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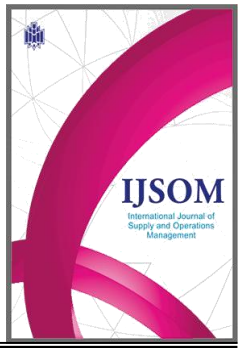

A Survey Paper in Transportation Logistics based on Artificial Intelligence

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Abstract

In the recent era, Transportation considers the most powerful component of the business logistics system. Likewise, there is an interdependent relationship between the transportation and logistics systems. This paper aims to make a comparative study of logistics transportation problems based on intelligence algorithms. The researchers surveyed the previous studies conducted in the Artificial Intelligent field to solve complex problems. In this research study, the authors focused on techniques that are mostly applied in transportation and logistics systems, especially, Artificial Neural Network, Genetic Algorithm, and Fuzzy Logic models. Also, a proposed model and algorithm was done to obtain customers' and organizations' satisfaction. Artificial Neural Network uses as a decision tool that combines the system stat sets and the operation state-dependent sets. As well, the genetic algorithm combines the best parameters as a method to finds the best evaluation solutions. And fuzzy logic uses a fuzzy set to help decision-makers in making the best decisions in multiple fields. Finally, authors recommended to work in two new areas which are FGA, NFGA Algorithms to solve complex and multimodal problems that faces transportation logistics sector.

Keywords: Logistics, Genetic algorithm, Fuzzy logic, Artificial neural network, Transportation, Intelligence algorithms

1. Introduction

Nowadays, Artificial Intelligence plays a leading rule in recent research studies. Artificial Intelligence (AI) can be decided as intelligence executed by a man-made system. Consequently, it endeavors to create a machine that behaves in ways that would be called intelligent in case a human were to do the same thing. Also, AI has improved the management sectors that include logistics management. AI was found in the diverse fields of recent research studies that utilize a determination of strategies and pursue a spectrum of logical objectives. The most point of an Artificial Intelligence based system is to achieve a human level of intelligence (Sudarshan and T. Nageswara Rao, 2010).

Especially the logistics considered being a science of managing and controlling a flow of products, information, and other resources. Also, logistics contains the integration of knowledge, transportation, inventory, storage, material handling, and packaging. For that, all these components can be defined as business logistics (Turkay Yildiz, 2014). The most effective component of the business logistics system is the transport system. Without this system, the communication, and the power of logistics strategy, cannot represent its maximum capacity into full play. Also, there is an interdependent relationship between the transportation and logistics systems. Logistic management needs transportation to apply its activities and at the same time, a successful logistics system could enhance the traffic atmosphere and transportation development (M. Sreenivas and T. Srinivas, 2014).

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Paper organization. Section II briefly explains the research background. Section III surveyed the previous related work. Section IV discusses the results. Section V illustrates the comparative analysis study. And section VI provides the conclusion of the study.

2. Problem Definition and Objective

The aim of any organization is to achieve the maximum profit. Maximum profit is achieved from purchasing maximum number of elements that obtain customer needs; however, organizations cannot fulfill all customer satisfaction in a product. So, it is extremely complicated neutralization to have customer satisfaction and to maximize profit of an organization at the same time. So, this research tries to find solutions to solve these problems "to gain both customer satisfaction and to maximize organization's profit", to achieve the optimum solution using possible AI techniques. Finally, the main objective of this survey is to make a comparative study to solve complex multimodal problems in Transportation Logistics in a useful way.

3. Background of Research Study

3.1. Genetic Algorithm Science in Transportation:

Genetic Algorithm (GA) utilized as a searching algorithm that adapts to solve genetics as patterns and finds the nearest optimum solutions. For optimization and searching problems, the basic steps of GA illustrated in figure 1. Here, GA begins with a population of random solutions provided. Hence, the fitness function should be evaluated for each “chromosome” in that population. For reproduction, crossover and mutation are used to select chromosomes with the highest fitness value. If the criteria ended without meeting the goal required, the procedure will be repeated to evaluate the new population, and so on (S. Rajasekaran and G.V. Pai, 2003).

In GA, the crossover applies a genetic operator to vary the set of chromosomes from sole choices. Especially, parallel to selection and biological crossover and upon which GAs was based, as shown in (Sudarshan and T. Nageswara Rao, 2010), (B.P. Haddow and G.Tufte, 2010) and (John H. Holland, 1992). GA composed of three essential factors explained below.

a. Selection:

Reproducing strings according to their goals FN: values of "Fitness Function"

- It is always the first operator used on the population.
- Chromosomes are chosen from the population of parents to cross over and process children.
- It relies on Darwin’s normal theory of “the existence of the fittest”.
- Subsequently, this operator is also known as “Reproduction operator”.

b. Crossover:

Organ of the newly generated strings is linked at random. Each pair of strings undergoes crossing over.

- After the selection stage, the population is improved with superior individuals.
- It makes twins of great strings but does not produce new things.
- Crossover operator is supposed to the mating pool with a purpose with it would produce superior strings.

c. Mutation:

Supplementation Selection and crossover and act as a confirmation policy against early loss of serious concept.

- After crossover, the crossover, the strings are a concern to mutation.
- Mutation of a bit contains flipping it, changing “0 to 1” and vice-versa.

Selection produces freshly reduplicated strings for the coming descent’s mating group. For all the strings in the mating group, "crossover and mutation" are executed agreeing to the rate of crossover and the rate of mutation separately. After these processes, Selection according to the following descent is implemented once more. These processes are renewed until optimum descent is obtained. A few parameters of GA, rate of crossover, rate of mutation, and so on should be decided experimentally. Describe these parameters to determine the common criteria. To execute the GA to the solution proceedings for the minimum loss issue is formulated here; and it should detect a fitness function.

