UAV-based Blockchain-assisted Automated Traffic Accident Management System using Multi-access Edge Computing

Md Masuduzzaman and *Soo Young Shin

Department of IT Convergence Engineering,
Kumoh National Institute of Technology (KIT), Gumi, South Korea
Email: {masud.prince, *wdragon}@kumoh.ac.kr

Abstract

The conventional human-based approach takes a long time to identify the traffic accident and the injured person. Therefore, an unmanned aerial vehicle (UAV)-based traffic accident management system is developed in this article to reduce the operation time among multiple parties like hospitals, insurance companies, and law enforcement. Due to the limited resources, the UAV forwards the roadside video data to process it inside the nearby multi-access edge computing (MEC) server. A deep learning model is used in the MEC server to spot the accident and the injured person. Symmetric key cryptography is utilized to secure the data transmission between the UAV and the MEC server. Finally, the accidental data is stored in the blockchain to record and share the synchronized data with others.

I. Introduction

Road traffic accidents cause severe and significant concerns with traffic and human injuries that negatively impact society and human life [1]. Therefore, spotting accidents and quick response are crucial not only to save lives but also to lessen the damage. Unmanned aerial vehicles (UAVs) can be utilized to automatically spot-on traffic accidents because of their extreme acceleration and bird's eye view of the scene [2]. Additionally, photos and videos of the accident area can be taken using UAVs fitted with cameras and used for investigation and analysis. However, a deep learning (DL) model is required with the UAV to identify the accidental vehicle on the roads [3]. Moreover, a DL model can help to determine the injured person who needs emergency medical attention. Most UAVs cannot process the DL model using its limited hardware resources and battery powers. Therefore, forwarding the data to the multi-access edge computing (MEC) server for running the DL model and evaluating the output could be a promising approach [4]. For multiple parties, including law enforcement, insurance companies, and hospitals, to access the same information in real-time and collaborate more effectively, a secure and tamper-proof system for recording and sharing information about accidents can be created using blockchain technology after the accident has been identified. This technique may speed up the claims procedure and enhance overall accident response, which in turn may help lessen the frequency of accidents and the seriousness of injuries.

II. Proposed Methodology

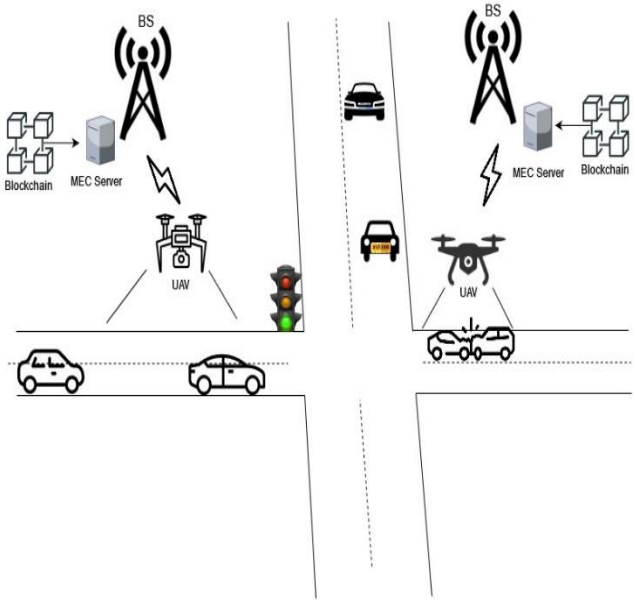

Fig. 1 illustrates the fundamental components of the suggested traffic disaster management system together with their corresponding entities (UAV, MEC Server, vehicles, etc.). The UAVs equipped with cameras are sent in different directions on the roadside to identify accidental vehicles. Due to the limited hardware resources, the UAV forwards the video data to the MEC server. The symmetric cryptographic technique is applied in this proposed system to provide confidentiality between the UAV and the MEC server. Symmetric cryptography indicates that only one key is use for encryption and decryption while transferring data.

After receiving the data from the UAV, the MEC server uses a DL model to determine the accident and identify the injured person. If the MEC server detects the traffic accident successfully using the DL model, it stores the data in the blockchain to collaboratively access this information by multiple parties, especially hospitals and insurance companies. The hospital authority can send an ambulance based on the information to take the injured people quickly from the accidental place. Furthermore, the damaged vehicle owner can claim the insurance quickly based on the blockchain-stored secure data from the insurance company.

