Data Acquisition Techniques from IOT Devices for Smart Transportation: A Brief Overview

V. Ranjith and Kiran B. Malagi

Abstract Internet of Things has revolutionized the entire world these days. With the advent of the word smart in all the fields, for example, the smart city, huge amount of data gets accumulated every single day. For any application, processing this huge amount of data is very important. Prior to processing, acquisition of this bulk amount of data is very important. In the existing research, there are different ways to collect these data. In this paper, data acquisition using different modern approaches is outlined. These approaches encompass data acquisition using hierarchical deep reinforcement learning, data acquisition using energy efficient UAV, data acquisition using swarm intelligence. This paper outlines these approaches, brings out the assets and liabilities of each one of these approaches for smart com.

Keywords UAV · Deep reinforcement learning · Blockchain · SADOL · MADOL

1 Introduction

Smart city has been one of the major applications of Internet of Things. The Internet of Things has transformed the entire world spruce. Smart transportation is one of the major applications of Internet of Things. If we take up any smart transportation technology, for example, if there is a smart car and the car may have to travel from a specific source to destination and let assume that there are many routes from that source to destination. In such cases, it is required to find the optimal route from that source to destination. Henceforth, we rely upon the data that need to be collected from things in the Internet. The things in the Internet may be sensor nodes, cameras, and many more devices. Therefore, lots of data need to be collected from such remote devices.

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There are many traditional methods of data collection for smart transportation [1]. One of such methods is by using curvaceous tubes. These curvaceous tubes are installed on roads. When the vehicles pass on these tubes, cram air would be released from the tube. For each of these vehicles that have passed the tubes, the resulting cram sends a burst of air to air switch. These air switches are installed on traffic calculating device [2]. The cram sends the csv format of data collected to the traffic calculating device. The merit associated with this technique is that it is malleable. The demerit associated with this technique is that it is traffic reliant. The second traditional technique for collecting the IoT data is inferential loops. The inferential loop consists of embedded twisted cord, waver, and loop extension cord. Whenever the vehicles pass over the loop, the corresponding count would be recorded in the calculating device. The resulting output of this technique is the computed value of number of vehicles that have run over the loop. The merit associated with this technique is that it is not expensive and easily maintainable. The demerit associated with this technique is that it requires more than one loop to take the calculation of number of vehicles that have passed over. The third method of data collection is video conveyance detection. This is the secretive and discreet technique. This technique works as follows. Firstly, it computes the number of vehicles that are in the front. Secondly, it computes the number of vehicles that are in the back. Finally, it subtracts the number of vehicles that are in the back by number of vehicles that are in the front. The merit that is associated with this technique is that it is extensible [3]. The demerit that is associated with this technique is that it is expensive to maintain. The next technique is based on global positioning system. In this technique, the global positioning systems that are installed in the car collect the speed and other data from satellites. It collects the precise and error-free data [4]. The merit associated with this technique is that it is cheaper compared to other techniques. The next technique is by using fog sensor. As we know, smart transportation is not only about finding the optimal route. It is all about looking on to other factors for safe traveling. So, sometimes, especially during winter season, there will be lot of fog that gets accumulated on the vehicles. So, cleaning up of this fog is very important for safe transportation of vehicle. Therefore, the concept of fog sensor was introduced. With this technique, the fog can be monitored in a contemporized and discreet way [5]. The next technique to find out the traffic mass is by using ultrasonic sensors. This technique works based on the binary digits. The merit associated with this technique is that it is error free and easily transferable. It is useful in finding the traffic mass and discreet technique having high error-free feature. The next technique is by using magnetometer sensor. This technique collects the data for vehicle speed. It is used as an alternative to inferential loops. The merit associated with this technique is that it is coincided and discreet. The abovementioned techniques are few of the traditional methods that can be used for data collection or data acquisition. Nowadays, with the advent of machine learning models, data acquisition has become more reliable and efficient. In this paper, we outline few data acquisition techniques using machine learning.

