International Journal of Advanced Smart Convergence Vol.9 No.4 120-123 (2020)
http://dx.doi.org/10.7236/IJASC.2020.9.4.120

IJASC 20-4-15

Real-time video Surveillance System Design Proposal Using Abnormal Behavior Recognition Technology

Jiyoo Lee[1†], Seung-Jung Shin[2]

[1†] Ph.D. Candidate, Department of IT Convergence , Graduate School, Hansei University, Korea
iamjiyoo@gmail.com
[2]Professor, Department of ICT Convergence, Hansei University, Korea
expersin@hansei.ac.kr

Abstract

The surveillance system to prevent crime and accidents in advance has become a necessity, not an option in real life. Not only public institutions but also individuals are installing surveillance cameras to protect their property and privacy. However, since the installed surveillance camera cannot be monitored for 24 hours, the focus is on the technology that tracks the video after an accident occurs rather than prevention. In this paper, we propose a system model that monitors abnormal behaviors that may cause crimes through real-time video, and when a specific behavior occurs, the surveillance system automatically detects it and responds immediately through an alarm. We are a model that analyzes real-time images from surveillance cameras and uses I3D models from analysis servers to analyze abnormal behavior and deliver notifications to web servers and then to clients. If the system is implemented with the proposed model, immediate response can be expected when a crime occurs.

Key words: *Behavior Recognition, Deep Learning, I3D, Video Surveillance System*

1. INTRODUCTION

Video Surveillance Systems(VSS) are systems to protect the lives and property of the people, such as crime prevention and disaster monitoring, and are continuously developed as time passes and are used in a wide variety of fields. In addition, network-based intelligent video surveillance systems capable of recognizing the characteristics of objects or people are rapidly developing, not only in the form of monitoring the surrounding situation[1].

Intelligent video control is a technology that recognizes characteristics and extracts patterns by analyzing image data, and recognizes objects such as faces, letters, numbers, and objects according to purpose and object, or utilizes various functions such as motion recognition and tracking. In particular, it is possible to predict and track human behavior through artificial intelligence learning of big data.

Manuscript Received: October. 26, 2020 / Revised: November. 4, 2020 / Accepted: November. 11, 2020
Corresponding Author: expersin@hansei.ac.kr
Tel: +82-10-3664-0666, Fax: +82-31-450-5172
Professor, Department of ICT Convergence, Hansei University, Korea

Currently, the artificial intelligence-based video surveillance system market is still in its infancy and is mainly being progressed in the form of government projects by sector. In the case of local governments, the demand for the artificial intelligence-based video analysis market has gradually increased since two years ago due to the nature of the business that has to control multiple CCTVs. However, the distribution of CCTV intelligent screening system in 225 CCTV control centers nationwide is within 20%, and local governments already operating only about 20% of all CCTVs are applying artificial intelligence CCTV.

In addition, intelligent CCTVs currently in operation are also being used in the form of selective control. Research has shown that the ability of one controller to detect dangerous situations in two or more CCTVs drops to 45% after 5 minutes and 95% after 22 minutes[2]. Since humans cannot monitor all screens 24 hours a day, there is a growing need for a system that can respond effectively by giving a notification when a situation that has been learned in advance occurs within the range monitored by CCTV.

This paper proposes a design of a monitoring system that detects abnormal behaviors in real time using deep learning, reports them to the control system, stores the detected abnormal behaviors in a server, and learns them again to increase accuracy.

2. RELATED RESEARCH

Surveillance systems can be broadly classified into unmanned surveillance systems and intelligent surveillance systems. The unmanned surveillance system is a system that monitors places without people, and the intelligent surveillance system is a system that analyzes unusual behavior in public places.

The first unmanned surveillance system detects intrusion in a restricted area using infrared cameras or sensors. This system considers all unauthorized users to be intruders. Therefore, when motion is detected by a heat sensor, etc., it alerts the guard to recognize the situation[3][4].

On the other hand, the second intelligent surveillance system uses the same equipment, but detects behavior that is not common in public places. For example, it detects infrequent behaviors such as a person falling, falling, or wandering around a restricted area[5][6].

3. SYSTEM DESIGN

3.1 Selection of Intelligent Data Aanalysis Model

In order to construct a learning model for intelligent surveillance, learning data was first required.In the beginning, AI Hub, an AI integrated platform built by the National Information Society Agency, built in 2017[7]. In order to be able to recognize the features of space-time, we performed detection and learning of abnormal behavior through 2D CNN, -LSTM, 3D CNN, and I3D models[8][9]. After training and testing a series of three models, the I3D model that shows the best results was selected as the analysis model[10].

As shown in Figure 1, in order to compose data that can be used in I3D, the video is divided into 16 frames and composed of one clip. After learning through the I3D model, the data created in this way is judged for abnormal behavior. In this system, in order to increase the learning performance in the I3D-based neural network, the learning performance is increased by adding RGB frames and optical flow as input values[10].

