Implementation of Ant Colony Optimization For Call Drop In Gsm Network

L. G. Igakeh, V. I. E. Anireh(Ph.D), D. Matthias(Ph.D)
Department of Computer Science, Rivers State University, Port Harcourt, Nigeria

Abstract
Global System for Mobile Communication (GSM) handover failure due to poor signal have resulted to call drop because is based on signal strength received by Mobile Base Transceiver Station from current base transceiver station, when a mobile user is moving from one cell towards its neighbouring cell either trekking or driving, the received signal strength of mobile station decreases as it is moving far from its Base Transceiver Station and call is release suddenly. The three major Base Transceiver Station (BTS) hardware faults that causes call drops in live network distinctive features have been extracted to form call-drop dataset. The researcher provided a design model for Call Drop Threshold Getter (CDTG) and Call Drop Predicting System (CDPS). An Object Oriented Software Development(OOSD) which incorporates Object Oriented Analysis and Object Oriented Design plan was similarly embraced to help indicate the relationship between an object and its class. Training and simulation were performed on the dataset using Ant Colony Optimization. Prediction was made based on the optimum value obtained. The result shows that, the network performance varies as a result of variation in the base transmission stations in their area that is, the distance away from the base transceiver station then call will drop and the closer you are to the base transceiver station then no call drop, hence general network performance status is fair and users may experience call drop.

Keywords: *GSM, Call Drop, Ant Colony Optimization, Base Transceiver Station, threshold Value and Optimum Value.*

I. INTRODUCTION

Global System for Mobile (GSM) Communication is a wireless communications that connect number of Mobile Users (MU) interacting with Base Stations (BS) to transmit and receive signal in real time [1]. The growth of telecommunication industry in Nigeria has been tremendous in about seventeen years after its liberalization and regulation by government through the Nigerian Communication Commission [2]. The industry growth was mostly in the voice segment until recently when attention is being paid to data. GSM services were launched in the country in 2001 and commenced operation fully in 2002, the total teledensity was 1.89%, with a total of 2,271,050 subscriptions for both fixed and mobile lines[1]. In 2017, the total number of subscriptions for fixed and mobile lines in Nigeria was in excess of 145 million with an estimated teledensity of 103.61% [2]. This shows that, there has been a continuous growth since 2001 as regards total number of active voice subscribers, teledensity and Network service providers are licensed to operate on a designated spectrum to serve their subscribers. However, despite the Gross Development Product contribution of GSM and as innovative as GSM may seem to be, many difficulties are faced by the sector such as, Inter-Network connectivity, Network congestion, Call setup failure, Security of infrastructure and Call drop.

Global System for Mobile Communication Subscribers are facing greatest problem of call drop due to unexpected termination of call during handover as a mobile user move from one cell towards its neighboring cell, the received signal strength of mobile station decreases as the user is moving far from its base station and call is release suddenly causing bad experiences on user especially when contacting someone[3].GSM handover failure caused by poor signal have resulted to call drop because it'sbuilt on signal strength received by Mobile Station from current base station, the weaker the network strength, the more likely you will experience call drop [3]. Drop call rate is main Key Performance Index that is very important in Radio Frequency.

Researcher [4] exhibited Analysis of Telecommunication Data: Call Drop**.** They stated that, Call drop has been identified as one of the fundamental cause of the unsatisfactory voice services rendered to subscribers in cellular network today. [4], [5], and [6], proposed that, call drop affects the quality of experience of the subscribers which can take place due to a variety of technical issues including; Inadequate coverage, problems with the quality of signals, overloaded cell tower, misunderstood signal strength, change of weather (raining), distance from the cell tower, and tower handover problems.

Persistent problem with the quality of mobile voice calls continue to affect the attitudes of customers towards their network operator, network providers must consistently invest in better performing technologies to improve on voice quality in order to reduce customer churn [7].There are several papers which study call drop minimization and solution in cellular networks, Adigwe and Alumona were the first to Investigation of Call Drop in a Cognitive GSM Network [8]**.** Their Investigation of call drop was consider as network monitoring and evaluation, whose focus was to evaluate the performance of the quality of service (QoS) of a radio network in terms of call drop rate. It is essential for network operators to feature user's needs in their network technical standards by measuring the voice quality perceived by the users. In his report, Mr. Ndukwe the Executive Past Vice Chairman of Nigerian Communications Commission stated that, for effective communication service in Nigeria, the telecommunications services organizations must take quality seriously and be determined to achieve quality on a continuous basis[9]. They should make a statement, emanating from the top management by specifying company quality goals and objectives, and giving directives as to how the goals and objectives are to be met.

A related work was proposed by [10], which investigated handover effect on mobile network performance using a kind of Cat swarm intelligence algorithms. The Cat Swarm algorithm to improve the decision tree and improve the prediction effect of the entire hand over performance. Some pre-progressing methods were used to solved imbalanced and high-dimensional problems in datasets obtained to concluded that handover performance also affect mobile network performance.

Cellular networks which remain the major telecommunication infrastructure in the existent and succeeding generation wireless network was proposed by [11] in their paper named "An Analysis on Call Admission Control and Particle Swarm Optimization". The article gives an exhaustive study of CAC algorithms in present day remote systems during which it was found that there is bandwidth utilization problem in CAC algorithms, so further algorithms like Particle Swarm Optimization are studied which can be used to solve this problem and provide efficient networks with minimum call drop rates.

A technique to "minimize the cost of call routing with assigned cell in wireless network using Ant Colony Optimization (ACO)" was studied by ([12]). The two components that were considered for optimizing the call routing cost with assigned cell in wireless network are paging cost and handoff cost. It was assumed that the total network is divided into some location areas which are already known. When a terminal wants to set up a connection with another terminal, it will first search for the location of that. If the destination terminal is in the same location area it resembles to paging cost only, otherwise it resembles to both paging and handoff cost. Connection between two terminals in a wireless network can be established in a number of ways via different terminals. In this paper, Ant Colony Optimization technique were applied and other different algorithm to minimize the call routing cost. A comparative assessment of the execution time has been made among different call routing algorithm.