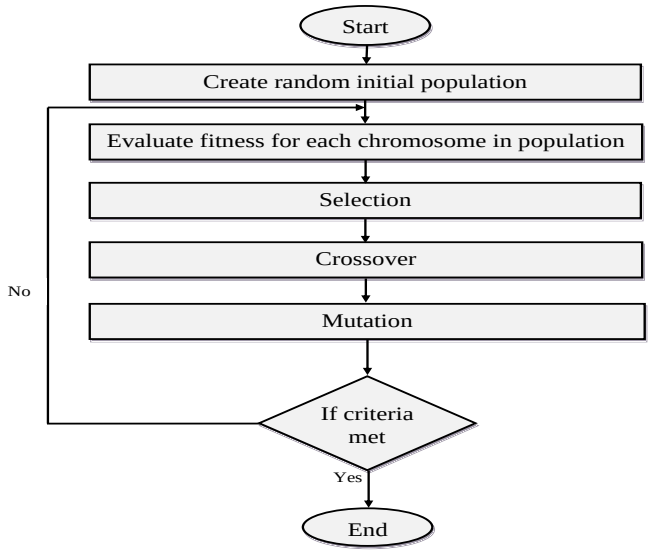

Figure 1. GA Flowchart

3.2. Fuzzy logic science in Transportation

Fuzzy logic is one of the shapes of logic that has been utilized in systems and applied artificial intelligence, which could be a significantly effective technology to discover solutions to the issues of application and includes a clear impact in decision-making in solving the different issues confronting decision-makers, including researchers due to inexactness, which leads to mistakes in deciding the goal inquired by decision-makers, And through applying this logic, particular conclusions are gotten from vague data in opposite to "classical logic Which needs the definition of the numerical values of the system and hence the fuzzy logic is a kind of multi-value logic and a system of concepts utilized within the methods of precise conclusion. This logic was formed in 1965 by the Iranian scientist Lutfi Zadeh. Wherever he developed it as the leading method of data handling, that target to display mathematical functions which at the starting were utilized at mathematical rules and statistical methods, after that the mathematical rules and statistical strategies were combined. There are various reasons that motivated researchers to develop this logic moreover with the development of new technology the fuzzy logic has gotten to be one of the theories that modern theories have been built on (Afraa Abbas Hamada, 2018). Fuzzy logic has been utilized in all sorts of applications such as neural systems, manufacturing processes, etc. since of its incredible significance in decision making to select the ideal solution to the issue (Abdullah, et al, 2012), And to have more adaptability to reach the ideal solution, it was essential to resort to the utilize of a few mathematical models with a fuzzy shape that is the optimal method in addressing such sort of problems (Afraa Abbas Hamada, 2018).

- **Types of membership liner:**

A. **Triangular Membership Function**

It is a functioning membership liner with three figures with a line shape when it be (Afraa Abbas Hamada, 2018): A= (L, m, U). It could be said that A: shows a triangle fuzzy number and we can express the function above, as follows:

$$\mu_A(x) = \begin{cases} \frac{x-L}{M-L} & if\ L \le x < M \\ 1 & if\ x = M \\ \frac{U-x}{U-M} & if\ M < x \le U \\ 0 & if\ otherwise \end{cases} \quad (1)$$

Where:

L: explain the minimum value
M: explain the center value
U: explain the maximum value

$\mu_A(x)$ the grade of (x) membership is ranging between [0, 1], and the function is illustrated as figure 2.

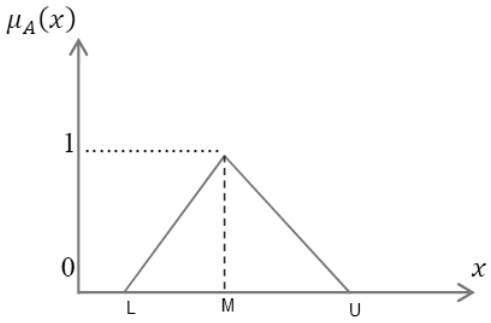

Figure 2. Triangular Fuzzy Logic.

B. **Trapezoidal Membership Function**

It is a function member ship liner with four figures.

A shows $four\ shapes\ to\ the\ fuzzy\ number$, where (Al-Ubaidi Marwan abdel hameed Ashwur, 2009), it can be performed by figure 3: A= (L, ML, MU, U)

$$\mu_A(x) = \begin{cases} \frac{x-L}{ML-L} & if\ L \le x < ML \\ 1 & if\ ML \le x \le MU \\ \frac{U-x}{U-MU} & if\ ML \le x < MU \\ 0 & if\ otherwise \end{cases} \quad (2)$$

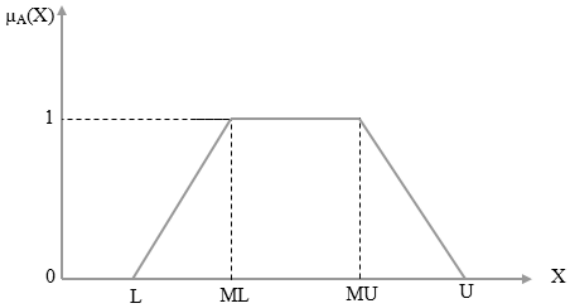

Figure 3. Triangular Fuzzy Logic.

C. **Linear Membership Function**

A linear membership function can be defined as follows (S. Narayanamoorthy, et al, 2013).

$$\mu_m(X_m\ (y)) = \begin{cases} 1 & if\ X_m \le L_m \\ 1\ \frac{X_m - L_m}{U_m - L_m} & if\ L_m < X_m < U_m \\ 0 & if\ X_m \ge U_m \end{cases} \quad (3)$$

Where L_m is the goal level of accomplishment and U_m is the most noteworthy accepTable level of accomplishment for the math objective function.

D. **Exponential Membership Function**

An exponential membership function can be determined as follows (D. Anuradha, and V. E. Sobana, 2017).

$$\mu^{E}_{m} = (X_m(y)) = \begin{cases} 1 & if\ X_m \le L_m, \\ \frac{e^{-s\psi m(y)} - e^{-s}}{1-e^{-s}} & if\ L_m < X_m < U_m, \\ 0 & if\ X_m \ge U_m \end{cases} \quad (4)$$

Where:

$$\Psi_m(y) = (X_m - L_m) / (U_m - L_m)\ m = 1, 2, 3, \ldots\ldots M \quad (5)$$

And "S" is a non-zero parameter recommended by the decision maker.

3.3. Artificial Neural Network Science in Transportation

Artificial Neural Network (ANN) has tremendously disseminated parallel computing made up of some handling units, which have a normal tendency to store knowledge and making it accessible as and upon request. The natural such handling unit is called a neuron. The motivation for ANN is create from the human brain; a greatly complicated structure made up of neurons and can perform or is trained to perform certain computations numerous times quicker than most computers in presence nowadays. Some cases of such computations contain design recognition, engine control, and so on. Neural networks are thus, machines that can be modeled to perform a specific mission and in doing so, imitating the human brain. The network can be developed by electronic components or simulated on computer software. The process utilized for training the network is called a learning algorithm, whose work is to change the junction weights of the network to get the required objective shows in figure 4 (S. Rajasekaran and G.V. Pai, 2003), (P. Vas, 1999).

