AGENT BASED LEARNING USING IMPROVISED ARTIFICIAL BEE COLONY ALGORITHM ON NETWORK ROUTING

A PROJECT REPORT
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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

Under the Guidance of

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BMS COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019

MAY 2018

ACKNOWLEDGEMENTS

We are extremely grateful to our principal, Dr. Mallikarjuna Babu K and our head of department, Dr. B G Prasad for giving us this opportunity to work on projects that has been implemented.

Sincere regards to our guide, Dr. Kavitha Sooda for guiding and motivating us to work efficiently and also to get a clear understanding of the survey that we did. We were guided in the right direction to come up with new ideas and go ahead with the feasible and innovative one.

We are also thankful to our team mates whose coordinated efforts helped us in completing this project. Our classmates have also been supportive and helpful in successful completion of our project work.

Introduction

Routing is the process of selecting paths in a given network along which to send the traffic. It is one of the important aspects of network communication which plays a major role in affecting the performance of any network, because other parameters of the network like reliability, congestion and throughput depend directly on it. With the enormous amount of data flow occurring on the Internet in addition to the conventional routing mechanisms, there are several scenarios for increased bottlenecks in the routing paths [1]. A network bottleneck results in slow communication speeds and limits user efficiency and productivity on a network. In order to improve the network routing there is a need for implementation of optimization techniques for the existing paths. The main challenges faced in obtaining an efficient routing path are various factors like increased operational costs, vessel utilization and reducing transport time have to be considered. Since many engineering and scientific fields involve these optimization issues, researchers pay greater attention to optimization techniques such as Swarm Intelligence.

Swarm intelligence (SI) is defined as the collective behavior of decentralized and self-organized swarms [2]. Some of the well known examples for these swarms are fish schools, bird flocks and the colony of social insects such as ants, bees and termites. The Artificial Bee Colony (ABC) algorithm is a swarm based meta-heuristic algorithm for optimizing numerical problems inspired by the intelligent foraging behavior of honey bees. The comparison results demonstrated that ABC is better than or at least comparable to the other EAs, such as GA, differential evolution (DE), and PSO [3].

Due to its simplest nature and efficiency, ABC is preferred over EA, GA, DE and PSO. Exploitation and Exploration are the two main characteristics of ABC. One possible limitation with the normal ABC algorithm is that for a given bee colony, the colony always tends to maximize exploitation and restricting exploration. Since exploration is also one of the important features of ABC algorithm, there exists a need to improvise the existing ABC algorithm to balance between Exploration and Exploitation processes to obtain better

performance [4]. There are several learning mechanisms that can be used to improvise the results of ABC algorithm, out of which this paper focuses on Information Learning technique. Basically the whole population is been divided into several sub populations so that it can assign different individuals to different sub regions. So the whole population is divided into different groups or different sub regions and hence every neighbour's information can be improvised [5].Due to this independency there may be chances of

inappropriate and inefficient solution to the given problem. Thus this can be solved by hence implementing multi population technique and two search mechanisms.

Artificial bee colony is a optimization technique which simulates the intelligent foraging behavior of honey bee swarms. It is swarm based meta-heuristic algorithm. In order to improve the network routing there is a need for implementation of optimization techniques for the existing paths. The main challenges faced in obtaining an efficient routing path are various factors like increased operational costs, vessel utilization and reducing transport time have to be considered. Since many engineering and scientific fields involve these optimization issues, there is a need to improvise these optimization techniques. Artificial bee colony algorithm has drawbacks. It is good in exploration and bad in exploitation. In order to overcome this problem information learning was used on ABC but it was not enough efficient. Hence artificial bee colony algorithm is further enhanced by using prior learning mechanism.

The objective of the project is to find the shortest and the most efficient optimal path in networking by improvising the artificial bee colony algorithm based on information learning. The improvisation is done by using prior learning mechanism. Two techniques of Information learning like Multipopulation strategy and Two Search Mechanisms with a prior learning on QoS metric paths are applied to get the most optimized results.

Artificial bee colony algorithm based on information learning is improved by prior learning mechanism to find the optimal path. Prior learning is done before applying information learning to the network. This prior learning includes selecting all possible paths based on the QoS constraints set by the user. The QoS metrics used for this system are bandwidth and delay. This will help to find the optimal path more efficiently in network routing.

To overcome the drawbacks as mentioned above, many improvisation techniques were applied to the original ABC algorithm. One of the techniques used was Information Learning mechanism on the original ABC algorithm. Two main modifications were Multi Population Strategy and Two Search Mechanism [5].

- Multipopulation Strategy

Initially the given population is divided into a number of sub populations, where each of the sub population is been assigned to a different sub region. Each of the sub population will search for that given sub region and later through Two Search Mechanisms information will be exchanged between the sub populations [5]. A random size is selected from the set of population size and the results are calculated, if

the obtained result is not optimizing the solution in terms of global fitness factor, then the size of the population is varied accordingly to optimize the solution.

- Two Search Mechanism

The Two Search Mechanism basically involves the Lbest Search equation and the Gbest Search equation. Both of these search equations are applied to each of the sub population to obtain an optimal solution through information exchange between the sub populations. Lbest search equation is applied onto the Employer Bee phase to obtain a Lbest candidate for that given population [5]. Similarly Lbest candidates are found for each of the sub population in the given whole population. Based on the fitness factor, Lbest candidates are obtained. This hence optimizes the exploration process. Similarly the Gbest Search equation is applied onto the Onlooker Bee phase to improve the exploitation process. The Gbest candidate thus determines how the information has to be carried between the populations through a Transmission Vector to maximize the output [5]. The global fitness factor is the main determining criteria as to who is the Gbest candidate for the given population. Higher the global fitness factor higher the optimum results. Thus by these techniques mentioned above Information Learning is applied onto the existing ABC algorithm to get optimized results [5].

From the above seen Literature Review and ABC related works, it was evident that there is a need for an improvisation for the existing algorithm. When ABC algorithm with Information Learning (ILABC) is implemented on network routing to obtain optimized results, it will be inefficient to apply it on all paths becomes it is time consuming and also wastage of resources allotted. Therefore the proposed system implements a prior learning before Information Learning to improve efficiency. This prior learning includes selecting all possible paths based on the QoS constraints set by the user. The QoS metrics used for this system are bandwidth and delay.

Design

System Architecture:

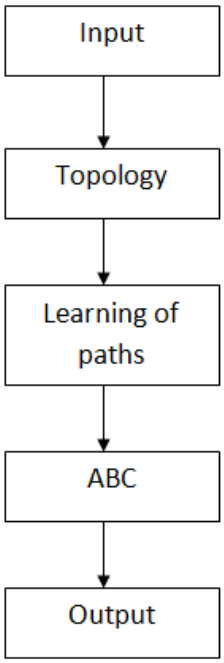


Figure 1: Flowchart of the working of the proposed system.

