an unfalsifiable framework, that is verifiable by third parties?

【Expected Research Achievements and Scientific Significance】

Results extend the three concepts of “Reuse,” “Human Resources,” and “Quality Control” in development and operation, leading to construct a new technology system. For example, upcycling of program code shifts most development and operation tasks from “make and modify” to “select.” Assignment of person and AI chatbots at strategic tasks at optimal time can transform organization and structure of development and operations, to facilitate creative efforts and skills. Quality control linked to external technical information will contribute to further utilization of academic information, advancing the Digital Transformation (DX).

Academic and technical contributions will free-up software developers and operators from complicated tasks, realizing a next-generation software ecosystem to open a range of new digital technologies, all connected with the software at its core.

Research Topic	Original technology and approach	
Product Upcycling	Code clone analysis Service extraction from legacy SW API value evaluation Dependency evaluation of SW libraries	Sanitized OSS Dev/Ops Repositories (30K PJs)
Right Person and AI in Right Place	Competency evaluation Skill index and benchmarking Ecosystem modeling and visualization	
Quality Control linked to External Technical Info.	Recording and monitoring SW build process using blockchain	

Figure 1 Research Topics and Approaches

【Publications Relevant to the Project】

- C. Tantithamthavorn, S. McIntosh, A. E. Hassan, and K. Matsumoto, “The Impact of Automated Parameter Optimization on Defect Prediction Models,” *IEEE Transactions on Software Engineering*, Vol.45, No.7, pp.683-711 July 2018.
- H. Hata, C. Treude, R. G. Kula, and T. Ishio, “9.6 Million Links in Source Code Comments: Purpose, Evolution, and Decay,” *Proc. of 41st International Conference on Software Engineering* (ICSE 2019), pp.1211-1221, May 2019.

【Term of Project】

FY2020-2024

【Budget Allocation】

145,400 Thousand Yen

【Homepage Address and Other Contact Information】

https://naist-se.github.io/FIT4NXSE
fit4nxse@is.naist.jp