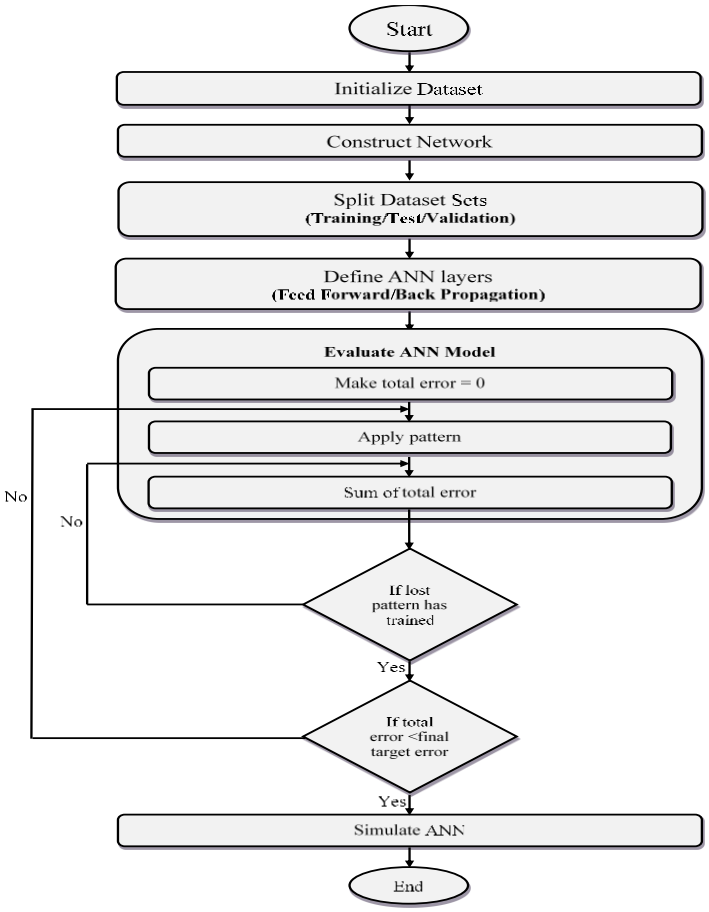

Figure 4. Artificial neural network flow chart

Neural networks are regularly organized in layers. Layers are drawing up of several interrelated 'nodes' which contain an 'activation function'. Models are represented to the network through the 'input layer', which exchanges to one or more 'hidden layers' where the specific action is done through a system of weighted 'connections. The unobserved layers then connect to an 'output layer' where the response is output. It is shown in figure 5.

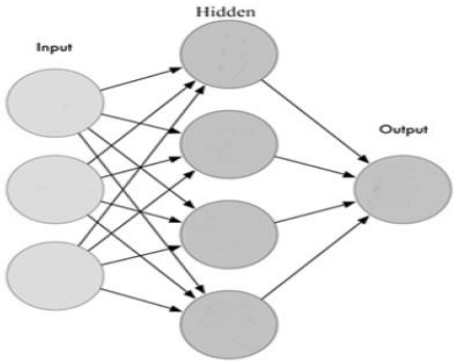

Figure 5. Neural Network Layers

3.4. Pros and cons for usage algorithms:

In this section we will briefly discuss the pros and cons for each algorithm used in our experiments as shown in Table 1,2 and 3.

3.4.1. Pros and Cons for Genetic Algorithm

Table 1. Pros & cons of GA

Pros	Cons
Elastic and massive viable optimization process.	Cannot be used in mathematical simplification.
Detect Comprehensive Solution.	It is hard to predict for a long period.
Optimize Multi-Objective Measurements.	Complex to be used in a multimodal problem.
Easy to Know and understand.	Low speed for detecting optimization solution

3.4.2. Pros and Cons for Fuzzy Logic

Table 2. Pros & cons of FL

Pros	Cons
Flexible and easy to understand, analyze and use linguistic variables.	It is hard to design a model.
Not expensive technique.	Estimation of membership function is very difficult.
Has the ability to understand human knowledge and understand unsteady applications.	It needs a lot of data.
It can reach solution in a short time.	Verification and validation need wide experiment with hardware.

3.4.3. Pros and Cons for Neural Network

Table 3 Pros & cons of NN

Pros	Cons
Adapts to conditions of unprecedented knowledge.	Overlook.
Massive.	Not accurate.
Easy to use.	Require the training to run.
It may be forced in any system.	Needs massive processing period for huge NN.
Not difficult to be executed.	It is hard to know the number of neurons and layers that are required.
NN is more powerful and efficient than linear process.	Need more time to learn it.

4. Literature Reviews

4.1. Literature Review in Transportation Based on GA

According to, (Hassan Jafarzadeh, et al, 2017); a generic reverse logistics network was presented. That designed to satisfy different industries' requirements and a mixed integer programming model was developed to solve it for the remanufacturing repair systems. Also, they used a genetic algorithm with modified priority-based encoding method to solve the model. Authors made an experimental design schema to validate the performance of the model and solved different large-scale problems.

(Mohamed Nour El-Din Abu Shamma, et al, 2017); Stated an optimization model, to generate optimal solutions of dynamic site layout planning for minimizing cost of resources travel and costs of facilities relocation that compatible with various site geometric constraints. This model was implemented by using genetic algorithm. The model was consisting of two phases. First phase layout planning, the model was considered four types of geometric constraints (boundary, overlap, distance, and zone constraints) to present the site space availability. Second phase logistics planning cost, the model was developed to make integration and simultaneous optimization of critical planning decision.

Similarly, (Stanislaw Iwan, et al, 2015); presented a model for optimizing the location and utilization of mobile terminals for urban distribution using bicycles. Benefits and results come from this paper: The location of terminals and allocation of suppliers to purchasers involving the simplest type of the localization problem of numerous transit nodes was investigated. So, a genetic algorithm was developed and used for identifying solutions for these networks.

Moreover, (Piotr Lesiak, et al, 2015); solved a transit routing and scheduling problem using genetic algorithm. The purpose of transit routing is to determine a good set of routes and it should satisfy some criteria like requirement of the people to travel, satisfy most of the demand without requiring passengers to transfer from one route to another, it should offer low travel time (including the time spent by passengers in transferring) to its passengers. Determine scheduling and finding the optimal timeTable for each given route. Authors put and follow some constraints to find the optimal timeTable.

Likely, (Qi Zhang, et al, 2014); present a study supports that "***solving the functional areas layout optimization problem of the railway logistics parks using Genetic Algorithm***". They solved the layout problem using mathematical methods instead of the traditional manual adjustment method. They create a model and taking the maximal arithmetic product of comprehensive relationship and adjacency degrees as the objective function. Then they coded the article with MATLAB based on GA. Finally, they evaluated the model to its feasibility and rationality by a practical illustrative example.

(Mustapha Oudani, et al, 2014); mentioned a multimodal transport problem, known by NP hard problem. Also, they concerned with the intermodal terminal location problem. So, authors solve these problems by using GA. However, they compare their solutions by CPLEX and other heuristics mode. Results come from this paper; authors found their model has high accuracy more than CPLEX and another heuristic model by 0.21%.

(Harshita Joshi, et al, 2018); stated a proposed mathematical model to minimize costs and time of transportation to be the optimum solution using Genetic Algorithm.

