Deep Learning and Graph-Based Indexing for Context-Aware Video Retrieval Systems

Dinh-Lam Pham[1], Lanh Thanh Le[2], Jeong-Hyun Chang[1], Sang-eun Ahn[1], Kyonghee Sun[1], Kyong-Sook Kim[1], and Kwanghoon Pio Kim[1*]

[1]Contents Convergence Software Research Institute, Kyonggi University, South Korea
{phamdinhlam, crime_tiger564, sangeun1804, sunkh0507, khmjmc, kwang}@kgu.ac.kr

[2]Faculty of Information Technology, Dong Nai Technology University, Bien Hoa City, Vietnam
lethanhlanh@dntu.edu.vn

Abstract— **Managing the CCTV recorded footage takes advantage of not only hardware resources but also labor costs in monitoring and searching content through vast amounts of video clips generated every minute from CCTV cameras. Many studies and practices were introduced to deal with this matter. However, several challenges still need to be solved when implementing a video retrieval system. This study explores the applications of deep learning and graphs to create indexed data in order to implement functions in a video retrieval system. In particular, in this paper, we proposed an approach using graph structure to index the content in CCTV videos after using deep learning algorithms to contextualize detected objects in frames from these videos. Furthermore, we extend the approach to manage all the CCTV videos using graph management approach. This strategy, on the one hand, takes advantage of graph structure, providing an intuitive view for the CCTV management centers in managing and searching content from the managed cameras. On the other hand, it offers easy and efficient retrieval of video content.**

Keywords— **Graph-based indexing, Video contextualization, Deep learning-based system, Contextualization dataset, Video retrieval system, CCTV management system.**

Dinh-Lam Pham is a research professor at the Contents Convergence Software Research Institute at Kyonggi University, South Korea. He is the vice-chair of Vietnam Innovation Network in Korea, as well. He received B.S. degree and M.S. degree in computer science from Thainguyen University in 2008 and 2010, respectively, and received Ph.D. degree in Computer Science from Kyonggi University in 2021. His research interests include video retrieving system, deep learning, BPM, process mining, deep-learning-based systems.

Lanh, Le Thanh is a lecture and Vice Dean at the Faculty of Information Technology, Dong Nai Technology University, Bien Hoa City, Vietnam. He received his M.S degrees in Electrical and Electronic engineering at Ho Chi Minh City University of Technology and Education, Ho Chi Minh, Viet Nam in 2015. He received his Ph.D in Electrical engineering and Computer Science at National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan in 2020. His research interests include Optimization System, Electrical Electronic Engineering. The Intelligence of Things, Intelligent Power systems, and Optoelectronics, Photonics and Optical System.

Jeonghyeon Chang received the Ph.D. degree in Police Administration from Kyonggi University, South Korea in 2017. From 2019 to 2020, he also worked as Assistant professor with science of international politics in University of Halla. In 2020, he joined the Contents Convergence Software Research Institute, Kyonggi University, South Korea, where he is currently a Research Professor. His interests include crime prevention through active content, community policing, and data mining

Ahn Sang-eun is a researcher at the Content Convergence Software Institute at Kyonggi University in Korea. She received her Bachelor of Arts and Master of Arts degree from Kyonggi University in 2017 and 2019, respectively. Her research interests include text mining, data mining, text-based criminal prevention system.

Kyunghee Sun received the B.E and M.E. degrees in the department of computer science and statistics from Jeju University, Korea, in 1998 and 2008, respectively. She received the Ph.D. degrees in the department of computer science and engineering from Kyunghee University in 2018. From 2006 to 2014, she was a senior researcher at Jeju Technopark. She is currently a research professor in the Contents Convergence Software Research Institute, Kyonggi University, South Korea. Her current research interests include Bigdata platform,

Data Fabric, Deep Learning, IT convergence, network protocol, and network security

Kyoung-Sook Kim is an adjunct professor of the department of computer science and engineering at Kyonggi University, South Korea. She received her B.S. degree in computer science from Kyonggi University in 1984. She also received her M.S. and Ph.D. degrees in computer engineering from Kyunghee University in 2001 and 2019, respectively. She had worked as a researcher and developer at FAST Systems Inc. and OSI Corp. in South Korea. Her research interests include large-scale database systems and applications, enterprise information systems, real-time databases, distributed databases, temporal databases, federate databases, object-oriented database management systems, and the Internet of Things collaboration architectures and services.

Kwanghoon Pio Kim is a full professor of computer science department and the founder and supervisor of the collaboration technology research laboratory at Kyonggi University, South Korea. He received B.S. degree in computer science from Kyonggi University in 1984. And he received M.S. degree in computer science from Chungang University in 1986. He also received his M.S. and Ph.D. degrees from the computer science department at University of Colorado Boulder, in 1994 and 1998, respectively. At Kyonggi University, he is Dean of the Computerization and Informatics Institute, and the director of the contents convergence software research center, as well. He has also been on the editorial board of the journal of KSII, and the committee member of the several conferences and workshops. His research interests include groupware, workflow systems, BPM, CSCW, collaboration theory, Grid/P2P distributed systems, process warehousing and mining, workflow-supported social networks discovery and analysis, process-aware information systems, data intensive workflows, and process-aware Internet of Things.