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Approach for shortest path in multiagent distributed scenario using AOMDV and tree topology

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ABSTRACT

The work adds on the transferable belief model to a multiagent-distributed context using tree topology. An agent acting as nodes collect data independently using a graph with cycles. The cyclic structure describes the interaction among mobile units. Two different scenarios are considered: In the first one, agents provide data that do not change (static scenario), while in second case agent provide data that changes over time (dynamic scenario). For a dynamic scenario, it will use the value of a number of nodes to change the value and for the static scenario, it will keep one node fixed for routing by keeping source node fixed. A Cyclic Graph Algorithm is converged to the basic belief assignment based on the transferable belief model. The results are integrated and form four graphs to show the simulation results. The simulation results are obtained through NS2. TBM is used as an application in sensor networks our works adds on the transferable belief model to a multiagent-distributed context using tree topology. An agent acting as nodes collect data independently using a graph with cycles. The cyclic structure describes the interaction among mobile units.

***Keywords**— Multiagent system, AOMDV, TBM, Tree topology, Cyclic Graph*

1. INTRODUCTION

In the framework of Multiagent, system data combination plays an important role where information approaching from multiple sources were arranged to provide useful description of the existing location. The single agent model may be insufficient when tentative logics were performed by entities of the system between which there is some distance either spatial, temporal or semantics. For such type of systems, a Multiagent system works, where each agent is an autonomous intelligent subsystem, is thus more suitable. Each agent holds its own limited information, accesses some computational resources. A Multiagent, system offers several advantages for higher value of task domain and higher flexibility. Transferable belief model introduces an idea with open world theory in the Dempster–Shafer framework. The related information is been interchanged locally along with agents using point-to-point topology [1].

We introduce a new work, which is the improved expansion of the transferable belief model to a Multiagent distributed system in this work distributed data aggregation unit is available based on tree topology. Nodes are representing agents and collects data autonomously using tree topology (graph with cycles). The cyclic structure defines better interaction among mobile units. Two different scenarios are considered: In first one, Static scenario is introduced where agents provide data that do not change over time, While in second scenario that is dynamic scenario is been considered where agents produced data that change with respect to time. Classification is been done by means of distributed data fusion based on tree topology. A cyclic graph algorithm is been proposed to converge to basic belief assignment based on the transferable belief model. The data summarization gives the idea to combine the data coming from different sources to route to eliminate redundancy, minimize number of transmission and thus sane energy. An efficient data transfer model with tree structure is available, Transferable Belief Model (TBM) is used as an application in sensor networks.

2. DESIGN

The implementation of research methodology is been done through NS2 simulation. As NS2 is been used to stimulate wireless sensor networks.

3. IMPLEMENTATION

The table 1 below shows the input parameters that are used in NS2.

Table 1. Input parameters

S no.	Parameters	Description
1	Routing Protocol	AOMDV
2	Nodes	30
3	Agents	UDP and Sink
4	Bounded Region	500*500
5	Transmission Range	250m
6	Mac Layer	802.11
7	Energy	100 joules

The wireless sensor network has been deployed 30 sensor nodes. AOMDV routing is used as a routing protocol. AOMDV routing protocol is been used as multipath is been taken into consideration. Among from these multiple path shortest path is been evaluated. Also UDP is as agent for source node and Sink is used as an agent for destination node. With the help of these input data name file is been created. In the Nam file, one node is selected as a source node and another node is selected as a destination node.

4. NETWORK FORMATION MODULE

In network formation, module one node is selected as a source node and the other node is selected as a destination node. These two nodes communicate with each other. The output is shown in the NAM output. In figure 1 below node 26 is selected as a source node and node 8 is selected as a destination node. Further cost is been calculated to generate optimal path. Two formulas are used to calculate the cost. A first formula is:

$$\mathbf{f\,(d,\,e)} \tag{3}$$

Which is used to calculate cost. In this formulae, d stand for delay and e stand for energy. Cost is a function of delay and energy which directly corresponds to distance and traffic. First it will check for the normal cost. If it is high then it will go to next path. Next formulae is

$$\sqrt{[(X_2 - X_1)^2 + (Y_2 - Y_1)^2]} * Traffic \tag{4}$$

This is used to calculate Euclidean distance. In this formula, X and Y are source and destination of the nodes. Traffic is number of nodes between source and destination. These two formulas are used to calculate the shortest distance between two nodes.