According to, (Mariusz Izdebski, et al, 2018); a Proposed multicriteria model to detect warehouse's location was done. Hence, to detect definitions and optimum criteria of that model. Authors using GA to facilitate founding optimum locations.

(Shekh Rasel, et al, 2018); mentioned a subediting disaster concerning to emergency satisfaction supply model using GA and linear programming. The model solves the problems that are related to excess and scarceness of products. As changeable and truck space as bonds.

(Amirah Rahman, et al, 2019); stated a study of counting product transportations problem to minimize the space enveloped in transportation process. As authors modelling the issues of "travelling salesman problem (tsp)" and fix it using GA. However, they propose a novel "Nearest-Node Pairing Crossover (NNPX)", to counting TSP.

4.2. Literature Review in Transportation Based on Fuzzy Logic

(P. Anukokila, et al, 2019); mentioned a proposed method "***Trapezoidal intuitionistic Fuzzy Fractional Transportation Problem (TIFFTP)***", to find optimum solution. Authors compare their method by "Gupta & Anupum" methods. Also, they achieve their goals successively, by solving uncertainty transportation problems.

Also, (Gaurav Sharma, et al, 2020); improves a model that used fuzzy sets with soft set approach, to solve multimodal and multi-objectives transportation problems. Besides, model achieves its goals by minimizing costs and time duration of transportation. In addition, it can be used as an intelligent system for making decisions.

However, (Vladimir Gajovic, et al, 2018); modelling Fuzzy Analytic Hierarchy Process (FAHP) model, to obtain the total risk of logistics process, depend on the importance of different risk elements evaluations based on Analytic Hierarchy Process (AHP) models. According to, its dependence on fuzzy logic. Authors provide a new approach to be used in multiple zones of science and for functional objectives. Also, they are measuring data consistency by expertise and takes their feedbacks to gain accurate results.

As well, (Ievgen Medvediev, et al, 2020); develop a logic linguistic model using fuzzy logic. To create several conditions for the accurate calculations of the vehicle needed and put on its consideration “technical, Technological, and weather conditions” of transport complex. Authors used ToolKit that it provides more accurate results than the classical approach.

Also, (Elifcan Gocmen, et al, 2018); focus on how to minimize transportation costs. Also, how containers can point to several transportation location. Solving this problem by creating mixed integer programming depends on mathematical models. Authors used fuzzy based approach to take optimum decision.

Furthermore, (Stefan Jovcic, et al, 2019); use decision-making tools in the selection of “Third- Party Logistics” 3PL provider that help in decision making. Also, create a “Fuzzy Inference System (FIS)” to detect a group of evaluation criteria and sub criteria to detect the relationship between them. Besides, implementing this system using Fuzzy Analytic Hierarchy Process (FAHP).

Else, (Natalya Sharmenko, et al, 2018); faced a problem on delivery grain shipment through sea transports. So, authors develop an approach using fuzzy logic to take a correct selection of trucks. Moreover, a mathematical operation was done to decide an alternative trucks transports and sea terminals.

4.3. Literature Review in Transportation Based on NN

Stated by, (Hongjing Liu, 2015); Author use back propagation neural network technology to apply it on SCM application. This application includes three topics which are "forecasting, optimization and decision support". Also, solves difficult problems that represented in SCM using neural network. Besides, that NN has intensive ability to adapt with other technologies.

As well as (Koorosh Gharehbaghi, 2016), presents the term of Artificial Neural Network (ANN) and its importance function. In addition, to obtain optimization of transportation infrastructure system. Author made a proposed model, which used to detect a definite group of transportation infrastructure assets.

(Lawal S.O, et al, 2021); Mentioned a proposed predictive model for increasing demand of goods to gain customer satisfaction. Therefore, authors used Recurrent Neural Network (RNN) and pre-processing data using min-max scaler to predict increasing demand on which product.

Furthermore, (Siti Nasuha Zubir, et al, 2020); present an application to predict the capacity of weight loaded on a cargo train using ANN. Hence, ANN helping in developing a predictive model using several directing Algorithms “Levenberg-Marquardt (LM), Quick Propagation (QP), Conjugate Gradient Descent (CGD)”.

In addition, (Saurav Dey, et al, 2020); propose a model that used to make integration between inputs from key performance indicators of logistics operations which are “arrival precision, pick up discrepancy alert, number of incidents, late delivery alert, filling rate in transport equipment, stock accuracy”. Moreover, applying it using ANN.

Also, (Feyza Gurbuz, et al, 2019); develop an application for predicting parameters error for logistics category. So, they used datamining and ANN techniques to make classification in Third- Party Logistics 3PL error parameters. moreover, using decision tree and decision forest modules to detect information and resemblance about 3PL error parameters.

4.4. Literature Review in Transportation Based on Neuro Genetic Algorithm

(Paolo Pagani, et al, 2018); Stated a case study for the responsibility of product transportation from the ingredient market to the accumulation line. Furthermore, made a comparison between administration politics "first come first served "FCFS" and "nearest vehicle first "NVF" " with the neuro-genetic algorithm model. Also, this comparison shows how ANN can connect a group of areas, that framework can have. Besides, a group of areas following decisions that able to use in the implementation. Also, training was done with neural network and genetic algorithm together, to generate a freshly neural network through joining parameters by the selected optimum neural network, within each iteration to find and evaluate the optimum solution.

Also, (Ci-yong Wang, et al, 2018); mentioned a proposed novel for prediction depend on combining Genetic Algorithm (GA) with Back Propagation (BP) model for convene logistics of road truck transportation. Due to testing dataset by GA only, it shows resulting good at predicting on short time prices. But combining GA with BP NN shows perfect results at predicting on long time prices.

Else, (Hector Rodriguez Rangel, et al, 2017); Stated a “model Predictive Control (MPC)”. Authors focus on forecasting issues that are related to water demand. The model created and trained using Neuro Genetic Algorithm. In addition to, authors claimed that this model will be well-accepted approach to obtain the optimum economic costs.

4.5. Literature review in transportation based on Fuzzy Neural Network

(NG Levchenko, et al, 2018); analyze fuzzy neural network model, and apply it on transportation and logistics process using Arctic and Subarctic approach. Results showed from applying model, involve a lot of applications that are related to analysis of situation, behavior of interacting components, monitoring, and forecasting of critical situation.

As well as (Chien-Chang Chou, et al, 2019); improve technical analysis indicator prediction of cargo rate in the dry volume freight market by fuzzy neural network FNN, for enhancing accuracy rate. Authors found that the combination between FNN and technical analysis indicator prediction approach will result a higher forecasting rate than, using technical analysis indicator approach alone.