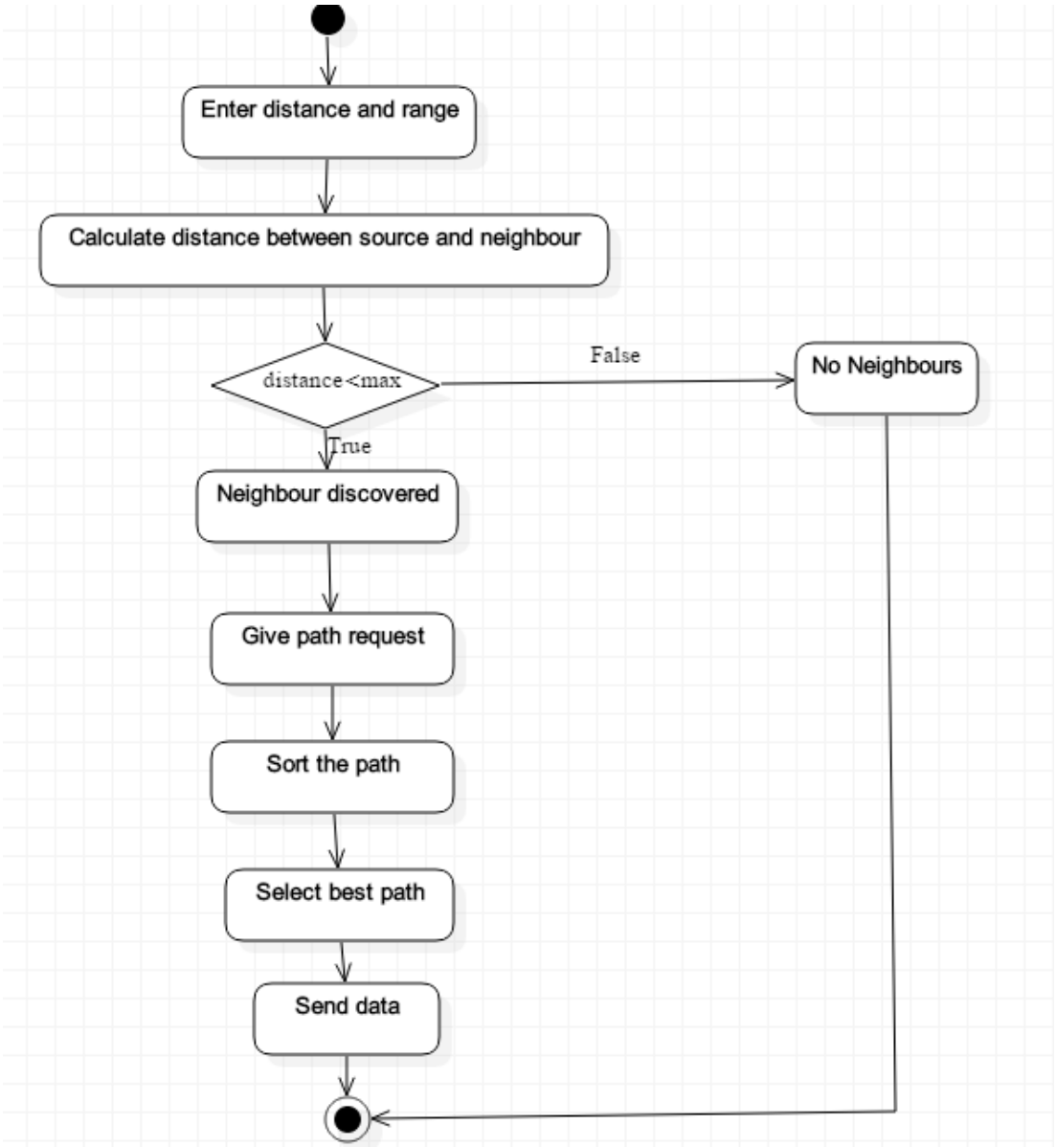
Abstract specification of Sub-systems

The system will have the following subsystems with the respective functions:

- Input: The input to our system will be the source from which data has to be sent, and the destination to which it has to send the data. This is specified by the user and can change for every execution.
- Topology: The topology that is considered here is a homogeneous network topology using wireless adhoc standard. This protocol uses a dual band wireless network technology. The network comprises of interconnected routers and nodes. Any good link can be utilized only to 80% of its capacity, i.e., 360 Mbps.
- Learning of paths: There are two phases of learning involved – Agent based learning and Information learning on ABC Algorithm. In agent based algorithm, we consider two user specific

metrics namely bandwidth and delay. The paths are filtered in a manner so as to select only those which use less bandwidth and give less delay. From all the possible paths, this process filters it down to fewer paths between the source and the destination. The information learning on ABC is applied in the next stage.

- Artificial Bee Colony Algorithm: In this stage, the information learning happens. The whole network is divided into subpopulations where each subpopulation discover the neighboring nodes based on the regions that have been formed. The path selected from the learning of the path mentioned above, the algorithm runs to transfer data from source to destination .
- Output: The output is the most optimized path discovered between the source and the destination. This path is the best route that is chosen from among the paths filtered in the previous stage of information learning.


Enter distance and range
Calculate distance between source and neighbour
distance<max
False
No Neighbours
True
Neighbour discovered
Give path request
Sort the path
Select best path
Send data

Implementation

1.Overview of technologies Used

- ## Java JDK 1.6

  The **Java Development Kit** (**JDK**) is an implementation of either one of the Java Platform, Standard Edition, Java Platform or Enterprise Edition platforms released by Oracle Corporation in the form of a binary product aimed at Java developers on Solaris, Linux, macOS or Windows. The JDK includes a private JVM and a few other resources to finish the development of a Java Application. The JDK has as its primary components a collection of programming tools, including:

  - appletviewer – this tool can be used to run and debug Java applets without a web browser
  - java – the loader for Java applications. This tool is an interpreter and can interpret the class files generated by the javac compiler.
  - javac – the Java compiler, which converts source code into Java bytecode
  - javadoc – the documentation generator, which automatically generates documentation from source code comments
  - jar – the archiver, which packages related class libraries into a single JAR file. This tool also helps manage JAR files.
  - javafxpackager – tool to package and sign JavaFX applications
  - jdb – the debugger

- ## NetBeans 6.9.1

  NetBeans is an integrated development environment (IDE) for Java. NetBeans allows applications to be developed from a set of modular software components called modules. NetBeans IDE 6.0 introduced support for developing IDE modules and rich client applications based on the NetBeans platform. NetBeans IDE 6.9, released in June 2010, added support for OSGi, Spring Framework 3.0, Java

EE dependency injection (JSR-299), Zend Framework for PHP, and easier code navigation (such as "Is Overridden/Implemented" annotations), formatting, hints, and refactoring across several languages. Users can choose to download NetBeans IDE bundles tailored to specific development needs. The bundle that we have used for our project includes the following :

- Netbeans Platform SDK
- Java SE
- Java FX

2. Implementation Details of Modules

Node Initialisation Module

This is the most important and the most vital module of the project. It contains initialisation of nodes. Since nodes are the vital part in any simulation when it comes to networking, this module plays a very important role in node initialisation. There may be ‘n’ number of nodes created by the user as per the requirement. Each node has node specific details stored in it. The node details that are being stored are node name which is unique to each node, port number which is the system port number through which the corresponding communicates with other nodes, sname which is the system name in which the nodes are been created, distance parameter and range parameter together which determines as to which region the node belongs to in the region based learning, bandwidth and delay QoS metrics value based on which initial learning of paths take place depending on the user set threshold values , destination node indicating as to which node in the region the data has to be sent, Neighbour node details containing all the possible nodes the current node can identify and connect with in that network, Receive message tab to display any message that has been received, File name indicating which file has to be sent from the source to destination.

Each of the node also contain three buttons like

a) Browse - This button is used to browse for the data or file that has been stored in the local system.

b) Route Request - This button is used to find all possible paths from source to destination based on the underlying algorithm.

c) Send Data - Once the best path is chosen by the user based on the prior learning, this button is used to send data or file selected using the Browse button mentioned above from source to destination.