2 Modern Techniques

2.1 *UAV-Aided Data Acquisition Using Swarm Intelligence*

There are huge number of devices in the Internet of Things. The vivacity that these devices are having is very less [6]. There are situations where a greater number of IoT devices will be located in diverse demographic locations. The devices may be located somewhere near the oceans or located somewhere near the mountains. In such cases, these devices consume lot of vivacity which is not an efficient case. Secondly, the IoT devices may be very much influenced by the environment which leads to greater loss of vivacity. Therefore, the concept of unmanned aerial vehicles was introduced. The UAV acts as a communicating agent between the base station and the IoT devices. The UAV carries its own vivacity, so whenever it is flying from the base station to the IOT device, it can recharge itself recursively. Also, if any IOT device is located in the ocean beds, it can communicate with one more device that is located on the water surface of the ocean. This device acts as a mediator between UAV and the device that is located in the water. Therefore, this is how the UAVs help in energy efficient operation of data collection [7]. The regions where the IoT devices are located are divided into different divisions. Further, the divisions where the UAVs have to collect data are made specific [8]. For this purpose, the concept of swarm intelligence was introduced. Swarm intelligence is mainly used for disposition of UAVs. The data collection from IoT devices with the help of UAVs is shown in Fig. 1

The purpose of UAV disposition escalation is to reduce the vivacity consumption of both IoT devices and UAV. There are other techniques for disposition of UAVs. This technique works as follows. Firstly, the land points are predetermined. Later on, they are processed one after the other. For this, we use DEVIPS algorithm. By using this algorithm, the location of land algorithm gets adjusted automatically at the time of data collection. This method is very straightforward and uncomplicated, but its search is inefficacious. For this reason, swarm intelligence was introduced which identifies the landing point as a function of three coordinates. The number of landing points can be inserted or discarded arbitrarily. The demerit associated with this technique is that it does not address the elevation of the UAV. Also, the landing points cannot be interactively found every time.

2.2 *Data Acquisition Using Deep Reinforcement Learning in UAVs*

In the case of Internet of Things, large number of nodes will be connected. These nodes may be rechargeable or battery operated. To overcome this drawback, the disperse node can be used. These disperse nodes may not be required to recharge or battery operated, but the drawback associated with these disperse nodes is that the conveyance range of these devices may be not in boundary. To address this challenge,

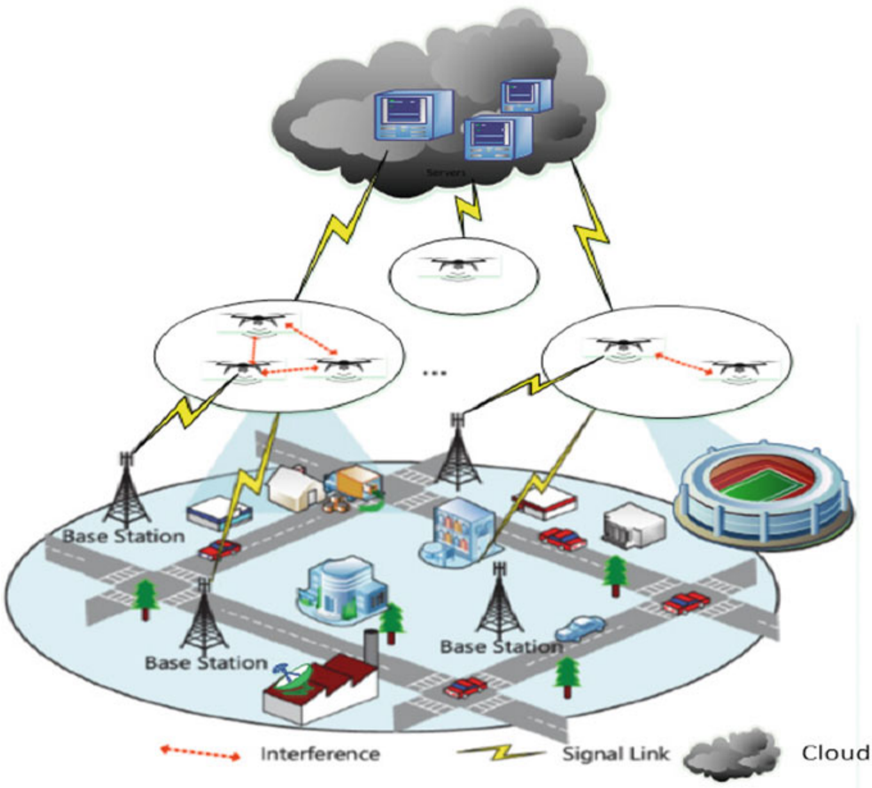

Fig. 1 UAV collecting data from IoT devices

UAVs [9] were introduced. In this technique, the UAVs can reach to the disperse nodes and collect the data individually. At the time of data acquisition, the UAVs can come back and recharge themselves again. In this technique, the UAV initiates itself from the rechargeable station and moves to the disperse nodes network. These disperse nodes can be charged by RF signals carried by UAVs. The UAVs initiates themselves and issues an inquiry signal to the disperse nodes. These disperse nodes update the UAVs with the data. Hence, the data collection is achieved. The procedure can be summarized as follows:

i. The Gaussian mixture model is used to divide the disperse nodes into bundles, and the UAVs would process each bundle individually. The bundles may be inescapable and cryptic.
ii. For inescapable bundles, we use single-agent deep option learning algorithm, and for cryptic bundles, we use multi-agent deep option learning algorithm.
iii. In this technique, the MADOL algorithm is scattered. Figure 2 can be shown.