Also, (Ayad Hendalionpour, et al, 2017); develop a new approach for measuring customer’s needs mensuration. By means of mystery and shortage of information, that are related to standard estimated, in the developed model and customer feedbacks, reflect as linguistic terms and using nonlinear relations for behaviors of human using FNN.

Furthermore, (Natlya Sharmenko, et al, 2019); develop a hybrid forecasting model depend on FNN. This model was made to help in planning decisions for organization. Also, help in avoiding Transportation organization in falling with maximum losses.

5. Research Methodology

A descriptive and qualitative study will be conducted, and it include two phases:

Phase 1 Data collection: first define a domain and datasets. Then, classify product items and its costs.

Phase 2 Intelligent Algorithms: and here we define the Algorithm that will be used to gain our objective. First, compute transportation cost and get the minimum cost to be the nearest optimum solution cause in this step we need to get the lowest cost to pay Using GA. After that, compute the total cost for each product, then get the lowest total cost to be the nearest optimum solution Using GA. Finally compute the profit value for each product and get the maximum profit to be the nearest optimum solution using AI Algorithms.

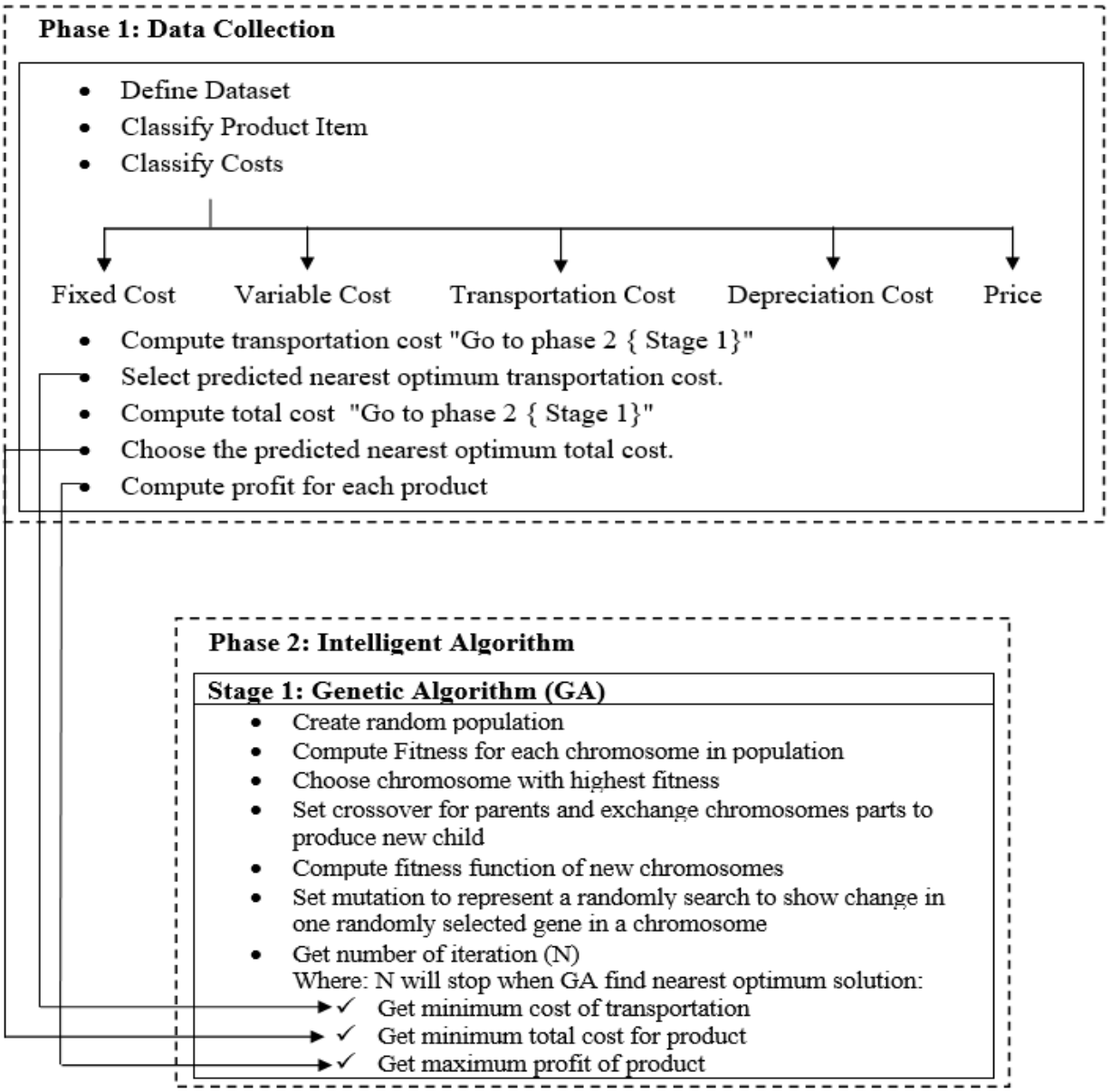

Figure 6. Methodology using GA.

6. A Proposed Model Using GA

A proposed model was done to detect the nearest optimum solution of transportation cost, total cost, price, and profit for each product. Hence, to gain customers' needs and organization satisfactions.

Therefore, the model was work in a several steps which include:
First, model will classify data according to its type. Then, will classify costs of products into 8 categories which are: "Fixed cost, Variable cost, Depreciation cost, Price, Accounting costs, Opportunity costs, Social cost and Private cost".

Then, model will compute the internal cost, external cost, transportation cost. To get finally the target as shown in figure7.

