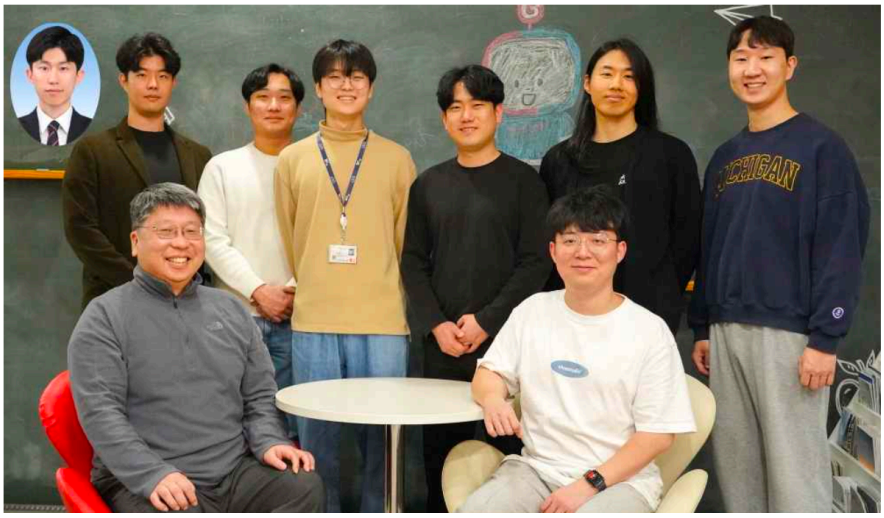
“Parking lot problem, now AI can solve it quickly!” GIST develops of evasive video reduction technology

- Professor Yong-Gu Lee’s team detects small shaking of vehicles using artificial intelligence and uses long video axes
- Expected to dramatically reduce manpower, cost, and time for accident investigation due to evasive maneuvers



▲ (From left in the front row) Professor Yong-Gu Lee of the GIST School of Mechanical Engineering, Dr. Sunjae Lee of the School of Mechanical Engineering
(From the left in the back row) Inwoo Hwang, a researcher at LG Electronics, Inho Park, a master's student in School of Mechanical Engineering, Jaeik Bae, a master's and doctoral integration program at the Graduate School of AI, master's student Gun Woo Shin at AI Graduate School, master's student Taehyung Gil at AI Graduate School, master's student Jinhoon Cha at the School of Mechanical Engineering, and master's student Dong Hyun Kim at the School of Mechanical Engineering

A technology has been developed that can easily use artificial intelligence (AI) technology to detect a hit-and-run vehicle that “shocked” a car parked in a parking lot and ran away.

The Gwangju Institute of Science and Technology (GIST, President Kichul Lim) announced that Professor Yong-Gu Lee's research team in the School of Mechanical Engineering succeeded in detecting the time of occurrence of a hit-and-run while driving from all CCTV images through artificial intelligence (AI) technology.

As the scope and severity of punishment for property-related accidents was strengthened in accordance with the Road Traffic Act revised in June 2017, the number of reported cases also increased significantly, and the actual number of property-related accidents reported by the police increased from 362,384 in 2016 to 626,609 in 2020 (Road Traffic Authority) TASS, as of 2021).

When a property damage accident occurs, the video stored in the black box in the vehicle is checked. If the video is not stored, the perpetrator must be tracked through nearby CCTV. At this time, due to the nature of CCTV, it is necessary to watch a large amount of video, and this method of video investigation increases the workload of the investigator in charge.

In particular, it is not easy to prove intention in parking hit-and-run accidents, and even if intention is proven, a fine of up to 200,000 won is only imposed. In contrast, it is difficult to find when an accident occurred, and there are many

difficulties in investigation, so it is necessary to develop technology that takes into account the on-site situation.

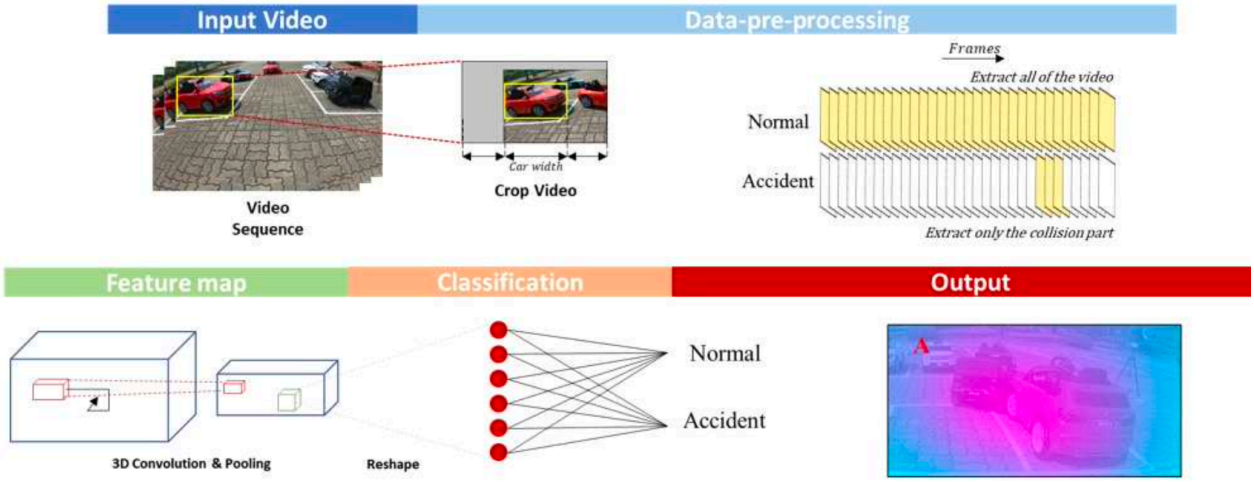
Currently, the video shortening program used in the field is very expensive, with a license fee of approximately 15 million won. Above all, because it is a program developed primarily for crime prevention purposes rather than specialized in escapes, it cannot detect small shaking of objects and cannot be properly used in the investigation due to compatibility issues.

