Blockchain Integrated Automated Garbage Management Scheme using Unmanned Any Vehicle

Md Masuduzzaman, Anik Islam, and *Soo Young Shin
Department of IT Convergence Engineering, Kumoh National Institute of Technology (KIT), Gumi, South Korea
Email: {masud.prince, anik.islam, *wdragon}@kumoh.ac.kr

Abstract

The burning issue of a garbage management system can be solved by using Unmanned any vehicles (UxV). An automated system can be made where the unmanned aerial vehicle (UAV) can be used to detect the garbage in both ground and sea surface and automated guided vehicle (AGV) and unmanned surface vehicle (USV) can be used to collect those garbage and place it in a dustbin or land-fields. In this paper, an automated garbage management scheme has been proposed using different kinds of UxV. Additionally, Multi-access edge computing (MEC) technology is introduced to transfer the information among the UxV securely. Moreover, blockchain technology is employed to create a shared ledger among the multiple companies to track and dump the garbage after collection. Result analysis has been demonstrated based on the successful object detection analysis using an image processing algorithm and analyzed the throughput of the blockchain network.

Ⅰ. Introduction

Due to the unconsciousness of the general people all around the world, the amount of garbage is increasing in our surroundings. Therefore, not only the ground surface but also the sea surface are suffering due to an excessive amount of garbage. Different types of plastic bags, cardboard, glasses, metals, papers, and other types of trash can be found everywhere in the environment even after cleaning by the dedicated cleaners. Even sometimes the cleaner faces physically issues like finger injury, bone fracture, different health hazards etc. during the long time collection of garbage from the environment [1]. Multiple authors proposed some smart garbage management system based on the collected data from the IoT devices. However, no one has proposed an automated solution to collect all of those garbage in a real-time scenario. Therefore an automated garbage management scheme can be proposed using unmanned any vehicles (UxV) with the assistance of different modern technologies.

Ⅱ. Proposed Methodology

The overall architecture of the proposed scheme is illustrated in Fig. 1. UAV is dispatched from the base station in a different direction to detect the garbage. After detecting the garbage, the UAV transfers the information about the garbage and its location coordinate to the base station. The base station transfers the information of garbage location and nearby land-fields to the AGV to collect and place the garbage from the ground surface and USV to collect the garbage from the sea surface.

Fig. 1. System Model for Garbage Management Scheme

Security issues must be considered before transferring the data from the UxV to the MEC server. Therefore, whenever any UxV transfer the information to the MEC server, public-key cryptography is used to transfer the data between UxV to MEC server. All of the UxV needs to register in the system at the beginning and after the registration process, every UxV has one private key and one public key. Every device in the network knows the public key of other existing devices.
Therefore, whenever any UxV transfers any message to the MEC server, it encrypts the data using the MEC servers public key. The MEC server decrypts the data comes from the UxV using its own private key. Additionally, to prove the identity of the sender, the UxV encrypts the hash of the information using the private key of its own that represents the digital signature. Therefore, after decrypting the messages, the MEC server can also verify the authentication of any UxV and vice-versa.

To dump the garbage from the land-fields, different companies are assigned by the central authorities. It is assumed that all the companies are registered in the system at the beginning to share the dumping information in a distributed ledger. Therefore, multiparty can access the same data with one another using blockchain which is immutable [2]. If one company dumped any garbage, it creates a block containing the dumping information in the blockchain network. Other companies verify the information by monitoring the land field garbage [3]. If the information is true, it updates the distributed ledger to share the information with other companies.

III. Result Analysis

The experiment was done using parrot bebop 2 as a UAV. Raspberry pi 4 model B was attached with the UAV to detect the garbage. One unique dataset is created using 2500 images to detect the garbage. The data set is trained using YOLOv3 image processing algorithm and the successful detection is shown in Fig 2. One private blockchain network is established using hyperledger fabric considering byzantine fault-tolerant (BFT) consensus. Fig. 3 illustrates the throughput in bit per second (bps) for different number of mining nodes. For less number of miners, the throughput is higher as they need to process more data. When the number of mining node is increased, the throughput is decreased as because the mining nodes are continuously mining the data.

IV. Conclusion and Future Work

In this paper, an automated garbage management scheme is proposed where UxV detects the garbage from both the ground and sea surface and place it in a land-field. Then different companies dump the garbage and update the information in the blockchain ledger. If the information is true, other companies verify the data and approve the block to add it in the blockchain. Result analysis of successful garbage detection and throughput analysis proves that our proposed scheme can detect and reduce the garbage from the environment to make the planet a safer place to live.

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