Research Article

Optimization Analysis of the Emergency Logistics Identification Method Based on the Deep Learning Model under the Background of Big Data

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Vehicle routing, which is effective and efficient, is a dominant aspect of supply chain management in general and deep learning (DL) in particular. It is also a right step towards the fuel conservation and environmental concern in disposing used commodities. Economics of logistics and transportation plays a major role in deciding the competitiveness of the product, either new or used, in the market. With the upward trends of fuel and logistics costs, manufacturing industries have little option other than keeping the cost of transportation the lowest. Many organizations now started implementing lesser expensive and proper transport modes to keep the maintenance of supply chain cost to the minimum. Proper handling of returned commodities to recover value without affecting the environment may need appropriate techniques or methodologies. This paper deals with the routing of vehicles with energy conservation as the agenda in the value recovering method named as repair service work. It is done through a big data-based deep learning model, in a multicommodity environment. Here, the transportation of commodities to repair service facilities is given an in-depth focus to reduce the energy use. The minimization of the distance traveled by the truck fleet reduces the energy consumption by the trucks. This article deals with the optimization of emergency logistic with the assistance of deep learning approach, whereas this approach attains 57.19 km with 6 optimized routes. The process of emergency flow control is attained effectively using deep learning approach.

1. Introduction

In today’s business, administering the returns of products, parts, and materials from the consumer to the supplier is a big challenge to organizations [1, 2]. This has been given more attention for value recovery, environmental concerns, and sustainable development. Customer protection legislation permits end-users to return goods at no cost, if they are not fulfilled with their performance [3]. Reverse logistics is the procedure of arranging, executing, and being in command of the raw materials and returned goods from the place-of-use to the place-of-origin. Reverse logistics activities are collection, disassembly, processing, remanufacturing, refurbishing, cannibalization, repackaging, and proper disposal of used parts and products so as to recapture value from the returned parts [4, 5].

Reverse logistics can be defined as the procedure of arranging, executing, and being in command of the flow of parts, raw materials, components, and finished goods as well as integrated information from the place-of-use to the place-of-source for the intent of recalling investment value or safer discarding. The process of supply chain and logistic with the support of Internet of Things (IoT) has necessitated computational algorithms [6, 7]. It
interlinks reverse logistics by means of inferior goods that are refused, returned, or rejected following a primary sell out. The benefits of reverse logistics to organizations and their customers are as follows:

(i) Increase in public perception
(ii) Encourage competition in manufacturing
(iii) Improved customer satisfaction and loyalty
(iv) Reduced risks to the business
(v) Recovery of capital investments in assets
(vi) Improved company’s image, benevolence, and reputation

For the effective treatment of returns, organizations require information management and communication system to arrange and be in command of the reverse logistics activities [4]. It is a great challenge for companies to manage reverse logistic operations because of improbability of time, place of origin, legal obligation, and quality and quantity of returns. From the above said reasons, it is advisable to implement information and communication know-how in organizations to manage reverse logistic operations [8].

Reverse logistics flow is extremely dissimilar to the onward flow. In forward logistics, the product is transmitted to a distribution center (DC), and afterwards, to the retail stores. In this network, forecasting can be utilized to calculate the requirement, and consignments are transmitted in reaction to the DC or retail stage [9]. At every stage, advanced shipping notice (ASN) technique is used which provides detectability of product arriving [10]. The process of utility estimation in logistic and supply chain plays a prominent role [11].

By drawing a distribution, the flow of reverse logistics is more immediate by means of visibility. Companies usually do not instigate the activities of reverse logistics according to arrangement as well as decision-making part of the business, on the contrary in reaction to the actions by consumers or downstream channel members. Generally, customer returns an item to a retail store. The collected items from the retail store are sent to a centralized sorting facility. The information system is used to record information about the item and its condition at the time of return. It is then advanced to the returns processing center [12].