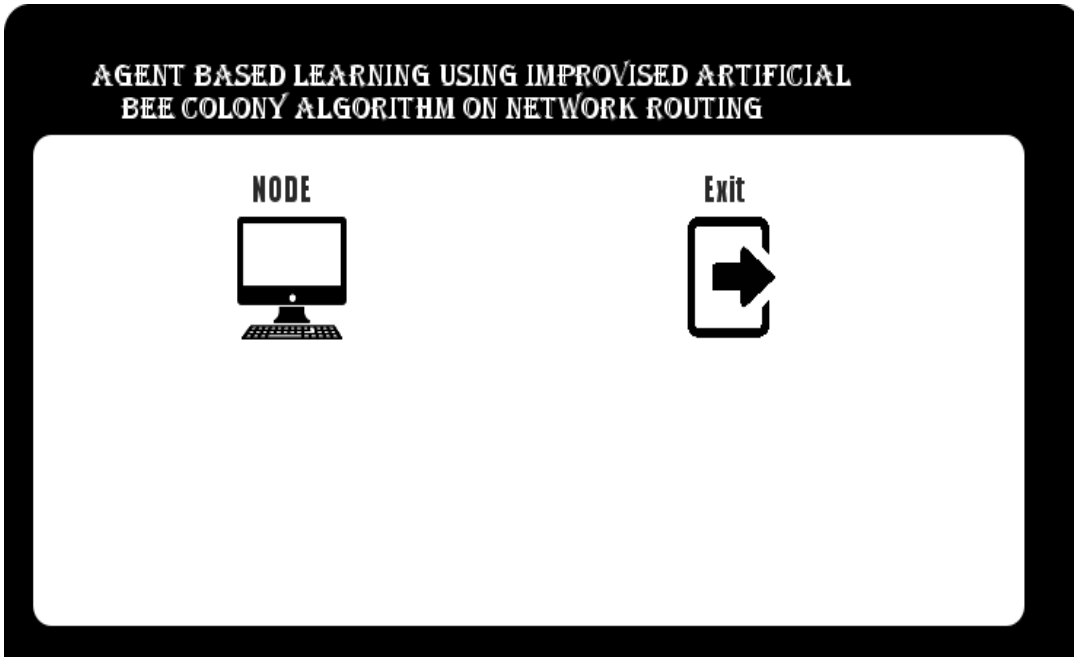


Figure 2: GUI of the system

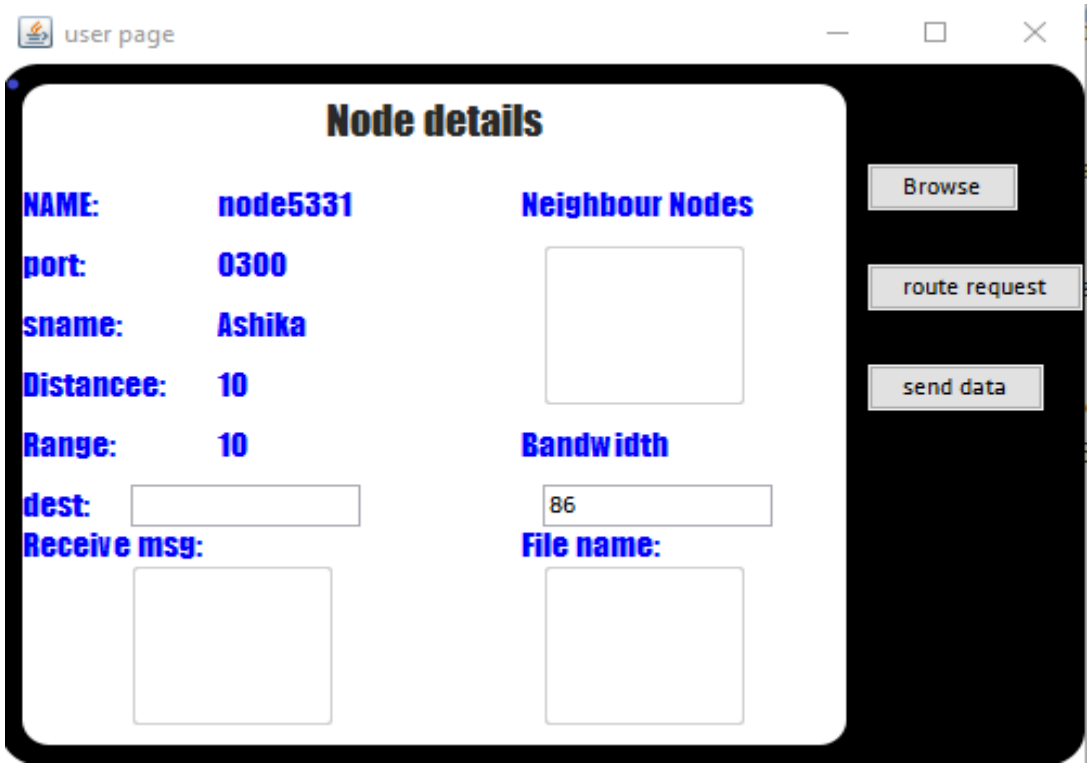


Figure 5.3:Node Initialisation module

Neighbour Discovery Module

This is the second module of the implementation which involves neighbour discovery. Based on the distance and range parameter as specified during each of the node during node initialisation, the nodes will start discovering its neighbouring nodes. The neighbour discovery is carried out based on Euclidian distance formula. Once the details is been obtained from the node, all the details is been broadcasted using Multicast IP protocol in this module to notify all nodes about their neighbours. MulticastSocket and Inet address are used to communicate with all nodes present in that region respective to that node. The region for every node is calculated based on the Euclidian formula where the inputs for this case are distance and range parameter in each node.

Thus this module is analogous to Employee Bee phase in the Artificial Bee Colony algorithm, where the neighbour discovery happens in a similar way of honey bees foraging for the food source. The Employee Bee phase in Artificial Bee Colony algorithm is sent to the food source and their nectar quality is estimated. Similarly in this phase al the initialised nodes starts discovery it possible neighbour through Multicast IP protocol and all the possible neighbours to which a node can establish a connection is been clearly displayed in the Neighbour node tab for each node. The Information learning technique which contains the Multi Population mechanism is been thus implemented in this module by discovering other nodes based on the different regions.