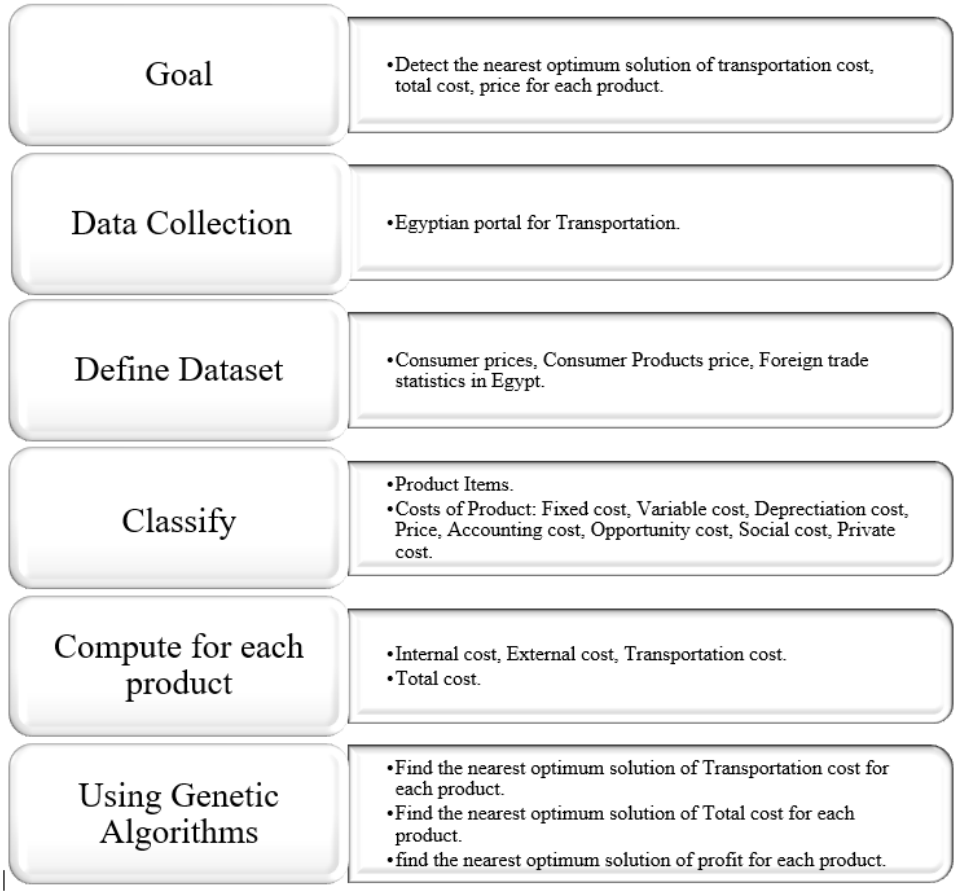

Figure 7. A Proposed model for detecting nearest optimum solution for each product.

7. A Proposed Algorithm Using Genetic Algorithm:

The aim of this proposed Algorithm is to Minimize Transportation Cost and Maximize Profit for each product using Genetic Algorithms as shown in Algorithm 1.

Algorithm1: Genetic Algorithm for transportation logistics.
Input: Fixed cost, Variable cost, Transportation cost, Depreciation cost, Price.
Output: Determine maximum profit for each product.
Procedure:
Step 1: Compute TC for each product.

- IC= ∑ (ACC, OPC)
  Where IC= Internal Cost
  ACC= Accounting Costs
  OPC= Opportunity Costs
- EXC= SC+ (- PC)
  Where EXC= External Cost
  SC= Social Costs
  PC= Private Costs
- TC= ∑ (IC, EXC)
- Get minimum of TC for each product "Go to step 2".
  Where:
  TC= Transportation Cost

Step 2: Find nearest optimum solution using GA.

- Produce random initial population.
- Compute Fitness for each chromosome in population

  Where:

  f(x)c= $\frac{Chromosome\ fitness}{\sum_i^N Chrom\ fitness}$

  f(x)c= Fitness function of Chromosome in population
- Choose chromosome with highest fitness.
- Set crossover for parents and exchange chromosome parts to produce new child.
- Compute Fitness function of new chromosomes

  Where:

  f(x)nc= $\frac{Chromosome\ fitness}{\sum_i^N Chrom\ fitness}$

  f(x)nc= fitness function of new chromosome
- Set mutation to represent a randomly search to present change in one randomly selected gene in a chromosome.
- Stop N when GA find nearest optimum solution.

  Where:

  N= Number of Iteration

Step 3: Compute tc for each product.

Avg.FC= FC/ Q

Avg.VC= VC/ Q

tc= ∑ (Avg.FC, Avg.VC) *Q

Where FC= Fixed Cost

VC= Variable Cost

tc= total cost

Avg.FC= Average of Fixed Cost

Avg. VC= Average of Variable Cost

Q= Quantity

- Go to step2 to get nearest optimum solution of minimum tc for each product.

Step4: Go to step 2 to find maximum profit for each product.

- TR= P*Q
- PR= TR- tc

Where: PR= Profit

TR= Total Revenue

tc= total cost

P= Price

Q= Quantity

End Procedure

8. Discussion and Results

A comparative study was done, to determine each research including which "algorithm, approach, data scope, data source and results" that comes from each research as shown in Table 4.

Results that come from this study:

- ✓ There is a study that combines GA method by NN method. Also, there is another study that combines Fuzzy logic method with NN method to solve a wide range of complex problems.
- ✓ A proposed model and Algorithm were done to minimize transportation cost and total cost and to maximize Profit for organizations. Besides, gaining customers' requirements.

Table 4. Comparative study on Logistics Transportation problem

Author	Year	Domain Orientation	Tool/Algorithm Used	Approach	Data Scope	Dataset/Source	Outcome/Results
Mustapha Oudani, et al.	2014	Yes	G.A	Realistic polynomial time	Optimize Transportation Cost	Maritime Terminal	Comparative solution accuracy more than CPLEX solution by 0.21%
Qi Zhang, et al.	2014	No	G.A	System Layout Planning	Logistics Park	Railway-china	Arranging production area & construction area in east & west in a shorten operation time.
Stainslaw Iwan, et al	2015	Yes	G.A	Holistic	Searching for multiple transit node in Logistics Network	_____	Optimal solution based on GA for 4 transit nodes & 20 purchasers, avg.dev= 46.43% and dev.=15.08%
Hongjing liu	2015	No	NN	Back Propagation.	Supply Chain Management	Bicycle market	BP NN forecasting value than linear by 887.30 relative errors 1.45%.
Pitor lesiak, et al.	2015	Yes	G.A	Nondeterministic Polynomial time	Design transit route network	Metro in Taipei city	G.A was able to determine the optimal solution.
Koorosh Gharehbaghi	2016	No	NN	Classification- Based	Transportation Infrastructure System	_____	NN can solve deep and alterable system problems.
Mohamed Nour Eldin, et al.	2017	Yes	G.A	Classification- Based	Optimization of construction Logistics Planning cost	_____	T.C of Construction logistics by 8.4% and cost savings from 14.5% to 33%.
Hector Rodriguez Rangel, et al;	2017	No	NN, G.A, Python	Mathematical, Classification- Based	Propose a new approach	Barcelona water network, Aguas Company	G.A and NN used to determine the connection weights and it give a better accuracy than traditional optimaization method.
Ayad Hendalionpour, et al;	2017	No	FNN	Linguistic terms, nonlinear.	Measuring Customer Satisfaction	Organization in south part of Iran	Measuring customer satisfaction using FNN has maintained some beneficial purposes over other traditional approaches.
Hassan Jafarzadeh, et al	2017	Yes	G.A	Tree- Based, Priority encoding-Based	Reverse Logistics Network	_____	Solve large scale problem with low error from 2.67% to 7.52%.
Mariusz Izdebski, et al;	2017	No	G.A	Mathematical	Optimization criteria indicated to transportation cost and cost warehouses	_____	Implementation of algorithm examined 200 chromosomes, 100 iteration, so it give sub-optimal solution.
Vladimir Gajovic, et al;	2017	Yes	Fuzzy Logic, AHP, MATLAB	Fuzzy Logic	Create the total risk of logistics process depend on different risk elements.	_____	FAHP model obtain accurate results more than AHP model.
Chien-Chang Chou, et al;	2018	No	FNN	FNN, Technical Indicator	Prediction of freight rate trend	Dry Bulk Shipping Market	using technical indicator approach forecasting =62%, using FNN approach forecasting = 24.76%, using two approach together forecasting= 83%, so it is better to use the two approach together to gain forecasting better.