A paper were investigated by [13] on the distributions of dropped calls rates for different wireless (cellular) carriers in different market and was titled "What is the true dropped calls rate when in the test it was found to be zero?". Their statistics comprises over seven hundred (700) different market or carrier combinations and they found that the dropped calls rates distribution was very close to lognormal. They output was the most probable dropped calls rate for particular carrier in particular market, which depends on the number of dropped calls observed, total number of calls and the parameters of the lognormal distribution.

A proposed paper on "Handoff and Drop Call Probability: A Case Study of Nigeria's Global System for Mobile Communications (GSM) Sector" the Quality of Service(QoS) of Nigeria GSM using call drop rate and handover success rate as key Performance Indicator(KPI) was investigated by [14]. Erlang B probability was used to highlight the service quality based on the number of channels available at any given time. The result of the paper showed that the service quality with respect to call drop in Nigeria is inadequate. It was recommended that further enhancement is urgently needed since the telecoms operators are far from providing a good service to their subscribers.

Call Drop Improvement in the Cellular Network by Reducing the Bit Error Rate explored by [15] narrated that Global System for Mobile Communication (GSM) is a standard to describe protocols for 2G digital cellular networks used by the mobile phones. Call Drop Rate (DCR) in GSM network is an important Key Performance Indicator (key Parameter Indicator) that directly affects the customer's satisfaction. Call drop happening when traffic channel is released abnormally after it is occupied successfully. One of the important reasons for call drop outs is high Bit Error Rate (BER). In general, many existing wireless systems set a threshold BER before a call is dropped. In this work, it is intent to reduce the call drop due to high BER here introduced a new signal processing subsystem at the receiver section to improve the BER and thereby improve the end-to -end performance of the system. The block incorporated the subsystems to generate the two mixtures of signal and noise, centering and whitening in particular, the calculation of un-mixing matrix and automated identification for distinguishing separated signals were carried out using independent component analysis (ICA) system. ICA is a technique to separate linearly mixed sources.

It is a computational method for separating a multivariate signal into additive subcomponents assuming mutual statistical independence of the source signals.

Root cause detection of call drops using feed forward neural network was investigated by [16]. It was based on a feed-forward Artificial Neural Network (ANN) for feature detection and classification. A root cause selection layer was also added for decision making. A set of flaw codes based on some statistical (mean, maximum, standard deviation, variance and signal powers) or technical parameters are used in training the system. The system shows three major units, namely (i) time series representation of traffic channel call drops, (ii) feature extraction and (iii) root cause detection of call drops using feed forward Neural Network. The result obtained showed that there was small mean-square error and that efficiency of the network can also be further improved in order to enhance customer satisfactions.

The common denominator of all the previous works is assumptions about network characteristics. They implicitly consider that, an appropriate radio planning has been carried out; therefore, propagation conditions are neglected and do not deal with mobile equipment failure and network equipment outages;these implied that calls are dropped only due to the failure of handover procedure, that is, the connection of an active user changing cell several times is terminated only due to lack of communication resources in the new cell without any prediction so as to minimize call drop. For this reason, this research focused on implementation of Ant Colony Optimization for Call Drop in GSM Network and it's based on pheromone following behaviour of real ants that helps find the shortest route between their nest and a food source through graph.

II. MATERIALS AND METHODS

The method adopted for data collection in this research paper includes: face to face Interview, Internet, Journals and past research chapters seminars conference paper. We discussed intensively with the network operator that work with MTN Nigeria around Rumuodara Area on what call drop is and how they actually know when call drop occurred in a particular location and he said, what is used to detect call drop in one particular location is called drive testing. He gave an example by saying that, when driving or walking down a freeway between Rumuodara Area of Port Harcourt, Rivers State contacting someone, and along the line, they was a sudden disconnection of the network which involved the problem created when a mobile subscriber moves from one cell to another during a call. Also, he stated that, to run this drive testing, the following items were used; Laptop, Battery or inverter Battery, Phones to make the call and Term investigation software for recording 2 network performances.

A. Design Methodology

System Development Methodology (SMD) refers to the framework used to structure, plan, and control the process of developing an information system. In this study, we applied the Object Oriented Methodology. The object-oriented approach combines data and processes (called methods) into single entities called objects. The stages for object–oriented design can be identified as:

1. Definition of the context of the system which could either is static or dynamic part.
2. Designing system architecture by partitioning the system into layers and each layer is decomposed to form the subsystems.
3. Identification of the objects in the system and the objects identified are grouped into classes.
4. Building of design models and
5. Design of object interfaces.

B. System Analysis

The proposed system is a system that implement Ant Colony Optimization for call drop in GSM Network. It is an unsupervised learning that is able to make more intelligent prediction in a lesser time and is a system that find a feasible solution to call drop in GSM Network and also it's called optimization algorithm modelled on the actions of an ant colony. [17].In order to study the effectiveness of the ACO for call drop in GSM Network, it is self-organize, it respond to internal disturbances and external challenges, tasks are completed even if some agents fail, the solutions are emergent rather than pre-defined, changes in the network can be propagated very fast and agents act independently of other network layers. Using Ant Colony Optimization to train data obtained from Upper Confidence Limit (UCL) repository to obtain a threshold value and the average best known as optimum value which is subsequently use as an input value to the system to determine the quality of network performance status and display the likelihood of call drop. To achieve this, three indicators for network performance is used, such as when the network performance is poor and there is call drop, is excellent and there is no call drop and when the network performance is fair and call drop may occur.