The research team collected datasets using RC cars rather than real vehicles to reduce dataset collection costs and the possibility of accidents.

The appearance of a real vehicle and an RC car are very similar, and when the RC car is recognized with weights learned from the real vehicle using an object recognition model, similar accuracy is obtained, so even if data is collected with an RC car, it will show similar performance to a real vehicle.

Because the latest type of black box has a built-in collision detection sensor, datasets were collected only from CCTV footage.

The research team analyzed 800 videos and developed a technology to detect the time of vehicle collision by training it in an artificial intelligence network.



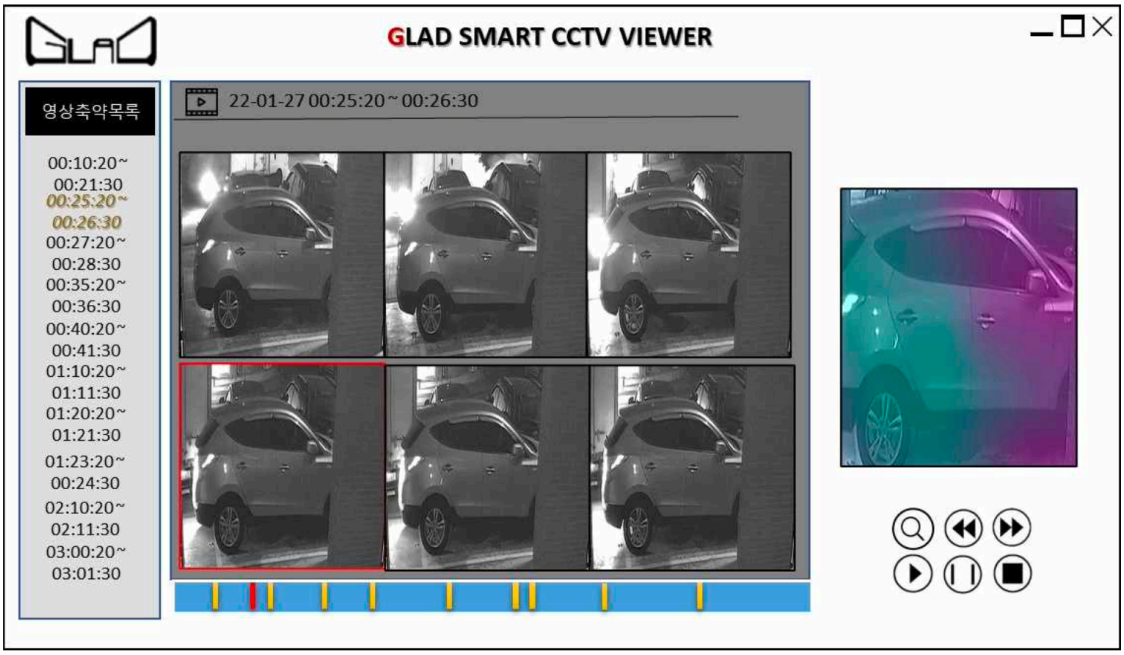
▲ Example of artificial intelligence model structure and results

In order to detect the point of collision, 'temporal information' to analyze the pattern of movement in consecutive frames and 'spatial information' to understand the structure and shape of the object must be analyzed simultaneously, so the research team developed a 3D-CNN capable of simultaneous analysis.

* 3D CNN (3D Convolutional Neural Networks): A network based on CNN, a deep learning structure created by imitating the human optic nerve. The widely known 2D CNN deals with two-dimensional data such as images, while the 3D CNN analyzes and learns from video by adding a time axis.

Due to the nature of an accident in which the victim vehicle was identified, a preprocessing method was used to prevent unnecessary background information from being input into the network by leaving a certain gap around the victim vehicle.

Vehicle crash images can be distinguished from movement patterns in non-collision situations because the shaking during the collision shows repetitive motion.



▲ User software example: In the black box video, a 3-ton truck in the upper left corner of the vehicle is reversing and collides with an SUV. The user software displays the relevant time in the time table on the left.

The result of this research is that it is possible to immediately check the movement of the object and the path it took before and after a suspected water escape accident, which can significantly reduce work time compared to the existing investigator in charge analyzing the video directly.

Furthermore, if this technology is applied to widely installed CCTVs, it can be used for crime prevention and analysis, which is highly effective in strengthening the safety of the community and preventing crime.

Professor Yong-Gu Lee said, "The most important aspect of this research outcome is that it significantly reduces the burden of analyzing massive CCTV images with advanced artificial intelligence technology. Future commercialization is expected to further increase social trust and safety by quickly identifying and handling accident situations."

This research was led by Professor Yong-Gu Lee and conducted by researcher Inho Park with support from the Ministry of Trade, Industry and Energy, the Ministry of Science and ICT, the Defense Acquisition Program Administration, and the Science and Public Security Promotion Center, and was published online in the renowned international academic journal 'JCDE (Journal of Computational Design and Engineering)' on February 19, 2024.

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