Table 4. Continued

Harshita Joshi, et al;	2018	Yes	G.A	Mathematical	Optimize Transportation Cos	_____	Using Algorithm with no of iteration, optimize solution through time.
Shekh Rasel, et al;	2018	Yes	G.A, Linear programing	Mathematical	Optimize amount of goods to be stocked and minimize cost	Emergency relief goods (UNO office)	G.A obtain performance than using linear programming.
Elifcan Gocment, et al;	2018	Yes	Mixed integer programing based mathematical model	Fuzzy Based	Evaluate types of risk factors for transportation systems	International Logistics company in Turkey	Model can minimize cost and supply opportunities to pass transportation logistics under any risk factor.
Ci- yong Wang, et al;	2018	No	Back Propagation NN, G.A	Mathematical, Classification- Based	Prediction algorithm based on G.A, BPNN	_____	3PL with AI is more powerful and feasible in freight transportation managemet.
Natalya Shramenko, et al;	2018	No	Fuzzy Logic	Mathematical, Fuzzy Based	Delivery of grain cargoes	_____	Model divided expected rates of change in transportation demand in five layer “more negative, not so negative, middle value, not so possitive, more possitive” and divided the optimal level of loads in the trucks in 3 layers “below optimum, optimum, above optimum”.
NG Levchenko, et al.	2018	Yes	Fuzzy Logic, NN	Arctic & Subarctic	Transport and Logistics process	Knowledge of expert group	Effective solutions and multiple options for uncertainty conditions.
Paolo Pagani, et al	2018	Yes	NN, G.A	Heuristic policy "FCFS,NVF"	Automated Guided Vehicle	_____	Using policies based on Neural GA =80.66% policies without Neural GA = 72.51%
Amirah Rohman, et al;	2019	No	G.A, MATLAB	Mathematical	Solving Travelling Salesman Problem (TSP).	_____	Tournament size of 2, mutation rate 5%, 10000 number of iteration, 30 instance per initial population.
P Anukokila	2019	Yes	Fuzzy Logic	Classification- Based	Transportation Shipping Schedule	_____	Intuitive Fuzzy number is more qualified in describing possibilities than fuzzy sets.
Stefan Jovcic, et al;	2019	No	AHP, FAHP, TOPSIS, Wang-Mendel method	Fuzzy Based	Design a Fuzzy Inference System (FIS)	_____	FAHP model is adequate when data input not friable values but extend descriptively within linguistic statements.
Feyza Gurbuz, et al;	2019	No	Datamining, NN	Classification- Based	Prediction of damage parameters	International logistics company in Turkey	Study proves that data mining and NN used to analyze and applied on multiple sectors and logistics sector is one of them.
Gaurav Sharma, et al.	2020	Yes	Fuzzy Logic	Soft set-Based, Vogel's approximation, Linear Programming	Transportation Problems	Road, rail, air transport in Delhi, Mumbai, Chennai	Best decision cost and time for transportation.

Table 4. Continued

Ievgen Medvediev , et al;	2020	Yes	Fuzzy Logic, MATLAB, TOOLKIT	Mathematical (set theory, probability theory), Classification-Based	Develop logic-linguistic model	_____	Applying the model solving issues of transport support for agro-industrial production and predict values of weather and climate factors that effects on reducing the harvesting and transport complex elements functioning.
Siti Nasuha Zubir, et al;	2020	No	NN, LM, CGD, QP, Alyuda Neurointelligence software	Mathematical	Develop a predictive model	_____	NN has the powerful to forcast the amount of carried weight.
Saurav Dey, et al;	2020	Yes	NN	Classification- Based	Storage function of an organization	_____	Solve issues of finding the correct demanded quantity which can be ordered.
Natalya Sharmenko, et al;	2020	Yes	FNN	Mathematical	Forecasting model by means of FNN system	Grain cargo in port	By using proposed forecasting model errors will decreased by 4.99% and decrease in losses of time and costs.
Lawal S.O., et al;	2021	Yes	RNN, NN	Classification-Based	Back Order Predictive System	Online Website "Kaggle" Transaction data with back order	ADASYN+ RNN performed with 0.901 precision, 0.879 recall, and 0.88F1- score.

BP: Back Propagation

FCFS: First Come First Served

NN: Neural Network

QP: Quick Propagation

G.A: Genetic Algorithm

CGD: Conjugate Gradient Descent

TC: Total Cost

NVF: Nearest Vehicle

LM: Levenberg Marquardt

ADASYN: Adaptive Synthetic

RNN: Recurrent Neural Network

TOPSIS: Technique for Order of Preference by Similarity to Ideal Solution

9. Comparative Analysis Study

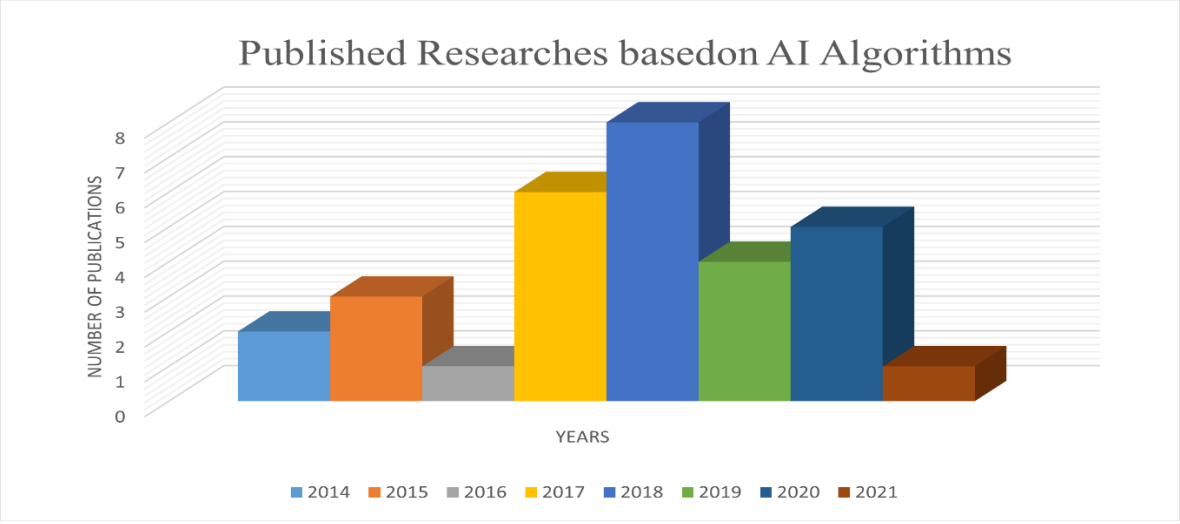

Figure 8. Published research based on AI algorithms

Some of the research that were published between the periods of "2014 to 2021", As shown in figure8, presented the algorithms that were used in each year. And all these researches are related to logistics transportation problems.