Dataset for the Proposed System Model: There are two dataset used for this system, the first dataset for training was obtained from the Upper Confidence Limit (UCL) repository and were collected for 10 days [16]. The second dataset was obtained by conducting a drive test in Rumuodara Area which was analyzed by term investigator software using interval of 20 minutes to obtained values for 6days.

Table 1: Fault Types

S/n	Fault	Fault Type
1	HDLC Communication between CMB and FUC broken	Type-1
2	Abis Control link broken	Type-2
3	PA forward power (3dB) alarm	Type-3
4	GSM Handover Failure	Type-4

Table 1 show serial number, fault and their fault type. Type-1 fault is when there is a Broken High Level Data Link (HDCL) communication between Control and Main Board (CMB) and Frame Unit Control (FUC). Type-2 fault is assigned to Abis Control Link broken alarm while Type-3 fault is when Power Amplifier (PA) forward power (3db) alarm[16].

Table 2: Dataset used for theproposed system (Model 1)

L1 (Fault Label)	U1 (Mean)	U2 (Standard Deviation)	U3 (Variance)	U4 (Signal Power)
Type-1	0.97	3.11	9.48	13.78
Type-1	1.06	1.48	3.53	7.07
Type-1	1.82	3.08	9.47	20.80
Type-1	1.41	3.28	10.79	25.94
Type-1	0.95	3.20	10.24	11.66
Type-1	1.24	3.80	14.40	13.00
Type-2	0.59	0.93	1.14	0.93
Type-2	0.52	1.26	1.61	1.13
Type-2	0.71	1.62	2.62	2.12
Type-2	0.67	1.22	1.49	1.18
Type-2	0.23	0.68	0.46	0.47
Type-2	0.36	1.01	1.02	0.53
Type-3	0.51	2.08	4.32	4.12
Type-3	0.55	1.45	2.09	1.65
Type-3	1.04	2.44	6.04	9.61
Type-3	1.17	2.14	4.59	6.84
Type-3	0.42	1.70	2.65	2.48
Type-3	0.64	1.13	1.27	1.96
Type-4	0.63	5.06	13.24	13.00
Type-4	23.53	4.20	18.24	13.93
Type-4	23.45	9.20	28.1	8.00
Type-4	0.67	1.22	1.49	1.18
Type-4	0.55	2.08	1.02	1.65
Type-4	10.4	12.40	0.22	2.00

Table 2 Combines Fault Types and Inputs vectors and their different values obtained[16].

Table 3: Value obtained in Rumuodara Area of Port Harcourt analyzed by Term Investigator Softwarefor Model (2)

S/N	RSCP	Value Obtained(km)
1	$-120 \leq$ Rscp< -100	8.82
2	$-99 \leq$ Rscp< -80	9.59
3	$-79 \leq$ Rscp< -60	9.24
4	$-59 \leq$ Rscp< -40	10.50
5	$-39 \leq$ Rscp< -20	9.52
6	$-19 \leq$ Rscp< -0	9.23

Table 3 show the second dataset that was obtained by conducting a drive test in Rumuodara Area which was analyzed by term investigator software using interval of 20 minutes to obtained values for 6days. RSCP stand for received signal code power which is the power measure on a particular communication channel by the receiver and it is used as an indication of signal strength.

C. System Design

Software represents a form of non-tangible problem solving artifact that must be properly designed and developed, using the right set of tools and techniques and in accordance with the right set of specifications. This painstaking process usually involves more than one individual developer in order to achieve fault-tolerant and fail-proof systems. The two specification design for this experiment are; Specification of Call Drop Threshold Getter and Specification of Call Drop Predicting System (CDPS). The components design architecture of the proposed system depicted in Fig.1 consist of;

(i) **Feature Extraction:** Three major BTS hardware faults that cause call drops in a live network are: Broken High Level Data Link (HDCL) communication between Control and Main Board (CMB) and Frame Unit Control (FUC), Abis Control Link broken alarm and Power Amplifier (PA) forward power (3db) alarm. The proposed system dataset was obtained from the UCI repository ([16]). The proposed system dataset were collected for 10 days. The mean, maximum, standard deviation, variance and signal powers were examined and these were used to form our call drop dataset.

(ii) **Call Drop Dataset**: This is the collection of the call drop dataset waiting for training by the Ant Colony Optimization.

(iii) **Ant Colony Optimization:** This trained the data in the call drop dataset using Ant Colony Optimization to extract data.

(iv) **Data Extraction:** The data extraction in the proposed system is done automatically without human interference through simulation process after training. This display Graph Area, Predictive Value and Predictive Mean value.

(v) **Threshold Value:** It is the means prediction value that is detected by a system or sensor under consideration after training.

(vi) **Optimum Value:** This is the best value obtained after training and it is usually the average best of the total different mean prediction value obtained.

(vii) **Condition:** Every valued obtained from test drive is tested against the Optimum value to determining the likelihood of call drop occurrences.

(viii) **Call Drop Prediction System:** This display weather there is call drop or not as well as the network performance status which are excellent, good, fair or poor and

(ix) **Call Drop Report Detail**: This display the final output of the system.

.