The exact meaning of “Big Data” varies depending on the potential of the organization handling large data sets and on the capabilities of the applications that manage and process it [13]. Big data usually consists of huge volume of unstructured data which is beyond the ability of traditional applications to manage and process it [14]. Data is growing in volume day by day due to the fact that it is gathered by various tools such as wireless sensor networks, social networking websites, data logs, satellite data, and ubiquitous data-sensing mobile devices [15, 16].

As the volume of data is growing exponentially, organizations are now focusing on how to derive advantage from this “large scale data” in the digital era [17]. The enterprises are leveraging this large data to support effective decision-making through big data analytics. Such big data analysis impels almost every aspect of our modern society, including retail, healthcare, manufacturing, mobile services, financial sector, life sciences, and education [18–20]. The essential requisite for big data analytics is scalability because of the massive volume of data which need to be gathered, extracted, processed, and analyzed [21, 22].

Data requires a set of advanced techniques and innovative technologies which can process large quantities of data sets [23]. It requires massive parallel applications running on a cluster of hundreds or thousands of servers. Recent studies have suggested various suitable applications running on a cluster of hundreds or thousands of servers. Recent studies have suggested various suitable applications running on a cluster of hundreds or thousands of servers.

Data science conceals predictive and statistics modeling and incorporates deep learning as a key component. In the perspective of business and logistics, the quantity of data is huge, and it can be effectively handled using big data technology [25]. The data prepared by big data is passed to the deep learning phase for flow control, and it is done using hybrid deep belief network with long short-term memory (DBN-LSTM) [25, 26].

In most of the existing works, performance of the system is not satisfactory. More innovative techniques are needed for the existing methods. Statistical modeling is also needed for the existing methods. To overcome these limitations, this article is proposed.

This paper deals with the routing of vehicles with energy conservation as the agenda in the value recovering method named as repair service work. It is done through a big data-based deep learning model, in a multicommodity environment. Here, the transportation of commodities to repair service facilities is given an in-depth focus to reduce the energy use.

The remainder of the research article is systemized as follows: the logistic optimization process using MapReduce is detailed in Section 2, the flow control using deep learning approach is given in Section 3, the results are elucidated in Section 4, and the article is concluded in Section 5.

2. Big Data for Logistic Optimization

The MapReduce is the programming model which has the capability to execute the numerous amounts of raw data resolving the number of allocable using comparatively inexpensive product hardware. It is a suitable framework for proficient huge scale data processing environment. It is evolved to overthrow the problems of executing the numerous amounts of data with the reference to the internet-oriented applications. These huge size data are essential to be indexed, deposited, recovered, examined, and also excavated to permit a modest and endure admission to these data and information.
In present days, there are four sequential aspects exist in the present business and inventiveness that are handling, storage, picturing, and investigating the huge amount of data. The MapReduce can routinely execute the applications on analogous cluster of hardware. Besides, it has the ability to execute the terabytes of data more promptly and proficiently. Henceforth, the reputation of MapReduce process has developed speedily for dissimilar varieties of enterprises in numerous fields. It delivers the extremely operative and proficient framework for the similar implementation of the applications and data distribution in distributed database systems.

The developers who utilize the library of MapReduce must deliberate the two significant processes such as Map and Reduce function. Here, the Map function receives the key/value pair as input and creates the intermediate key/value pair for further processing. The reduce function combines whole the intermediate key/value pair and then creates the final output. The MapReduce framework is implemented in the Hadoop open source software. It provides the upcoming features such as energy efficiency of jobs, scheduling of jobs and tasks, performance, elasticity, and load balancing of cluster.

Mapper is as follows: the mapper phase is initial phase of MapReduce framework where the provided input is going to segregate into two components such as key and value. Here, the key is writable and equivalent in the handling stage. Then, the provided input is split into the numerous input splits. The input splits are the rational splits in the environment. Here, the record reader translates these input splits in key-value pair. It is the real input data setup for the mapper input for auxiliary handling of the data that exists in the Hadoop system. The input format type changes adaptively for each application. Hence, the programmer has to perceive the input data and code consequently. In this, partition and combiner rationalities are come into the mapper process only to execute the special data process. The combiner is also known as the mini reducer. For huge amount of data processing in the Hadoop environment requires the high network bandwidth. To overwhelm this issue, the combiner phase is included after completing the mapper process. The partition module in the Hadoop framework plays a significant role in the process of separating the data acquired from either diverse mappers or combiners.