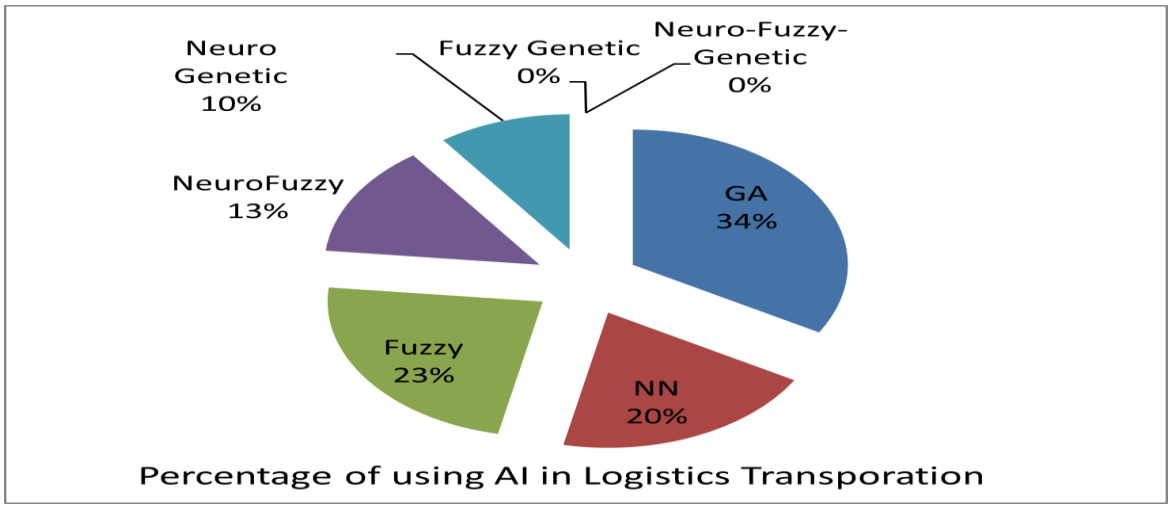

Figure 9. Percentage analysis of using AI in Transportation Logistics

The percentage of using AI algorithms in the logistics transportation field, as shown in figure 9, has present that the Genetic algorithm obtained the highest percentage in solving the transportation problems. On another hand, there are no publications or research that were handled by the Fuzzy Genetic Algorithm or Neuro-Fuzzy Genetic Algorithm methods.

10. Conclusions

This paper provides a survey on transportation logistics problems based on artificial intelligence algorithms. The paper includes studies, approaches, and algorithms that help in solving logistics transportation problems. In addition, a comparative study was conducted. Some of the most recent research that related to our research study had been applied in G.A, F.L, NN, and FNN in logistics transportation problems. Also, we present a proposed model and a proposed algorithm using GA that is useful in obtaining the nearest optimum solution in a complex problem in transportation sector. Besides, presenting analysis to show the percentage of each algorithm that was applied in transportation logistics sector. Also, to identify which new techniques and algorithms can be used to improve the quality in obtaining the optimum solution for each problem in transportation logistics sector.

11. Future Work and Recommendations

According to this study we can recommend working on two new areas can be used also, to provide an effective solution for complex and multimodal problems which are: - Fuzzy Genetic Algorithm and Neuro Fuzzy Genetic algorithm methods as shown in figure 10. These combination between these two new zones can be useful in gaining the best solution in the hardest issues in transportation logistics sector.

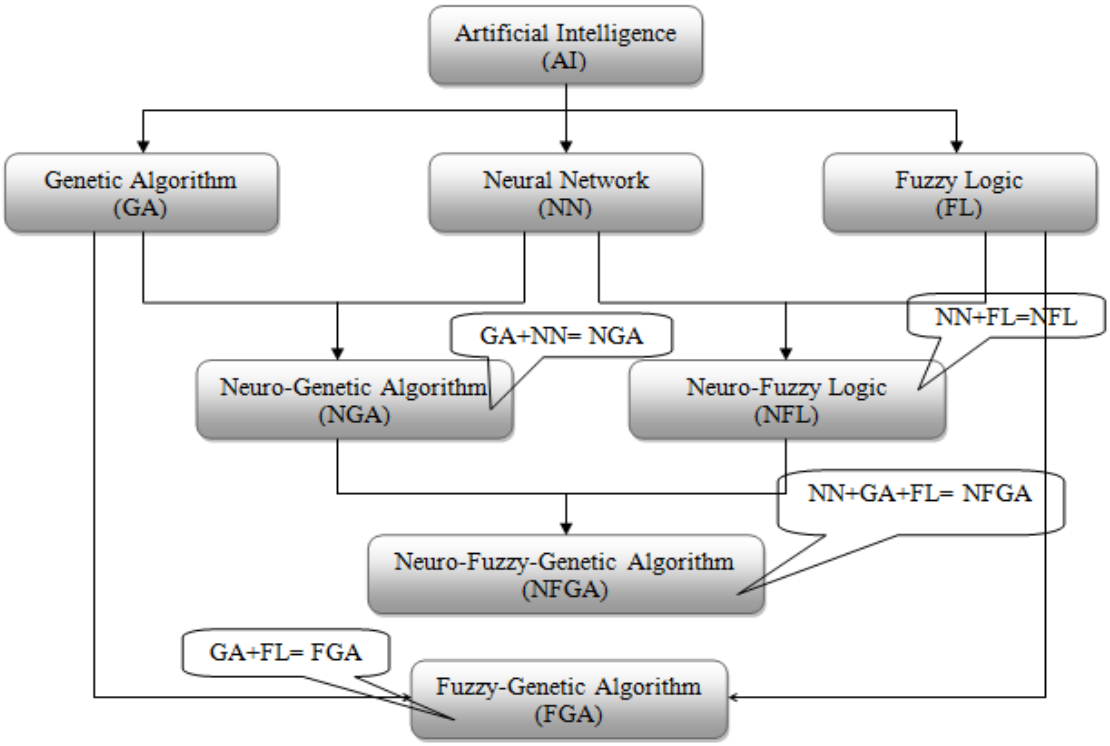

Figure 10. Novel Approaches in AI.

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