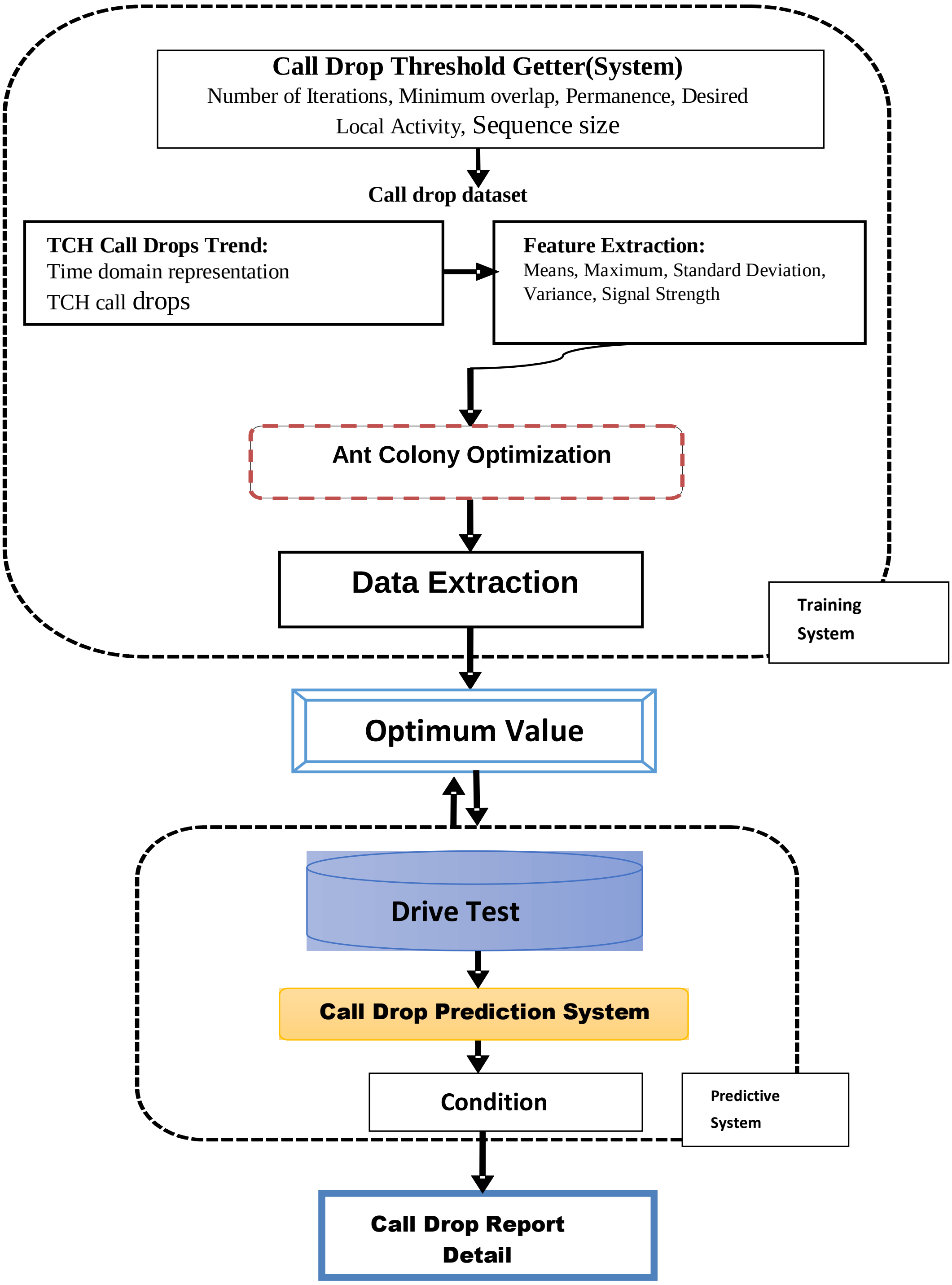

Figure 1: Architecture of the Proposed System

Ant Colony Optimization Techniques

Ant Colony Optimization Technique (Swarm intelligence) has been applied to a wide variety of problems in combination, continuous optimization and global system network operator (*[18]*). Ant Colony Optimization is metaheuristic, population based approach inspired by foraging behavior of ants. Artificial 'ants' simulation agents locate optimal solutions by moving through a parameter space representing all possible solutions. The simulated 'ants' similarly record their positions and the quality of their solutions, so that in later simulation iterations more ants are located for better solutions. ([19]).For example ACO is a self-organized, decentralized, Emergent that finds and analyzes hidden pattern in raw or unlabeled data. For example, We are using Ant Colony Optimization to train data obtained from Upper Confidence Limit (UCL) repository to obtained a threshold value and optimum value which will be used to benchmark data obtained from MTN Nigeria to enable the telecom operators know beforehand the likelihood of call drop and the network performance status. ACO technique was adopted because it has the advantage to respond to internal disturbances and external challenges, tasks are completed even if some agents fail, the solutions are emergent rather than pre-defined, Changes in the network can be propagated very fast and Agents act independently of other network layers.

Ant Colony Optimization pseudocode adopted ([20],[21]).

Get pheromone Label (T1,T2,T3,T4) and Obtained values.
T is the distance between two edges.
Represent the solution space by a construction graph namely cost matrix and pheromone matrix
Then for t = 1 to iteration_ threshold
  For k = 1 to 1 Ant   *kth is the length at which ant travels on the edge I, j*
    For move_Count = 1 to n
      Let Ant move base on $\Delta t_{i,j}^{k} = \sum \frac{1}{L_k}$
      Loop
      Calculate L_k
    Loop
    Update pheromone using graph by formular $\Delta t_{i,j}^{k}$
    Create all ants' solution (prediction value and Mean Predictive Value)
  Loop
  End

In this ACO Technique, the Ants drop pheromones when travelling in the search space and the quantities of these pheromones indicate the intensity of the trail. The ants choose the direction based on path marked by the high intensity of the trail.

Mathematical model used to get how the kth ant travel on each edges and the length between paths forms by the Ant are;

$\Delta t_{i,j}^{k} = \sum \frac{1}{L_k}$ formular kth ant travels on the edge I, j . Otherwise   equ.1

It is used to calculate the distance at which ant travel on each edge.