Shuffling and sorting is as follows: the shuffling and sorting is the intermediate process in the Hadoop system to perform the MapReduce process. After completing the mapper process, there exist huge amounts of middle data to be moved from all the Map nodes to shuffler. It sorts the key of the given input; hence, the whole pairs with the similar value key are gathered together. Besides, it is obligatory to transfer the sorted output to the reducer nodes for further MapReduce process.

Reducer is as follows: the reducer is the final process in the MapReduce framework. The reducer process obtains the transitional key and group of values of the given key. It gathers all the incoming data to create the smaller set of values, i.e., it combines the same key value pairs to provide the output. In reducer, record writer module writes the data from the reducer to the Hadoop environment. The MapReduce framework is implemented to be fault-tolerant since disappointments are a general phenomenon in huge scale disseminated computing. The MapReduce architecture performs to be a better choice for the following reasons:

(i) The processing of information yields from similar and dispersed architecture with easier software design process of map and reduce methods

(ii) The most of the data finding and mining statistics can be occupied into the MapReduce architecture, identical to the pattern-based explanation algorithms

The Hadoop framework qualifies the dispersed, data-intensive, and analogous applications through investigating an excessive task into the lesser tasks and enormous dataset into the slighter partitions in a manner that every job processes a diverse barrier in parallel. The Hadoop framework permits the dispersed processing of huge datasets through clusters of computers using the particular programming paradigms and models. It is modeled to speed up from a one server to thousands of nodes. It is modeled to estimate the failures at application level rather than depend on hardware for high accessibility.

3. Flow Control and Emergency Logistic Identification Using Deep Belief Network with Long Short-Term Memory (DBN-LSTM)

The flow control of multicommodities in RL network is analyzed by presenting the nature and magnitude of a RL problem, which arises in manufacturer’s repair service facilities, where the repair services of the commodities are made using deep learning approach [26–28]. For flow control-related logistic data categorization, the DBN-LSTM is an extension of the generative models. This model has been improved in several ways, the most notable of which being the replacement of the recurrent neural network (RNN) with an LSTM, a more powerful neural architecture capable of simulating temporal dependencies across long time steps. This guarantees that the model remembers information about the created sequence for a longer period of time. This feature lends itself very well to modeling creativity, especially for generative models. In the example of music production, using an LSTM rather than an RNN would result in less repetition and more diverse music owing to greater generalization, since the LSTM’s increased memory would include more information about previously created music in the sequence than an RNN.

There are essentially two points for interaction between the DBN and the LSTM. The input to the LSTM is calculated by equation (1) as

$$q_{il} = \Phi \left( y_{qit} + W_{hi}h_{il-1} + W_{sat} \right), \quad (1)$$

where $q$ is a vector encoding the concealed unit $q = (q_1, q_2, \cdots, q_T)$. Bias vectors are the $b$ terms (e.g., $y_q$ denotes bias
of the hidden layer). The nonlinear function $\Phi$ varies depending on the situation; however, in the case of a generic RNN, it is generally the adoption of element-wise sigmoid, as shown in the following equation.

$$
\Phi(x) = \sigma(x)
$$

where the bias vector for the hidden layer at $n$-th position is indicated by $b_h$. The hidden units of the DBN are equated by equation (2) as

$$
b_{vi} = b_{vo} + W_{qvi:1} + W_{qvi:1}
$$

where the bias vector for the hidden layer at $n$-th position is indicated as $b_{vi}$, and the visible layer at $t$-th time of the recurrence for the DBN is indicated as $b_{vt}$. As a result, the temporal dependencies acquired by the LSTM have a significant impact on the organizational depictions learned by the DBN to build the conditional probability that is $P(\sigma_i, h^1, \cdots h^K)$.