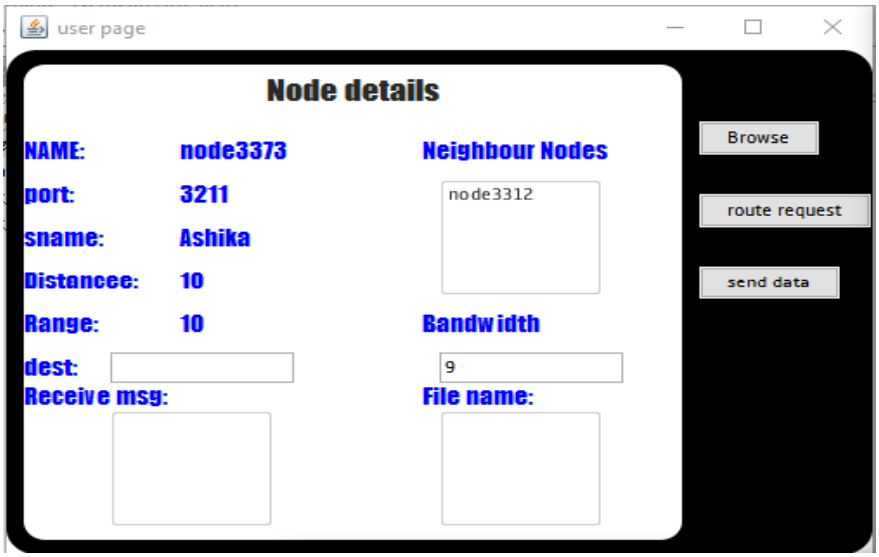


Figure 4: Neighbour Discovery module

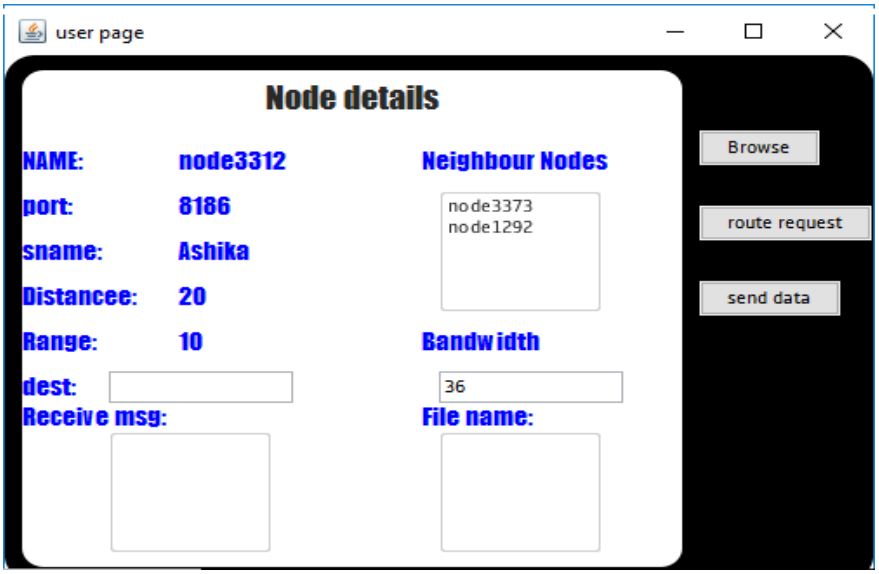


Figure 5:Neighbour Discovery module

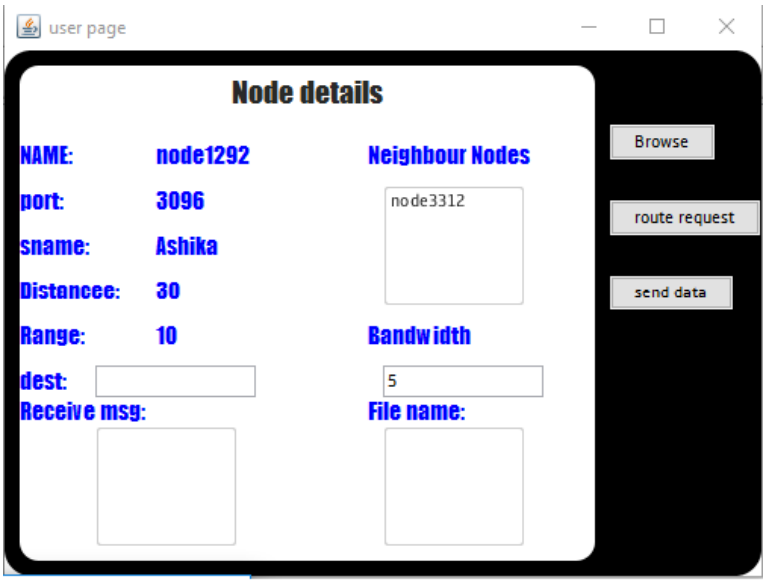


Figure 6:Neighbour Discovery module

Path Discovery Module

This module involves in the main functioning of the project where all possible paths between source to destination is formed. The source starts finding all possible paths from source to destination through all intermediate nodes also. Once all the possible paths are being formed from source to destination, all the paths which are possible from source to destination information is being sent back to the source so that it can be used later from the source to select as to which path it can take to transfer the data. This module also plays a very important role in the project because this is the one which finds all the possible paths from source to destination based on the underlying algorithm. This module is analogous to Onlooker Bee phase and Scout Bee phase in the native Artificial Bee Colony algorithm. According to the native Artificial Bee Colony algorithm, in the Onlooker bee phase, the onlooker bees select those food sources that are been identified by the Employee bees and estimate their nectar quantity. Similarly the Scout Bee phase in the native Artificial Bee Colony algorithm will come into picture when there is no food source detected and to randomly search for food sources. Taking this analogy in this project, when the destination node is a direct neighbour of the source node, then Onlooker phase is implied, and if the source and destination has any

intermediate nodes, then Scout bee phase come into the picture. Thus the Onlooker Bee phase and Scout Bee phase is been implemented in this module.

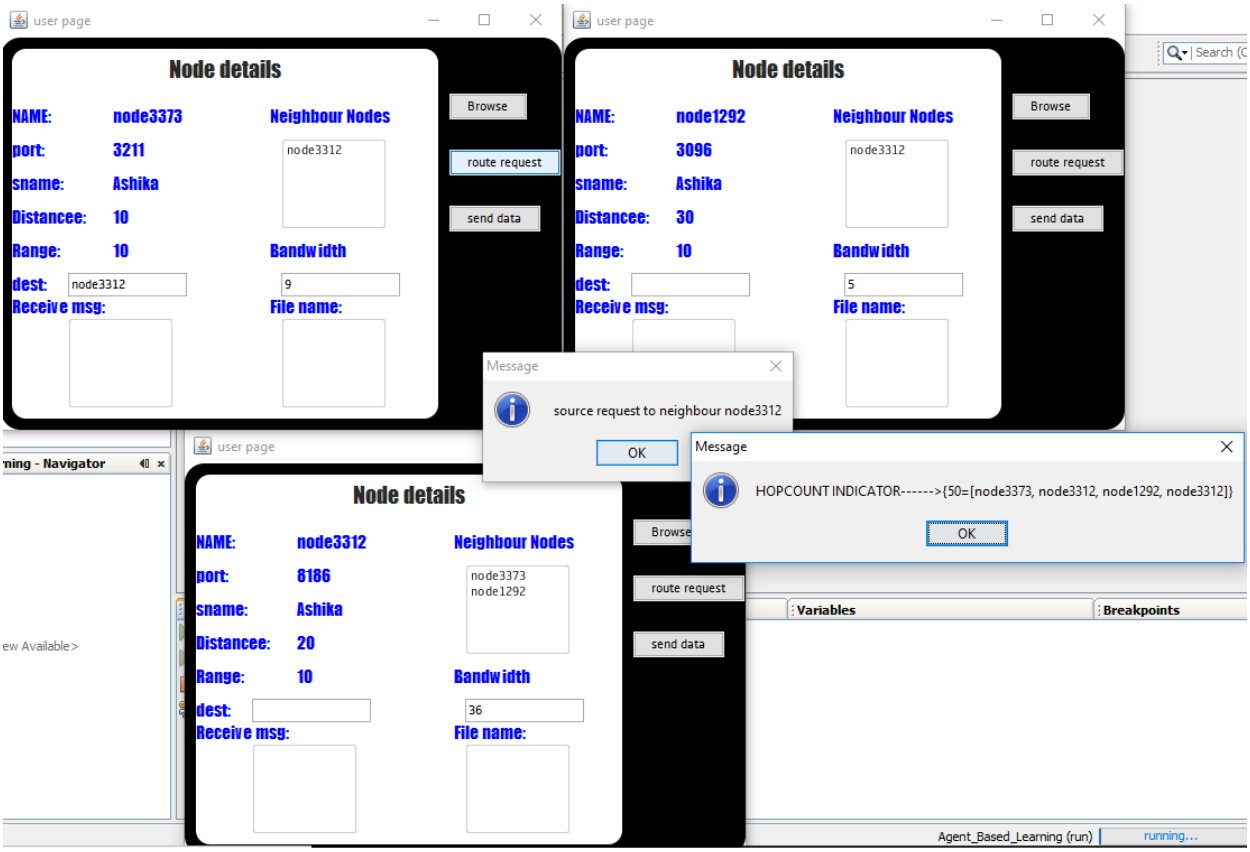


Figure 7: Route Request module

Data Transfer Module

This is the final module of the project which involves the data transfer from the source to destination node. The source and the destination are input by the user. The destination node number is entered in the

source node dialog box. The user then selects a file to be transferred to the destination and then selects weather the data has to be sent with highest bandwidth or lowest delay. The most optimal route is selected from among all the possible paths. The data is then routed to the destination using the multi socket service. The file can be viewed only by the destination and not any of the intermediate nodes. In case the source and destination are not connected, a pop up is displayed. The user is prompted to enter another connected destination and then routing takes place.