$t_{i,j}^{k} = \sum \Delta t_{i,j}^{k}$ Without vaporization   equ 2

To update amount of ant that move from one edge to another.

$t_{i,j}^{k} = (1-p)t_{i,j} + \sum_{k=1}^{m} \Delta t_{i,j}^{k}$ With vaporization and evaporation to be at the maximum level and it remove the graph for visualization.   equ. 3

$P_{i,j}^{k} = \frac{(t_{i,j})^{\alpha}((n_{i,j})^{\beta}}{\sum((t_{i,j})^{\alpha}((n_{i,j})^{\beta})}$ To calculate the probability of choosing a path   equ4

Where $n_{i,j} = \frac{1}{L_{i,j}}$ it's the length of path form by the Ant between two edges i and j. The shortest the path the higher the pheromones path is deposited.

- $n_{i,j}$ is the visibility of j from i that is, the distance between I and j.
- $t_{i,j}$ is the intensity of pheromone trail between I and j.
- α is the parameter to regulate the influence of $t_{i,j}$.
- β is the parameter to regulate the influence of $n_{i,j}$. we can increase or decrease the path of ($t_{i,j}$) or ($n_{i,j}$) in the process of decision you are making

The probability of the equation is to connect to each of the edges and what we are interested in is the shortest path that will give a feasible solution (Optimum Value).

Threshold value

Threshold value is the minimum and maximum value of signal that can be detected by a system under consideration. It act as a check point used in monitoring the data obtain from the UCL repository and it is used to compare with the associated threshold value. If the value do not suit with the data assign as threshold value then the data might lead to poor performances of the network. The threshold is used by system interval to determine the likelihood of call drop. The Minimum threshold detected by the system is 8.68 while 10.02 is the maximum.

Table 4 showing system interval (km) and network performance status

System Interval (km)	Network Performance Status and Call Drop Report
0 – 8.67	Network Performance is Poor and there is Call Drop
8.68 – 9.23	Network Performance is Good and No Call Drop
9.24	Network Performance is Excellent and No Call Drop
9.25 – 10.02	Network Performance is Fair and Call Drop Might Occur
10.03 – 25.00	Network Performance is Poor and there is Call Drop

Table 4 showing system interval (km), Network Performance Status and Call Drop Report Details used to determine the likelihood of call drop.

III. RESULTS AND DISCUSSION

There are two applications developed for this experiment, namely: Call Drop Threshold Getter **(Model 1)** and Call Drop Predicting System **(Model 2)**. These applications have been run and tested successfully.

A. Results of Experiment 1

Call Drop Threshold Getter(Model 1): The first model is launched as shown in Figure 2. used combination of five input parameters (number of iteration, minimum overlap, permanence, desired local activity and sequence size) to implement Ant Colony Optimization to obtained a threshold value and three output parameters (prediction value, mean prediction mean and graph) and the average best of the prediction means value known as the optimum value is subsequently used as an input value to Model 2.

Number of iteration is the number of times the training are repeated and it is set at 20.Minimum overlap is set at 2 because overlap can only occur when compare to different time Ant move through the distance between two edges. Ant1 move from T1 to T2 and Ant1 from T1 to T3 or as many time (TN). Where n could be any number apart from 1 and T is the edges in which a single ant can connect to at a time. Permanence is the value associated with synapse which is the connection of a column to the input bits or potential pool and it range from 0.0 to 1.0. It is set at 0.21 which mean when the input bits is below permanence 0.21; it should not response to the input bits. Desired Local Activity is the number of Ant in which a single ant can connect to at a time and the Sequence size is the input bits and the input bit used is 50. Simulate button was clicked in order to submit the imputed values.

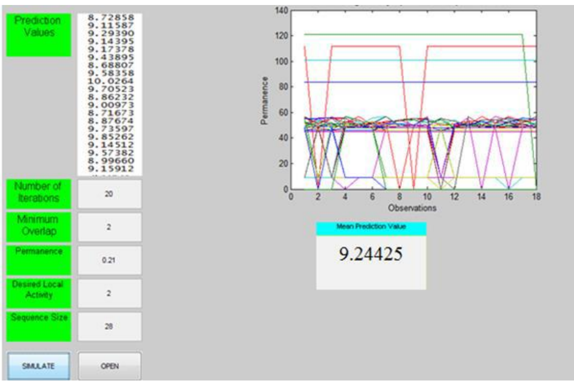

Figure2: ***Interface showing input and output result after simulation.***

Table 5: Results for all Mean Prediction Value (km) recorded from the Systems (Model 1)

Run Number	Mean Predicted value
1	8.72858
2	9.11587
3	9.29390
4	9.14395
5	9.17378
6	9.43895
7	8.68807
8	9.58358
9	10.0264
10	9.70523
11	8.86232
12	9.00973
13	8.71673
14	8.87674
15	9.73597
16	9.85262
17	9.14512
18	9.57382
19	8.99660
20	9.15912

Table 5 Present results for all Mean Prediction Value (km) recorded for each run and the experiment was repeated for 20times from the System (Model 1) Minimum predicted value is 8.68 which occurred at 7^{th} run while maximum predicted value occurred at 9^{th} run, which is 10.02 and the average best predicted performance value is 9.24 and is used as the optimum value at which the performance of network is excellence and subsequently this optimum value is the input value to Model 2.

Generated plots for ant colony after simulation are shown in Figures 3 to 6.

Figure 3 shows visualization of ant colony synapses of call-drop original data for training. It is graph of permanence against observation. Each colour showed different ant colony learning at each observation. It was observed that learning was at peak within permanence range of 45 and 55. In relation to the visualization of ant colony synapses of call-drop for original data. This confirms that learning in a sparse way does not affect how pattern can be learnt.