Customers return their commodities, when it needs any repair service work, to the respective disposer market. From the disposer market, the commodities are sent to repair service facilities. The controls towards the assignments of flow of commodities into repair service facilities are made based on neural network. After the repair service, the commodities are returned back to the reuse market, i.e., the customers who have returned them. The situation stated here has the major consideration of assigning the flow of multicommodities into repair service facilities through neural network and to decide on the capacity levels of the repair service facilities, while satisfying both minimum investment and operational costs and maximum customer satisfaction.

### 4. Result and Discussion

To get effective control on the allocation of multicommodities into various existing repair service facilities, so as to improve the profit of the network and service levels, here, genetic algorithm approach is used. The flow of commodities is supported by the neural network. The algorithm gives better results when compared with the results obtained by simulation approach.

Table 1 indicates that the commodities collected from the disposer markets are allocated to different repair service facilities with different settings. The illustration of Table 1 is given in Figure 1.

The control and allocation of flow of commodities into the repair service facilities obtained by both DL approach and with simulation approach are given in Tables 2 and 3 and Figures 2–4.

The model was simulated with a real time data obtained from a service facility. The simulation involves the flow of returned commodities to the repair service facilities. The simulation results shows that the vehicle routing problem proposed along with the methodology for energy conservative measures reduces the energy use by the trucks and the emission and noise of the trucks to a large extent.

In this work, research formulated a vehicle routing problem for solving the real logistic problem involved in a DL model with multicommodity flows. The model formulation has been done with the objectives of reducing the energy use by the trucks while transporting the commodities to existing service facilities and thereby reducing the emission and noise, which impact the environment greatly.

The vehicle routing heuristics optimized the routes to be followed to pick retuned multicommodities; hence, there is considerable reduction on the logistics cost, Rs. 1806597.32 saved with improved customer’s satisfaction. Energy conservation measures as suggested would further reduce the transportation time, and it was found that there is 49 sec of time saved and operating cost of the repair service facilities
Comparison of commodity flow

Figure 1: Diverse setting for flow commodity.

Table 2: Computational result.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Simulation OBJ value (Rs)</th>
<th>DBN-LSTM OBJ value (Rs)</th>
<th>Time (sec)</th>
<th>Time (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1800474.37</td>
<td>1800152.24</td>
<td>45.78</td>
<td>41.00</td>
</tr>
<tr>
<td>II</td>
<td>1800925.37</td>
<td>1800737.27</td>
<td>102.86</td>
<td>62.00</td>
</tr>
<tr>
<td>III</td>
<td>1801327.37</td>
<td>1806597.32</td>
<td>59.12</td>
<td>49.00</td>
</tr>
</tbody>
</table>

Table 3: Results of emergency logistic identification.

<table>
<thead>
<tr>
<th>Result</th>
<th>Before optimization</th>
<th>After optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total distance</td>
<td>196</td>
<td>57.19</td>
</tr>
<tr>
<td>Number of routes</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Truck capacity-commodity</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
**Figure 2:** Comparison of OBJ value.

**Figure 3:** Comparison of time.

**Figure 4:** Results of emergency logistic identification.
while conserving the precious fuel. DL services provided as little bit complex.

5. Conclusion

Vehicle routing which is a significant aspect in logistic and deep learning (DL) plays a prominent role in supply chain management. It is also a good move toward fuel saving and environmental concerns when it comes to dumping used goods. The economy of shipping plays a significant influence in determining the competitiveness of a product, whether new or used. With rising fuel and logistical expenses, industrial businesses have no choice but to keep transportation costs as low as possible. Many firms have begun to develop less expensive and proper transportation alternatives in order to reduce supply chain costs to a minimum. The proper treatment of returned goods to recover value while minimizing environmental impact may need the use of certain procedures or methodologies. This article deals with the optimization of emergency logistic with the assistance of deep learning approach, whereas this approach attains 57.19 km with 6 optimized routes. The process of emergency flow control is attained effectively using deep learning approach. In future, the flow optimization can be accomplished using artificial intelligence approaches.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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