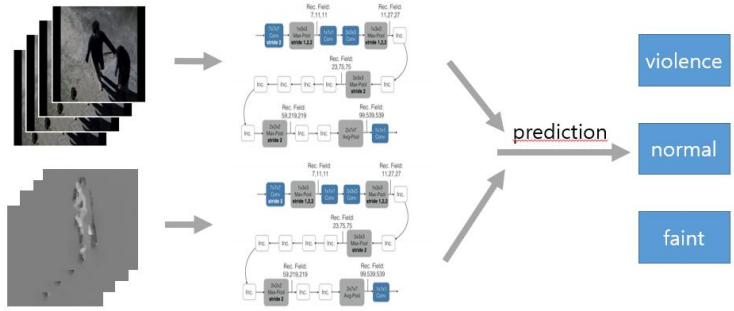

Figure 1. I3D Model

3.2 System Structure

The overall monitoring system proposed in this paper is shown in Figure 2. First of all, the video from the CCTV camera is transmitted in real time to the abnormal behavior analysis server and the client web browser. The abnormal behavior analysis server determines the abnormal behavior through the model learned from the image. If an abnormal behavior is detected, the abnormal behavior analysis server stores the image in the database for 5 seconds from the detected time point. The data stored for 5 seconds is designed to increase the accuracy of abnormal behavior detection by periodically learning the abnormal behavior analysis server.

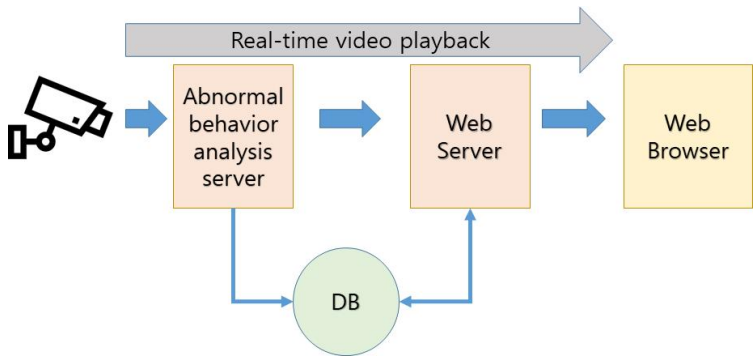

Figure 2. Video surveillance system structure

The detected abnormal behavior video data stored in the database is transmitted to the web server. The web server communicates with the abnormal behavior analysis server through the Rest method. The detection result of abnormal behavior is transmitted to the web browser via web socket communication. The web browser displays the push alarm received through the web socket so that the user can recognize it. The user who receives the alarm can inquire and store the image data of the detected abnormal behavior.

4. CONCLUSION

In this paper, we proposed a system design that detects abnormal behavior in video in real time through CCTV, automatically notifies users, and enhances detection function through learning of detected abnormal behavior.

If the abnormal behavior system is configured according to the design proposed by us, it is not necessary to have several personnel who can detect abnormal behavior around the clock in a control center with multiple

CCTVs. In addition, continuous real-time detection and information analysis are possible according to the type of abnormal behavior to be learned, and the effect of improving real-time detection capability through warning or notification service accordingly can be expected.

We expect that if a system that can monitor abnormal behavior in real time is implemented, it is not only used for crime prevention such as violence and fainting, but can be extended to daycare centers, kindergartens, and nursing homes that require continuous monitoring.

REFERENCES

[1] How to use ICT to prepare a crime prevention response system, Korea Information Society Agency, 2013.12.

[2] S. Fleck and W. Straber, "Privacy Sensitive Surveillance for Assisted Living-A Smart Camera Approach," *Handbook of Ambient Intelligence and Smart Environments*, H. Nakashima, H. Aghajan, and J.C. Augusto, Ed., Springer, 985-1014, 2010.

[3] Sang-Jun Kim, Young-Hoon Cho, Seong-Geun Park, Gwang-Min Oh, Dae-Gil Yoon, Dae-Rak Son, "A Study on the Unmanned Surveillance System Using Sensors", *Journal of the Korean Magnetics Society Academic Research Conference*, 132-133, 2015.

[4] J. H. Park, K. L. Jang, & M. W. Bang, "A Study on a Moving Object Recognition Algorithm for an Implementation of Unmanned Surveillance System," *The Institute of Electronics and Information Engineers*, 265-268, 1996.

[5] Joo Young-hoon, "Intelligent unmanned surveillance system", *Kunsan University Industry-Academic Cooperation Foundation*, Small and Medium Business Administration, 2010. 5.

[6] Jae-Young Chang, Sung-Mun Hong, Damy Son, Hojin Yoo, Hyoung-Woo Ahn, "Development of Real-time Video Surveillance System Using the Intelligent Behavior Recognition Technique," *The Journal of the Institute of Internet, Broadcasting and Communication*, 19(2), 161-168, 2019.
DOI : 10.7236/JIIBC.2019.19.2.161

[7] AI HUB, http://www.aihub.or.kr, 2019.

[8] S. Hochreiter and J. Schmidhuber, "Long Short-term Memory," Neural computation, vol. 9, 1735-80, 12/01 1997.
DOI:https://doi.org/10.1162/neco.1997.9.8.1735

[9] S. Ji, W. Xu, M. Yang, and K. Yu, "3d convolutional neural networks for human action recognition," in ICML, 2010.
DOI: https://doi.org/10.1109/TPAMI.2012.59

[10] J. Carreira and A. Zisserman, "Quo Vadis, Action Recognition? A New Model and the Kinetics Dataset." *2017 IE EE Conference on Computer Vision and Pattern Recognition (CVPR)*, 4724-4733, 2017.
DOI:10.1109/CVPR.2016.90