Fig. 2 UAVs using disperse nodes

The merit associated with this technique is that it is efficient than other RL techniques. The demerit associated with this technique is SADOL algorithm takes more time.

2.3 Data Acquisition Using Deep Reinforcement Learning for Multi-UAVs

In Internet of Things, lot of devices will be connected in the network. The data that are being collected by the IoT devices will be sent to the central coordination center [10]. Since both UAVs and IoT devices consume lot of vivacity when they are operating, there is a need to reduce the vivacity consumption of both of these devices. Also, the UAVs can easily readjust their paths if they come across any obstructions to reach the IoT device [11]. The steps in this process can be summarized as follows:

i. **UAV map-reading**: In this step, the UAV finds the IoT device from where the data have to be collected by overcoming the obstructions if any. This process is done by using the scope determiners.
ii. **Device current dominance**: In this step, the UAVs collect the data from the IoT devices. The UAV sets the clear transmit power for the IoT device. In this way, the UAVs achieve the vivacity efficacy of the IOT devices.
iii. **Multiple UAV Organization**: In this technique, the data collection is planned in a proper way. It is made sure that the UAVs do not run out of vivacity.

For all the above processes, we use deep reinforcement learning algorithms. The merit associated with this technique is that it achieves efficiency in terms of vivacity. It provides better solution. The demerit is that it is more complex.

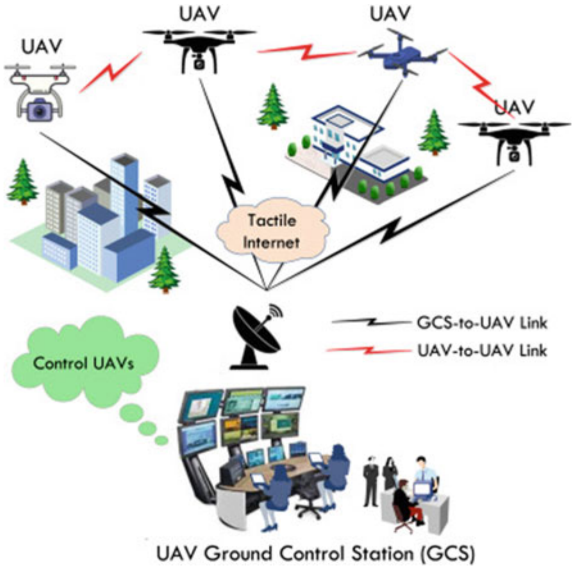

Fig. 3 Blockchain-enabled UAVs

2.4 *Data Acquisition Using Blockchain in UAV*

In the normal process, UAVs may run out of their vivacity, and since the IoT devices are externally visible to the environment, these devices may be subjected to attacks. To overcome these problems, blockchain technology was added to the existing process. By pushing data and transactions, UAVs get charging coins as benefits. To provide security, this technique uses blockchain to protect the IoT devices from unwanted invasions. The merit associated with this technique is that it uses prediction algorithm to reduce vivacity and provide protection for IoT devices. The demerit associated with this technique is that it is more complex. Figure 3 for the above process is shown.

The table below summarizes the above techniques.

Methods	Merits	Demerits
Data acquisition using swarm intelligence	Less complex	Elevation of UAV not addressed
Deep reinforcement learning	Provides better efficiency	SADOL algorithm is not time efficient
Deep reinforcement learning using multiple UAVs	Efficient vivacity	More complex
Blockchain-enabled UAV	Reduces vivacity consumption using prediction	More complex

3 Conclusion

In this paper, we have identified and looked over the various modern data acquisition techniques. We have outlined each and every techniques. We have also identified the merits and demerits of these techniques. Though these techniques are having merits, they are some way not better than each other. Based on their merits and demerits, we can select a particular technique for data collection from IoT devices for smart transportation. In the next paper, we would outline the different methods of providing security for IoT data.

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