III. Result Analysis

One Parrot Bebop 2 UAV connected with a Raspberry Pi 3 model B IoT device is used to conduct the experiment for this proposed system. For detecting road accidents and injured persons appropriately using the DL model, two distinct datasets comprising hundreds of damaged car and injured person photos are being developed. You only look once (YOLOv3) is considered to be utilized in the MEC server to detect accidental vehicles and identify the injured person. An Intel (R) Core i5-4590 CPU running at 3.30GHz with 8 GB of RAM is used as a MEC server in this experiment. Before executing the DL model in the MEC server, the video data is transferred securely using the Advanced Encryption Standard (AES)-128 bit symmetric key cryptography.

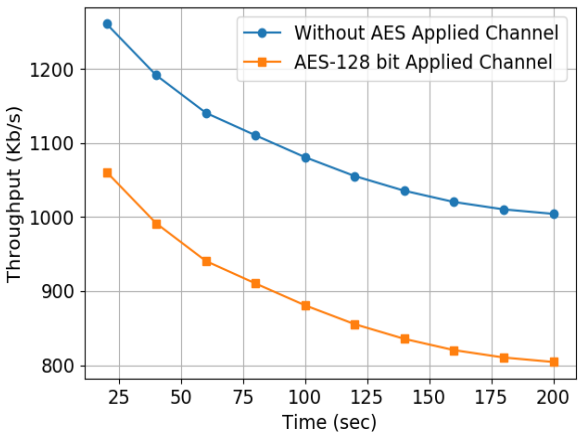

Fig. 2. Throughput analysis of the proposed system.

Fig. 2 compares and displays the channel's throughput before and after using the AES-128-bit symmetric key encryption while forwarding the video data from the UAV to the MEC server. Throughput is higher in Fig 2 using a cryptographic technique like AES-128 because the encryption and decryption process takes a little time. However, using AES-128-bit encryption adds an extra level of security to the transmitted data, which can help prevent unauthorized access or tampering with the data. Therefore, the applied cryptographic technique is employed in this proposed system while forwarding the roadside video data between the UAV and the MEC server.

IV. Conclusion and Future Work

UAV-based blockchain-assisted traffic accident management system using MEC is proposed in this article. Firstly, the UAV is dispatched to identify the accident and injured person on the roadside. Then the UAV forwards the data to the MEC server using AES-128 symmetric cryptosystem to provide data security. The data is finally stored in the blockchain to create a secure system, provide real-time access to the same data, and improve communication. Blockchain-based secure data-sharing implementation might be the future work of this article.

ACKNOWLEDGMENT

This work was supported by Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology"(2018R1A6A1A03024003).

Reference

[1] M. Masuduzzaman, A. Islam, K. Sadia, and S. Y. Shin, "UAV-based MEC-assisted automated traffic management scheme using blockchain," Future Generation Computer Systems, vol. 134, pp. 256-270, 2022. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0167739X22001418.

[2] Md Masuduzzaman, R. Nugraha and S. Y. Shin, "Industrial Intelligence of Things (IIoT 2.0) based Automated Smart Factory Management System using Blockchain," 2022 13th International Conference on Information and Communication Technology Convergence (ICTC), Jeju Island, Korea, Republic of, 2022, pp. 59-64, doi: 10.1109/ICTC55196.2022.9952653.

[3] M. Masuduzzaman, T. Rahim, A. Islam and S. Y. Shin, "UxV-based Deep-Learning Integrated Automated and Secure Garbage Management Scheme using Blockchain," in IEEE Internet of Things Journal, doi: 10.1109/JIOT.2022.3156617.

[4] M. Masuduzzaman, R. Nugraha and S. Y. Shin, "IoT-based CO2 Gas-level Monitoring and Automated Decision-making System in Smart Factory using UAV-assisted MEC," 2022 International Conference on Decision Aid Sciences and Applications (DASA), Chiangrai, Thailand, 2022, pp. 1023-1027, doi: 10.1109/DASA54658.2022.9765275.