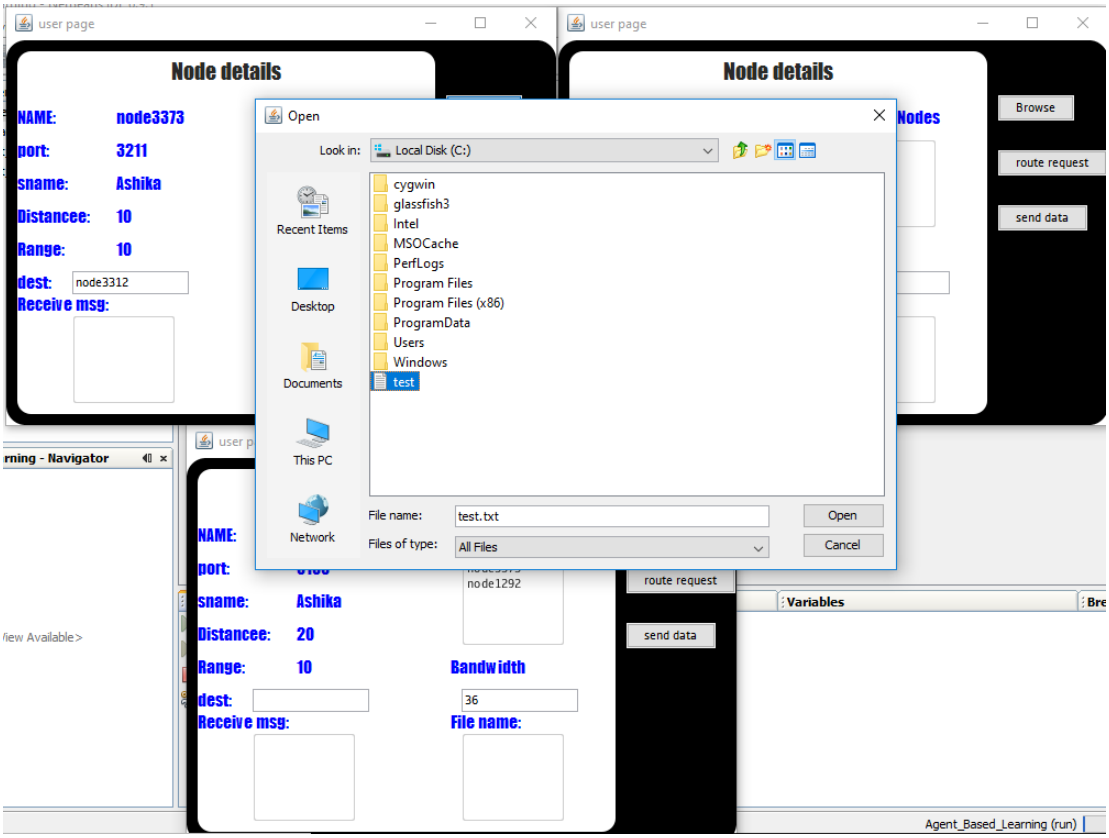


Figure 8: Browsing File to send data

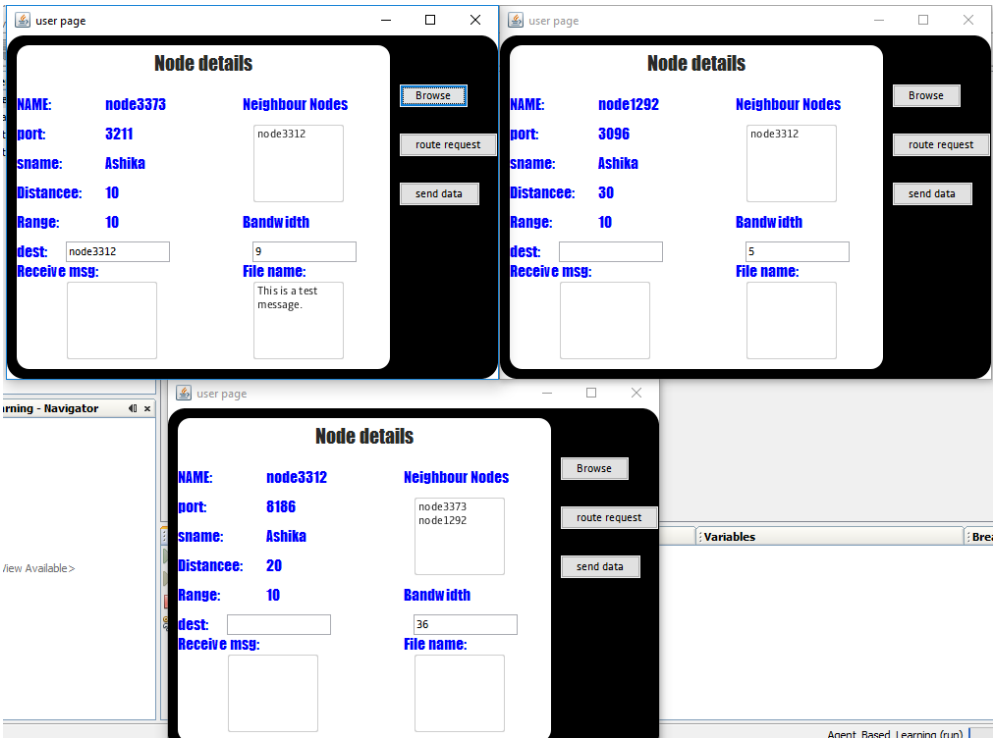


Figure 9: Uploading File to send data

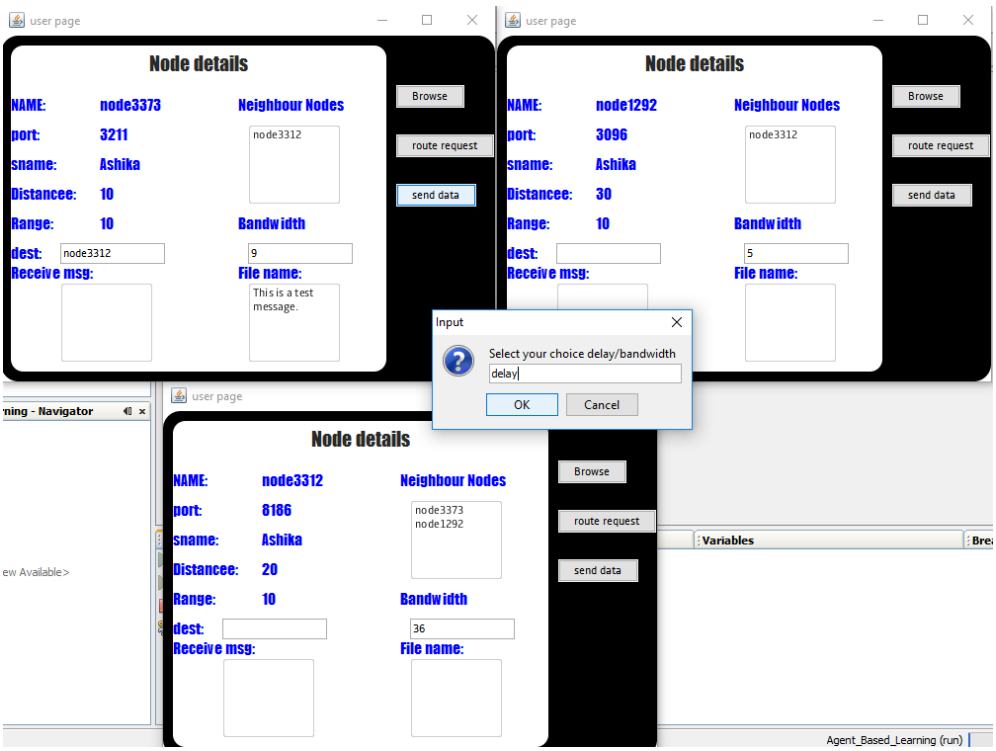


Figure 10: User selecting bandwidth or delay to send data

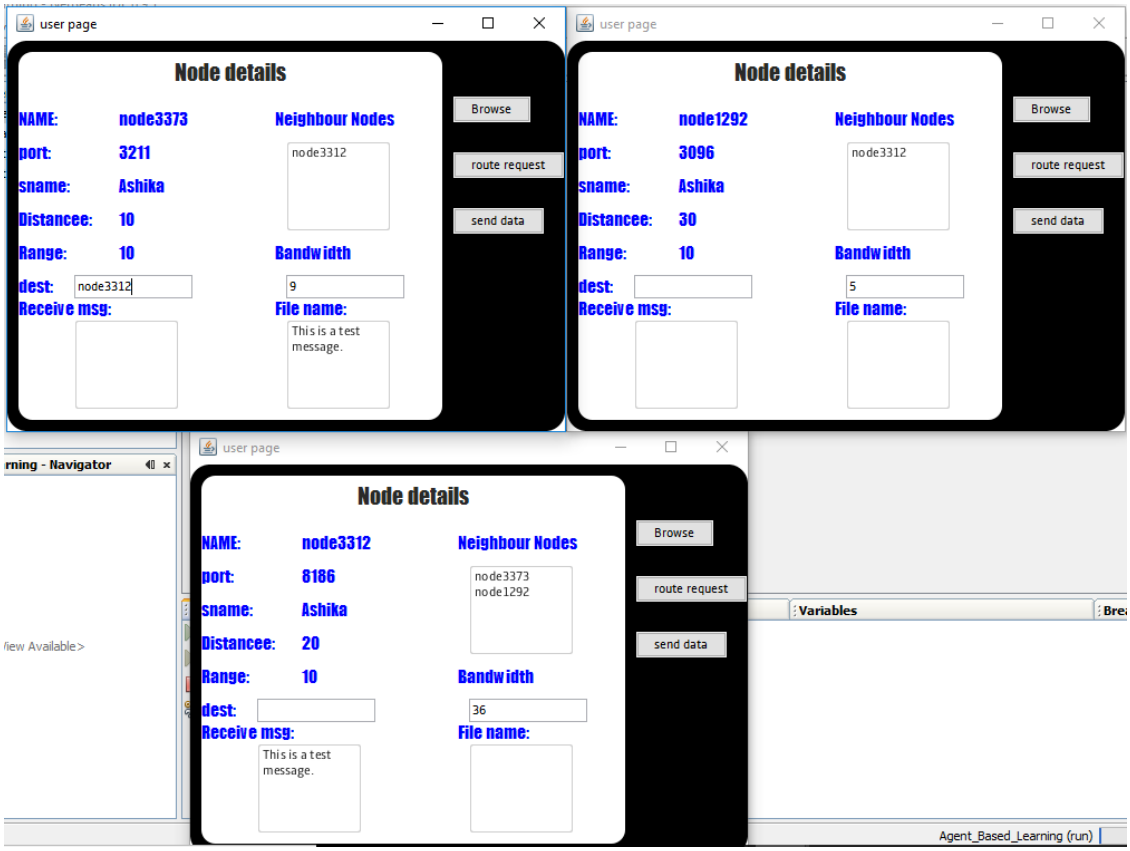


Figure 11: Data Transfer Module

Conclusion

The original ABC Algorithm performs the exploration process well, but is not so efficient in the exploitation of the resources. This is handled by the Artificial Bee Colony Algorithm with Information Learning. Information Learning on Artificial Bee Colony implements the multipopulation strategy by dividing the population into many subpopulations or regions. The learning within a subpopulation and between subpopulations is based on the QoS metrics of choice. This optimal solution can be obtained by implementing the learning prior to ABC algorithm where all the paths satisfying the threshold value defined by the user based on the QoS constraints are satisfied. This reduces the load on the ABC algorithm as few routes have already been eliminated based on the QoS constraint. So ABC algorithm is then run on fewer nodes to find the optimal paths in a lesser duration and in a more efficient manner.

The implementation of our proposed algorithm, Improvised ABC using agent based learning involves two main concepts: Multipopulation Strategy and QoS metric learning. The multipopulation strategy aids in dividing the network into regions so that local routing can be performed faster. Routing between regions is the next level of search that is executed. This eliminates a global search that may be performed even if the routing needed is local. The QoS metric taken under consideration here is the bandwidth. The total available bandwidth for a path is calculated simply by summation. The path with the maximum available bandwidth is chosen as the preferred path and the data packets are sent along that route. This is how native ABC is improvised by our proposed algorithm.

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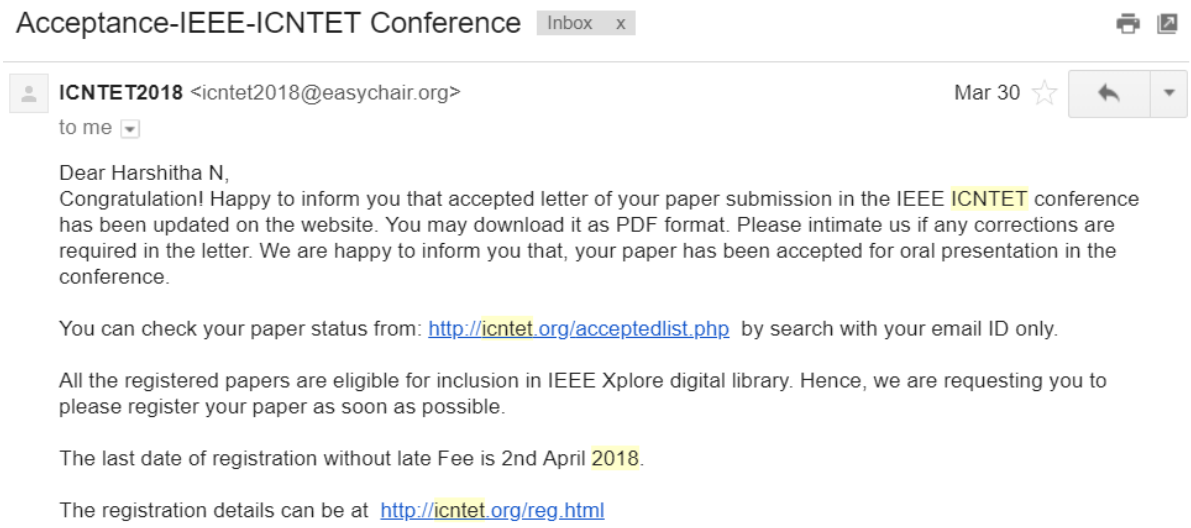
Details of Publications



Acceptance-IEEE-ICNTET Conference Inbox x

ICNTET2018 <icntet2018@easychair.org> Mar 30

to me

Dear Harshitha N,
Congratulation! Happy to inform you that accepted letter of your paper submission in the IEEE ICNTET conference has been updated on the website. You may download it as PDF format. Please intimate us if any corrections are required in the letter. We are happy to inform you that, your paper has been accepted for oral presentation in the conference.

You can check your paper status from: http://icntet.org/acceptedlist.php by search with your email ID only.

All the registered papers are eligible for inclusion in IEEE Xplore digital library. Hence, we are requesting you to please register your paper as soon as possible.