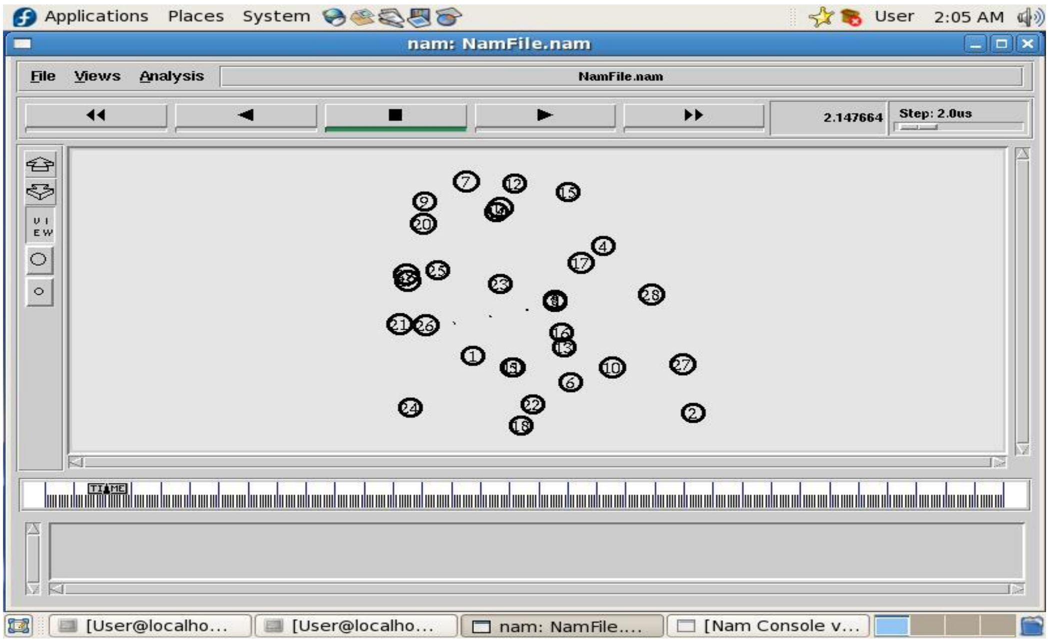


Fig. 1: Network formation module

5. TREE FORMATION MODULE

Figure 2 shows tree topological module where it shows node connection having minimum distance. It checks how to transmit the data with minimum retransmission using tree topological belief model. After that it will find closest node from the source node. Then it will check this till the destination node. In figure 2 data range is 1.5 meters. Routing with minimum distance is been calculated by using cyclic graph algorithm. In figure 5, node 8 is selected as a source node and node15 is selected as a destination node. The shortest distance path is selected between these two nodes. The shortest path is 8-3-37-30-31-32-22-35-14-29-39-4-17-5-24-16-25-26-10-32-18-15.The nodes are arranged in a tree form so that the tree can parse. On the top of a tree is the node which is at minimum X and minimum Y co-ordinate. The tree would expand based on the location of nodes. The shortest path is mainly used in tree topology to find the optimal routing. Cyclic graph is been formed and the nodes follow that path. This path is shown in cyclic graph module.