In Figure 4, predicted values' performance during the training was plotted against number of iteration. Each iteration shows the corresponding predicted value with the total number of iteration. The rate of firing of ant colony cells in minimum and active duty cycle is shown in Figure 5 and 6 respectively.

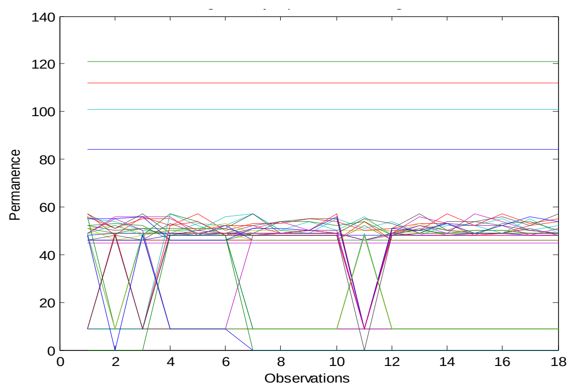

Figure 3: ***Interface showing visualization of Ant colony Segment Synapses of Call-drop of Original data after simulation***

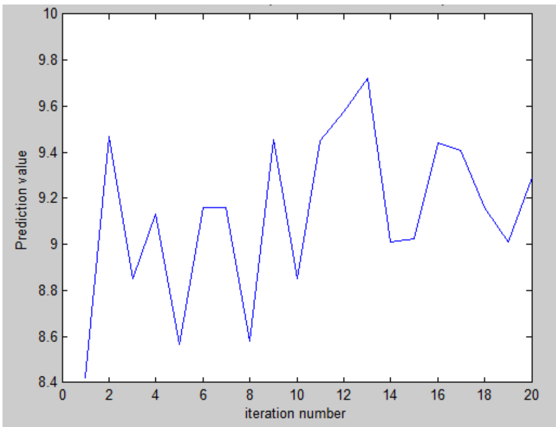

Fig. 4: ***A graph of performance for predicted results for 20 iterations***

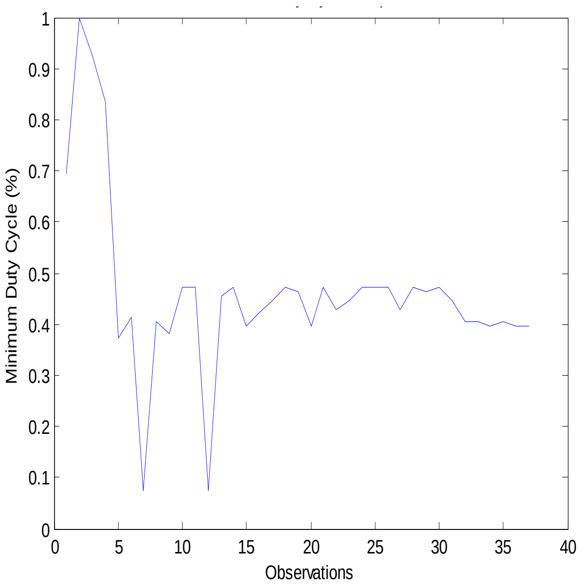

Fig. 5: Minimum Duty Cycle Plot after simulation

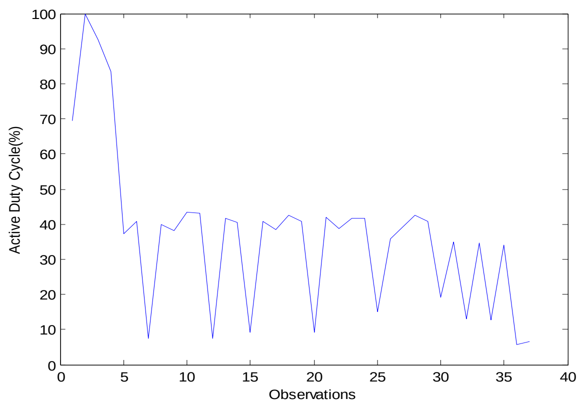

Fig. 6: ***Active Duty Cycle Plot after simulation.***

B. Results for Experiment 2

Call Drop Predicting System (Model 2): The application is launched as shown in Figure 4.6,value obtained is the result recorded from the drive test; Location address is the area in which the data used for the training was obtained. Other info tells more about the site and other info is a Co-location or Greenfield (3G GSM Voice Line). Submit button was clicked in order to submit the imputed values and then the corresponding report is displayed.

Test 1: Implementation with the first valued obtained 8.82

Figure 7 depicts report when 8.82 was entered into the system, the display report is the network performance at Rumuodara Area is good and there is no call drop experience by the customer but can be improve and Other Information is 3Gsite.

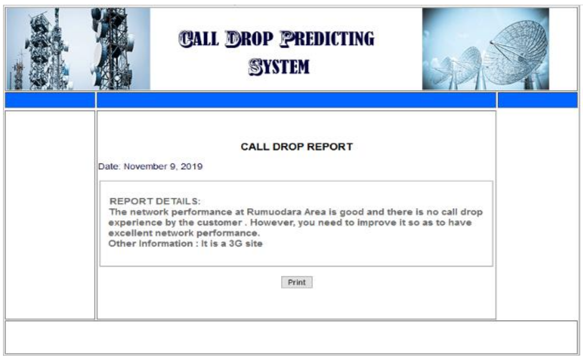

Figure 7: ***Interface showing report when the valued obtained is 8.82***

Test 2: Implementation with the second valued obtained 9.59

The display report when valued obtained is 9.59 as shown in figure 8, is the network performance is fair and call drop may occur and Other Information is 3G site.

Figure. 8: Interface showing report when the valued obtained is 9.59

Test 3: Implementation with the third valued obtained 9.24

The display report when valued obtained is 9.24 as shown in figure 9.