The last date of registration without late Fee is 2nd April 2018.

The registration details can be at http://icntet.org/reg.html

Figure 12: Snapshot of acceptance mail from the publication for literature survey

The survey paper supporting this project has been accepted into the International Conference on New Trends in Engineering and Technology 2018 (ICNTET). The conference is to be held in GRT Institute of Engineering and Technology, Chennai on the 7th and 8th of September, 2018. The supporting document is attached above.

Agent Based Improvised Artificial Bee Colony Algorithm for Network Routing

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***Abstract*— The aim of this paper is to implement an algorithm to find the shortest and the most optimal path in network routing, by using one of the Swarm Intelligence algorithms - Artificial Bee Colony(ABC) Algorithm. It discusses the improvisation required for the existing ABC algorithm to obtain best results for network routing. The implemented algorithm overcomes the defects of native ABC algorithm by implementing a prior learning and Information Learning on the native ABC algorithm. The technique of Information learning incorporated here is Multi population strategy, which along with a prior learning on QoS metrics are applied to get the most optimized source to destination paths. This implementation depicts that the improvised ABC algorithm improves the efficiency by finding better and optimized results than the existing ABC algorithm.**

Keywords—Artificial Bee Colony;Information Learning;Multi Population;

I. INTRODUCTION

Routing is the process of selecting paths in a given network along which to send the traffic. It is one of the important aspects of network communication which plays a major role in affecting the performance of any network, because other parameters of the network like reliability, congestion and throughput depend directly on it. With the enormous amount of data flow occurring on the Internet in addition to the conventional routing mechanisms, there are several scenarios for increased bottlenecks in the routing paths[1]. A network bottleneck results in slow communication speeds and limits user efficiency and productivity on a network. In order to improve the network routing there is a need for implementation of optimization techniques for the existing paths. The main challenges faced in obtaining an efficient routing path are various factors like increased operational costs, vessel utilization and reducing transport time have to be considered. Since many engineering and scientific fields involve these optimization issues, researchers pay greater attention to optimization techniques such as Swarm Intelligence.

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The rest of the paper contains the following sections. Section II briefly covers various topics like Network Routing, Learning Mechanisms, Bio Inspired Algorithms, Artificial Bee Colony algorithm .In Section III, the native ABC algorithm is explained. Section IV contains the existing improvisation of Information Learning. Section V depicts our proposed system supported by a flowchart. Section VI gives the implementation

details of our proposed algorithm. Sections VII and VIII are the results of our paper and conclusion respectively.

II. Literature Review

A. Network Routing

Network Routing is the process of forwarding data packets from the source to destination. A mobile ad hoc network (MANET) is a continuously self configurable network of wirelessly connected mobile devices [6]. Routing in mobile ad hoc networks is broadly classified as Reactive (on Demand) and Proactive (Table Driven) Protocols. Reactive protocols set up routes on demand. In the Ad-Hoc On-Demand Distance Vector (AODV) reactive routing protocol, the topology information is sent by the nodes on-demand to only those nodes to which it wants to establish a route. Proactive protocol like the Destination Sequence Distance Vector or DSDV maintains a list of all the destinations and their routes, by sending routing tables throughout the network in a periodic manner. However both the protocols are not highly scalable since they result in traffic overhead due to increased mobility. This drawback can be overcome by Improved Artificial Bee Colony Algorithm as described in the following sections.

B. Learning Mechanisms

Learning is a process of modifying the existing or acquiring new knowledge and behaviors. The ability of learning is acquired by all living creatures including human beings and some machines. There are many types of learning mechanisms out of which they are broadly classified into Supervised and Unsupervised Learning. From their names only it is evident that Supervised learning is a task of inferring outputs from the supervised trained data [7].This supervised trained data is under the supervision of supervisor or trainer. Using this trained data set learning can be easily implemented to any test data to obtain an optimal solution. On the other hand, under Unsupervised learning algorithm, results are inferred from datasets without labeled responses or classes [7].

C. Bio Inspired Algorithms

Optimization plays a significant role in solving complex mathematical problems in engineering. Optimization algorithms can be categorized as deterministic and stochastic in nature. The former method requires an enormous computational effort which tends to fail as the size of the problem increases, which is a motivation to employ bio inspired algorithms[5].These algorithms are a motivational approach for employing computationally efficient alternative models for deterministic approach. Also they are a problem solving methodology derived from the structure, behavior and operation of natural system and remarkably flexible and adaptable nature. The significant beauty in nature inspired algorithms is that it receives its sole inspiration from nature, they describe and resolve complex relationships from intrinsically very simple initial conditions and rules with little or no knowledge of the search space.

Bio inspired computing is efficient in solving problems of almost all areas, including computer networks, data mining, power systems, image processing, security, control systems, robotics and many more.[8]

III. ABC and Related Work

A. Original ABC

Artificial Bee Colony Optimization is inspired by the behavior of bees in nature [9].This solution search process is a step by step iterative process. The colony of artificial bees contains three groups of bees: onlookers, employed bees and scouts. A bee which is waiting in the dance area, making decision to choose a food source is called Onlooker bee. The one which is going to the food source visited by it before is called a employed bee and the one that carries out random search for new food sources is called a Scout. The food source location corresponds to a possible solution to the optimization problem and the nectar amount corresponds to quality of the solution. For every food source, there is only one employed bee[2]. An employed bee makes modification on the position in her memory depending on the local information and tests the nectar amount of the new source. The employed bee whose food source is exhausted by the employed and onlooker bees becomes a scout. If the nectar amount of the new food source is higher than the previous one, then the employed bee memorizes the new position and forgets the old one[10]. After completing the search process, they share the nectar information of the food sources and their position information with the onlooker bees in the dance area[10]. The search process of ABC has three major steps:

I) Employed bees are sent to a food source and their nectar quality is estimated

II) food sources are selected by Onlooker bees based on information collected from employed bees and estimate their nectar quality

III) scout bees are determined and are employed on possible food sources for exploitation.

The position of the food sources are selected by the bees at the initial stage and their nectar qualities are measured. The employed bees then communicate the nectar information of the sources with the onlooker bees waiting at the dance area within the hive.

The main steps of the algorithm are as below:

1: Initialize Population
2: **repeat**
3: Place the employed bees on their food sources
4: Place the onlooker bees on the food sources depending on their nectar amounts
5: Send the scouts to the search area for discovering new food sources
6: Memorize the best food source found so far
7: **until** requirements are met. [3]

B. *Drawbacks of Original ABC*

- As from the above working of the Artificial Bee Colony algorithm it is evident that the algorithm provides efficient results in exploration processes at the cost of exploitation process.
- For a given bee colony, best results are obtained only for exploration of food source and exploitation process is not that efficient.
- So there exists a need for an improvisation for this existing system which is the purpose of this paper.[4]

IV. Existing Improvisations

To overcome the drawbacks as mentioned above, many improvisation techniques were applied to the original ABC algorithm. One of the techniques used was Information Learning mechanism on the original ABC algorithm. This mechanism employs the Multipopulation Strategy which is described in detail as follows. [5].

A. *Multipopulation Stratergy*

Initially the given population is been divided into a number of sub populations, where each of the sub population also known as a region. Each of the sub population will search for source and destination in that given sub region [5]. If a solution is not found, then the search area is expanded to other regions. This eliminates the effort of searching through a larger space when the network route is local to the region.

V. Proposed System

From the above seen Literature Review and ABC related works, it was evident that there is a need for an improvisation for the existing algorithm. When ABC algorithm with Information Learning (ILABC) is implemented on network Routing to obtain optimized results, it will be inefficient to apply it on all paths becomes its time consuming and also waste of resources allotted. Therefore the proposed system implements a prior learning before implementing ABC to improve the efficiency. This prior learning includes selecting all possible paths based on the QoS constraints set by the user. The QoS metric used for this system is bandwidth. Higher bandwidth is preferred for optimized results since more data can be sent on such paths. Thus this proposed system improves efficiency according to the user requirements.

VI. IMPLEMENTATION

Our application which uses artificial bee colony algorithm for routing is region based, where the employee bees are the nodes, the food sources are the routing paths, the onlooker bees find the paths from the specified source to destination from the information collected from the employee bees. The neighbouring nodes are determined and if the paths from the neighbouring nodes are exhausted scout bees perform the

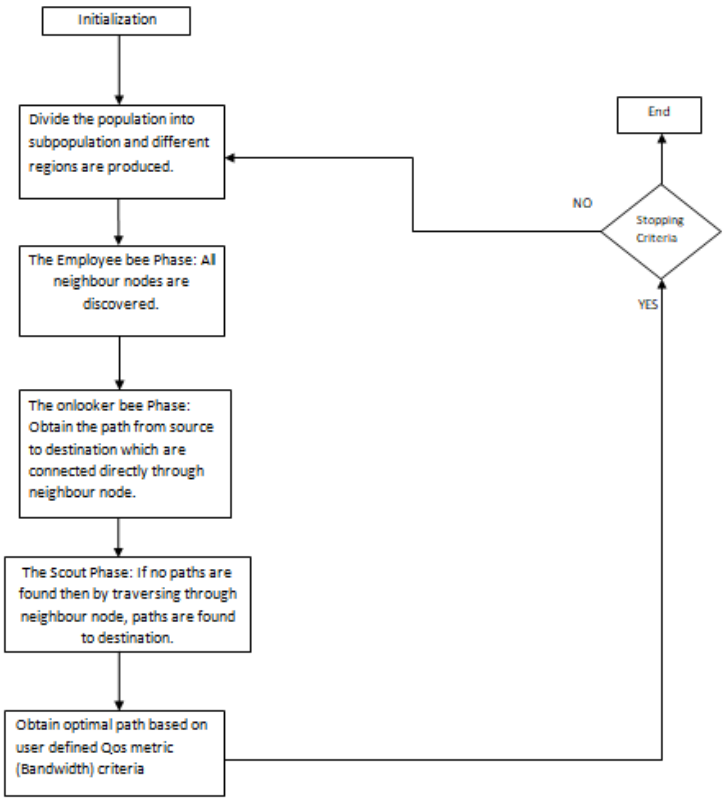

Fig. 1. Flowchart of the working of the proposed system.

random search for the destination nodes by determining its neighbouring nodes. Hence, the initial step in our application is creation of the nodes by specifying the distance and the range. JavaFx which is used for creating the user interface for desktop applications is used to create the graphical user interface for our application. Each node has a specific node name, port number, system name, user specified distance and range, the destination port number to be specified by the user and the list of neighbouring nodes. Each node will determine its neighbouring nodes using the Euclidean's distance and groups the neighbouring nodes into regions. Depending on the distance and the range given by the user, it determines the neighbouring

nodes and a list of all its neighbouring nodes will be displayed in each node. We are using multicast ip routing protocol to distribute the data to multiple recipients.