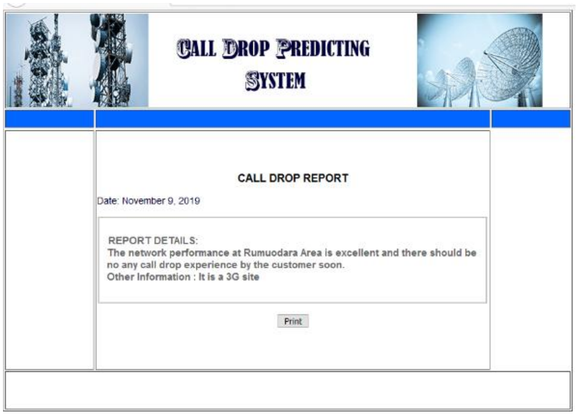

Figure 9: Interface showing report when the valued obtained is 9.24.

Test 4: Implementation with the forth valued obtained 10.50

Figure 10: depicts report when 10.50 was entered into the system, the display report is that, the network performance at Rumuodara Area is poor and there is call drop. Urgent attention is needed immediately and Other Information is 3G site.

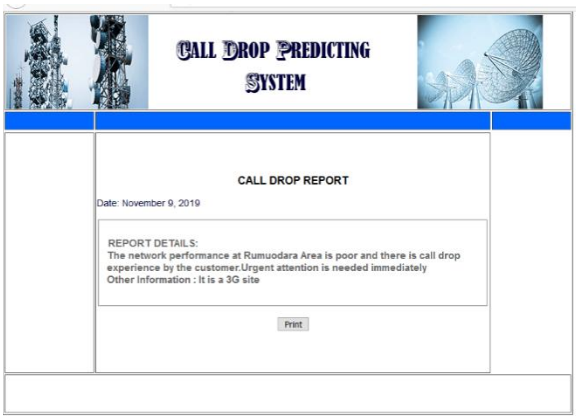

Figure 10: ***Interface showing report when the valued obtained is 10.50***

Test 5: Implementation with the fifth valued obtained 9.52

The display report when valued obtained is 9.52 as shown in figure 11 is the network performance is fair; call drop may be experience by the customer and other Information is 3G site.

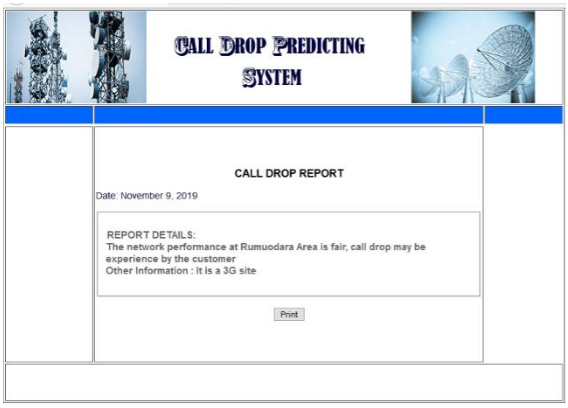

Figure 11: ***Interface showing report when the value obtained is 9.52***

Test 6: Implementation with the sixth valued obtained 9.23

The display report when valued obtained is 9.23 as shown in figure 12 is the network performance is good and there is no call drop experience by the customer but it can be improved and It is 3G voice line.

Figure 12: ***Interface showing report when the valued obtained is 9.23***

Table 6 Results presentation show for different Test Run, Obtained Value (km), and Network Performance and call drop report (Model 2).

Test Run	**Value Obtained (km)**	**Network Performance Status and Call Drop Report**
Test 1	8.82	Network Performance is Good and No Call Drop
Test 2	9.59	Network Performance is fair and there may be Call Drop
Test 3	9.24	Network Performance is Excellent and No Call Drop
Test 4	10.50	Network Performance is Poor and there is Call Drop
Test 5	9.52	Network Performance is fair and there may be Call Drop
Test 6	9.23	Network Performance is Good and No Call Drop

Optimum value recorded from Table 5(Model 1) after training was used to test against Obtained Value (km) in Table 3 and Network Performance Status and Call drop Report was displayed as shown in Table 6.

Figure 13 shows that the network performance varies as a result of variation in the base transmission stations in their area; hence the sum of result in Figure 14 obtained is 56.9 and the average best is 9.48. This was entered into the system to obtained the final call drop report detail and therefore, the general network performance at Rumuodara Area is fair and call drop may be experience by the user.

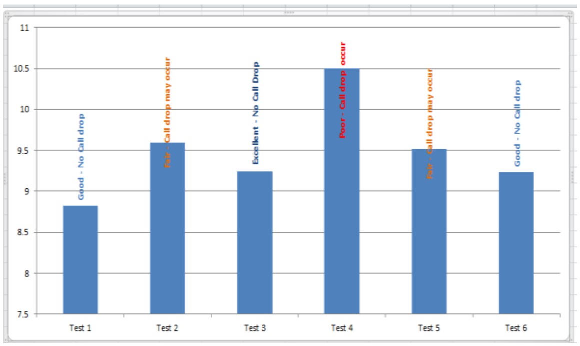

Figure 13: ***Interface showing result of different network performance and call drop report.***

Figure 14: ***Interface showing general network performance and call drop report detail for users.***

C. Discussion of Results

This research was centred on implementing Ant Colony Optimization for Call Drop in GSM Network. The propose system implement Ant Colony Optimization to obtained an Optimum value which was used by the system to determine the quality of network performance status and display the likelihood of call drop. Three indicators for network performance is used such as when the network performance is poor and there is call drop, is excellent or good and there is no call drop and when the network performance is fair and call drop may occur. The result shows that, the network performance varies as a result of variation in the Base Transceiver Stations in their area; that is, the distance away from the Base Transceiver Station then call will drop and the closer you are to the Base Transceiver Station then no call drop, hence general network performance status is fair and users are to experience call drop.

IV. CONCLUSION

As the mobile communication infrastructure is growing everyday, it becomes complex to perform handover between different networks. Problem of call drop with handover failure due to poor quality of signal is the measure issue being discussed. The system applies the ideology of ant learning to make online predictions on a given dataset. An Encoder Unit (EU) was used to transform the call-drop dataset into a sparse distributed representation (SDR). Training and simulation were performed on the dataset using Ant Colony Optimization. The threshold value and optimum value known as the average best generated after running Call Drop Threshold Tester (CDTT) was recorded. This was used as an input into the Call Drop Predicting System (CDPS). Prediction was made based on the optimum value obtained. The system show that general network performance at Rumuodara Area is fair and call drop may be experience by the user. Basically, the system performed well according to expectations, making Ant Colony Optimization a more robust alternative. This system helps mobile network subscribers to receive optimal satisfaction and increase the business potentials of the operators. The researcher recommended that other researchers should attempt to use different programming language to achieve the purposes of this dissertation, telecoms industries should use the threshold value obtained as a benchmark to checkmate all call drops and NCC should endeavour to know if network providers are consistently investing in better performing technologies to improve on voice quality of services provided in order for the subscribers to enjoy good quality of service without experiencing any call drop.

REFERENCES

[1] Y.A. Adediran, H. Lasisi, andO. B. Okedere, “Interference management techniques in cellular networks: A review”. E-mail: lashammed@yahoo.com Reviewing editor: 2017. 7(3).

[2] Nigerian Communication Commission”, Overview By Telecom Operators Risk Nigerian Communication Commissions (NCC) Sanctions Over Drop Calls, 2017. (1-2).

[3] K. K. Jatin, Call Drop Minimization using Vertical Handover Algorithm in 4G. ISSN-2278-1323 International Journal of Advance Reserved in Computer Engineering and Technology (IJARCET), (2016), 5(1776-1777)

[4] S. R. Pradeep, T. Navin, S. Vikas, S. Yashwant, P. S. Ravi, “Analysis of Telecommunication Data: Call Drop” International Journal for IJRASET,4 Issue IV ISSN: 2321-9653, 2016, 8(2).

[5] Nathan, “4 Reasons Your Phone Keeps Dropping Calls” https://electronics.howstuffworks.com, 2018,

[6] Jeff , “Causes of Dropped Calls and How to Fix Them” https://www.ubersignal.com/blog (1-3), 2017.

[7] S. Aparna & P. Richa, “Call Drop Factors and Possible Solution”. Asian Journal of Science and Technology Issue, 2793-27967, 2016, (4).

[8] W. Adigwe and T. Alumona, "Investigation of Call Drop in a Cognitive GSM Network" (CAE)–ISSN: www.caeaccess.org12. Member 2394-4714, 2015,3(5).

[9] Ndukwe, Report on Effective communication Service in Nigeria. Nigeria Communications Commission at the Commissioning of the Digital Bright Institution Nkako, 2004, (1-5).

[10] X. Wang, Y. Haihua and L Jiayi, "An Improved Supervised Learning Defect Prediction Model Based on Cat Swarm Algorithm" Chinaxuchen.wang@foxmail.com,yhh@buaa.edu.cn,ljyss 9@163.com. Conf. Series: Journal of Physics: Conf. Series 1087 022005 doi :10.1088/1742-6596, 2018, 6(3).

[11] J. Sonia and S. Aakriti, An Analysis on Call Admission Control and Particle Swarm Optimisation. IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834, www.iosrjournals.org. p-ISSN: 2278-8735. Issue 5, 2018, 13(PP 42-48).

[12] D. Champa, "Advanced Computing, Networking and Informatics". Smart Innovation, Systems and Technologies, cctina4@gmail.com, 199 DOI: 10.1007/978-3-319-07350-7_22. (2014), 2(28).

[13] M.V. Simkin & J. Olness, "What is the true dropped calls rate when in the test it was found to be zero?" Telephia, Inc., 1 Beach St., San Francisco, CA 94133. 25.11University of California, Los Angeles, 2017.

[14] N. A. Rex, "Handoff and Drop Call Probaility: A Case Study of Nigeria's Global System for Mobile Communications (GSM) Sector", www.saspublisher.com. 166-1691SSN 2347-9523, 2015, 3(2A).

[15] D. Dhanya andS. Perumal, "Call Drop Improvement in the Cellular Network by Reducing the Bit Error Rate". International Journal of Advanced Research 0502025 1117, (2016), 5(1).

[16] Sudhinda K. R. & Sridhar V., "Root Cause Detection of Call Drops using Feed forward Neural Network kr@rediffmail.com. ISSN 2224-6096 (print) ISSN -0581 (online), 2017, Vol 2(6)1-8.

[17] E. B. Carlos, D. C. Leonardo and T. G. Authur, Variation of Ant Colony Optimization for the Solution of the Structural Damage Identification Poblem. ICCS 2015 International Conference on Computational Science.ceduardobraun@gmail.com. Published by Elsevier B.V., 2015, 51(878-882).

[18] B. Jason, "Clever Algorithms: Nature-Inspired Programming Recipes" lulu.com. ISBN-10: 1446785068, ISBN-13: 978-1446785065, 2015.

[19] M. Dorigo, "Optimization, Learning and Natural Algorithms", Politecnico di Milano, 1992, 1(8).

[20] P. P. M. Gopal, Introduction to Ant Colony Optimization Algorithm and how it is applied on TSPA Concept Demo-Concept Visualization of Ant Colony Optimization on TSP Problem Pseudo code of Execution, Utube, 2017.

[21] M. Seyedali "Combinatorial Problems and Ant Colony Optimization Algorithm and How it work".Utube (https://www.udemy.com/antcolonyoptimizationalgorithm), 2018