Shortest and best path is discovered for routing the information. The path has to be found to send the data from source to destination. In Onlooker phase, source node will discover if its neighbour node has destination node as its neighbour to find path. If it is present then direct path is found. If no path is found then scout phase is initialized and path discovery is done by checking if each neighbour node has destination node and bandwidth of each node is added. All paths are discovered which connects source to destination node. Best and optimized path is selected from all paths based on QoS metric Bandwidth. The path with highest bandwidth is selected to send data. User will select the data which needs to be sent from the source to destination following which the data will be sent using the best path. Data will bind to the destination node when size of hop count is equal to zero. Based on bandwidth the optimized path is found.

Following are the snapshots of the implementation of Improvised Agent Based ABC.

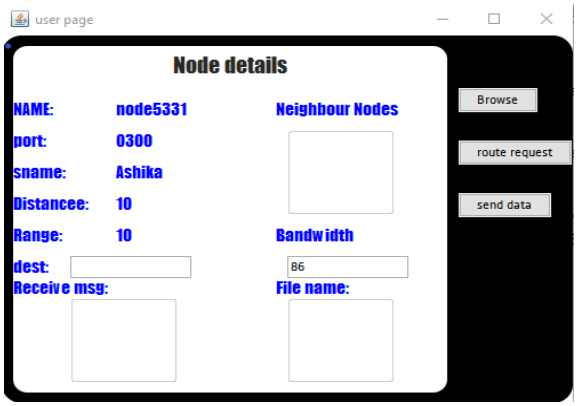

Fig. 2. Node initialisation screen.

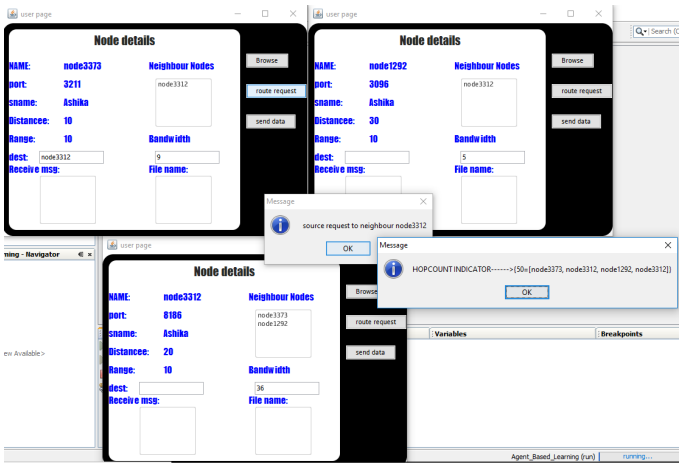

Fig. 3. Route request module.

VII. RESULTS

The implementation of our proposed algorithm, Improvised ABC using agent based learning involves two main concepts : Multipopulation Strategy and QoS metric learning. The multipopulation strategy aids in dividing the network into regions so that local routing can be performed faster. Routing between regions is the next level of search that is executed. This eliminates a global search that may be performed even if the routing needed is local. The QoS metrics taken under consideration here are bandwidth and delay. The total available bandwidth for a path is calculated simply by summation. The path with the maximum available bandwidth or less overall delay is chosen as the preferred path and the data packets are sent along that route. This is how native ABC is improvised by our proposed algorithm.

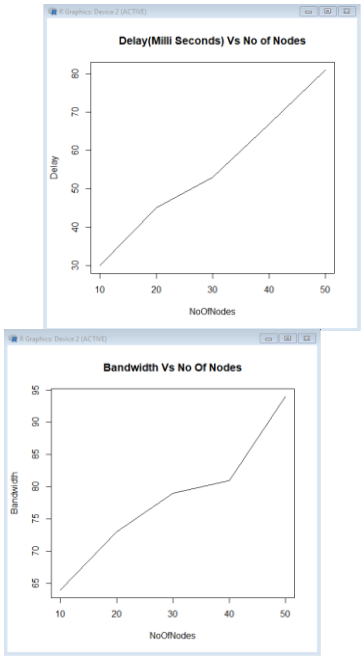

Fig. 4. Performance analysis with delay and bandwidth respectively.

The above line graphs depict the linear dependency of Delay and Bandwidth on the number of nodes in the routing network.

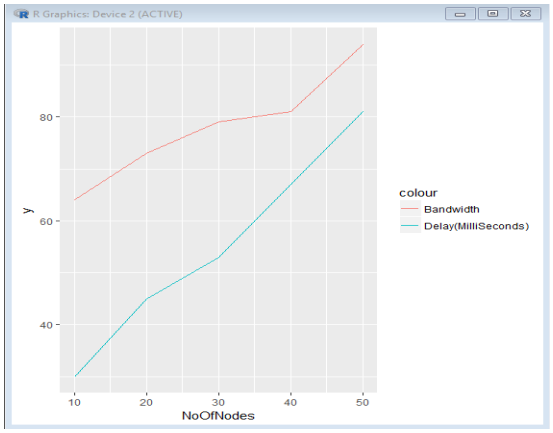

Fig. 5. Performance analysis with delay and bandwidth on the same scale.

From the observation, we can say that both the parameters are directly proportional to the number of nodes. So in selection of an optimal path, higher bandwidth and lesser delay is preferred.

VIII. Conclusion

The original ABC Algorithm performs the exploration process well, but is not so efficient in the exploitation of the resources. This is handled by the Artificial Bee Colony Algorithm with Information Learning. Information Learning on Artificial Bee Colony implements the multipopulation strategy by dividing the population into many subpopulations or regions. The learning within a subpopulation and between subpopulations is based on the QoS metrics of choice. This optimal solution can be obtained by implementing the learning prior to ABC algorithm where all the paths satisfying the threshold value defined by the user based on the QoS constraints are satisfied. This reduces the load on the ABC algorithm as few routes have already been eliminated based on the QoS constraint. So ABC algorithm is then run on fewer nodes to find the optimal paths in a lesser duration and in a more efficient manner.

IX. Acknowledgement

This work was supported in part by the B. M. S. College of Engineering, TEQIP-3 funds.

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BMS College of Engineering.

Department of Computer Science and Engineering.

Batch no. : 07 Date: 10/05/2018

Project Title: Agent Based Learning Using Artificial Bee Colony Algorithm On Network Routing

PROGRAM OUTCOMES	Level (1 or 2 or 3)	Justification if addressed
PO1	3	Our application involves application of technical knowledge obtained over the past semesters.
PO2	3	Our application involves complex mathematical model to solve a real world problem.
PO3	3	This application will increase the efficiency of finding optimal paths in networking.
PO4	3	Our application was designed by researching various schemes available in the market.
PO5	2	This application involves modeling of a new type of problem architecture.
PO6	2	This application applies reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues.
PO7	3	This application efficiently uses the infrastructure involved and uses less infrastructure as compared to currently available Applications.
PO8	3	Applied ethical principles and committed to professional ethics

		and responsibilities and norms of the engineering practice.
PO9	3	Our team functioned effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	3	Our team communicated effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	3	Our team demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work.
PO12	2	Our team recognized the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1	3	Applied Software Engineering Principles and Practices to provide software solutions
PSO2	3	Designed and developed Network and Web based Computational systems under realistic constraints.
PSO3	3	Designed efficient algorithms and develop effective code.

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