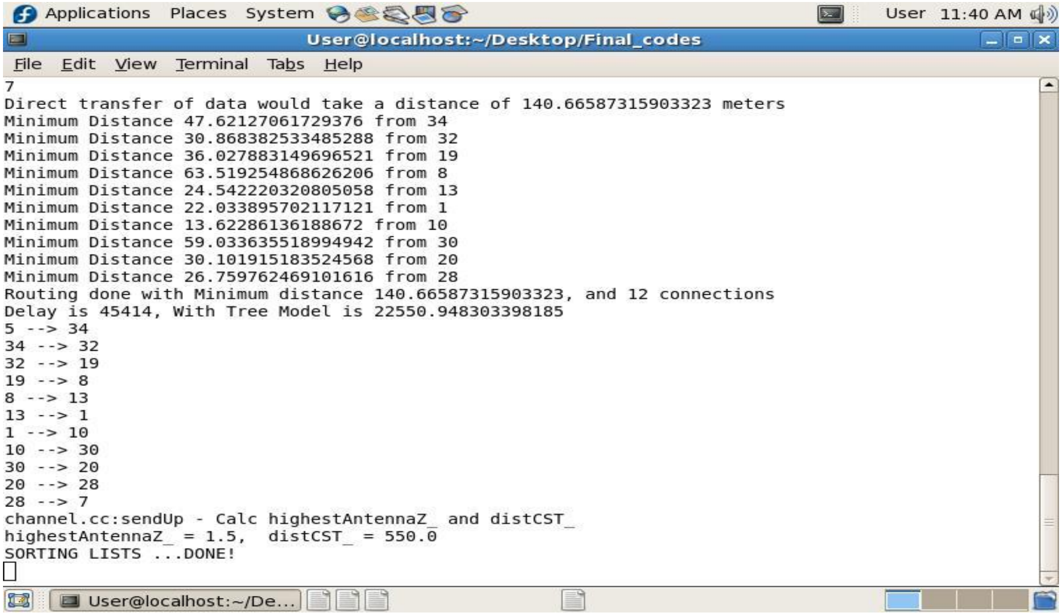


Fig. 2: Tree formation module

6. CYCLIC GRAPH MODULE

Figure 3 below shows cyclic graph module, which shows shortest path in the name output. Figure 3 shows that path which is the most likely shortest path. The most likely shortest path is been selected with the help of cyclic graph module. Further integration of tree topological module and cyclic graph module is been done and the graph is obtained from the output parameter. According to the optimal routing output parameters are evaluated.

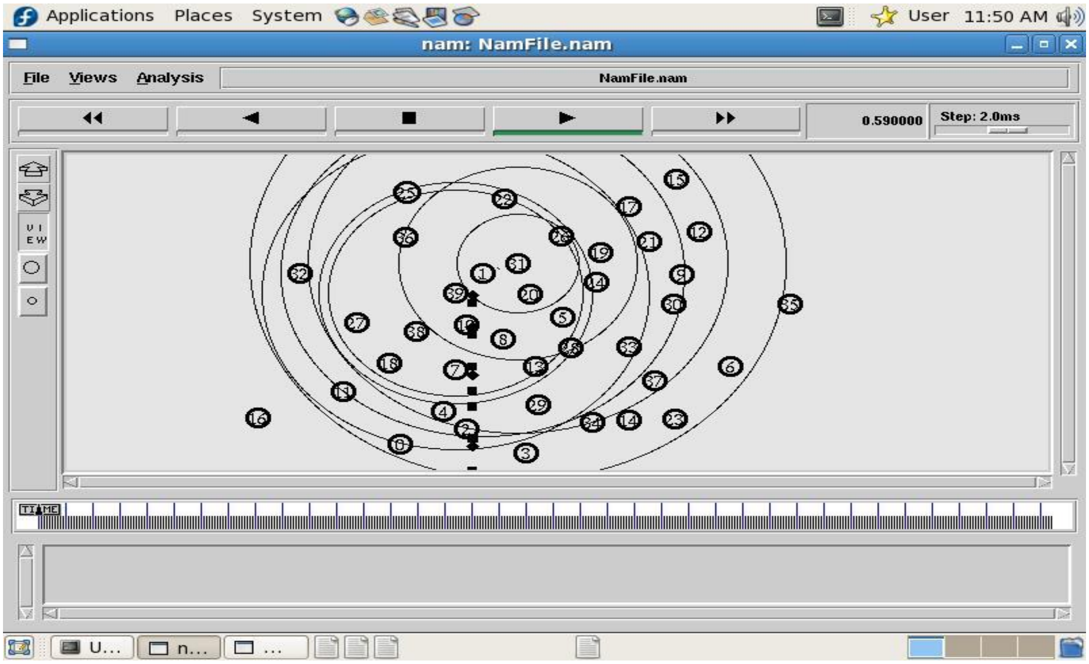


Fig. 3: Cyclic graph module

7. INTEGRATION OF SECOND AND THIRD MODULE

The second module means tree formation module and third module means cyclic graph module. These two modules are combined and output parameters are evaluated. The output parameters are:

(a) Cost combined graph
(b) Delay combined graph
(c) Packet loss combined graph
(d) Network load combined graph

7.1 Cost combined graph

The optimized cost is the parameter in which cyclic graph algorithm is applied and normal cost is the parameter in which cyclic graph algorithm is not been applied. Figure 4 below shows comparison between normal cost and optimized cost. Below, X-axis represents number of communication and Y axis represents cost combined parameter. In graph, red line represents normal cost and green line represents optimized cost. Optimized cost is the cost evaluated through cost function and Euclidean distance formulae. In figure 4below at point 2, the cost is the optimized cost that can be observed as shown in green line.

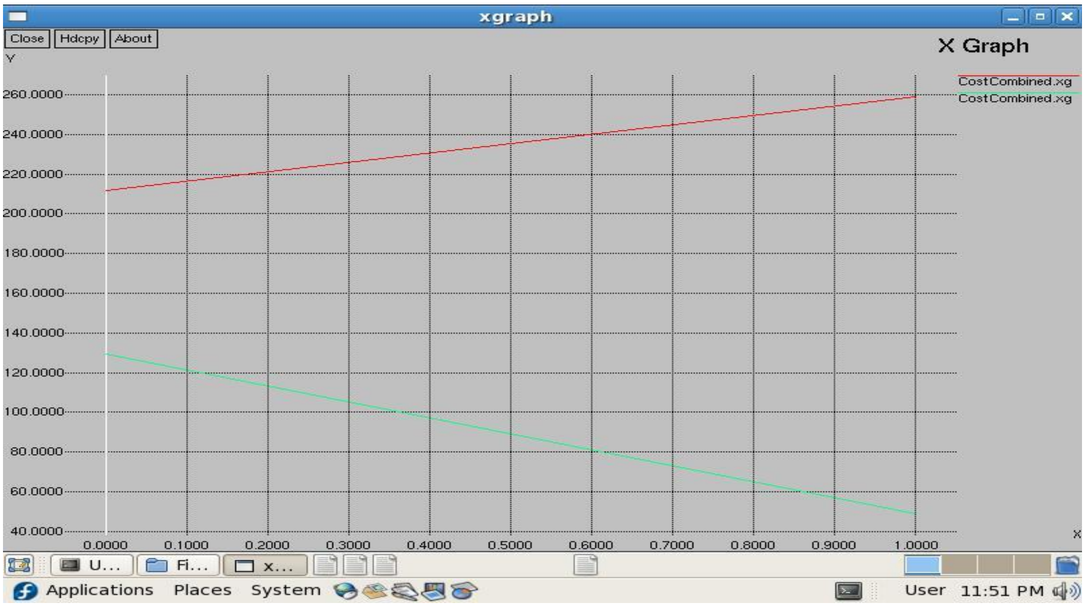


Fig. 4: Cost combined graph

[Red Line: Normal Cost and Green Line: Optimized Cost]
[X axis: Number of Communication and Y axis: Cost]

7.2 Delay combined graph

The delay-combined graph shows the improvement in delay in optimized cost as compared to that of delay in normal cost. While transmitting the data delay can come and the delay should be less. The optimized cost is the parameter in which cyclic graph algorithm is applied and normal cost is the parameter in which cyclic graph algorithm is not been applied. Figure 5 shows comparison between delay in optimized cost and delay in normal cost. In figure 5, X-axis represents number of communication and Y axis represents delay combined specification. Red line represents delay in normal cost and green line represents delay in optimized cost. Green line shows that the delay minimized in optimized cost as compared to delay in normal cost at point 1, delay in optimized cost is 187 and delay in normal cost is 864.

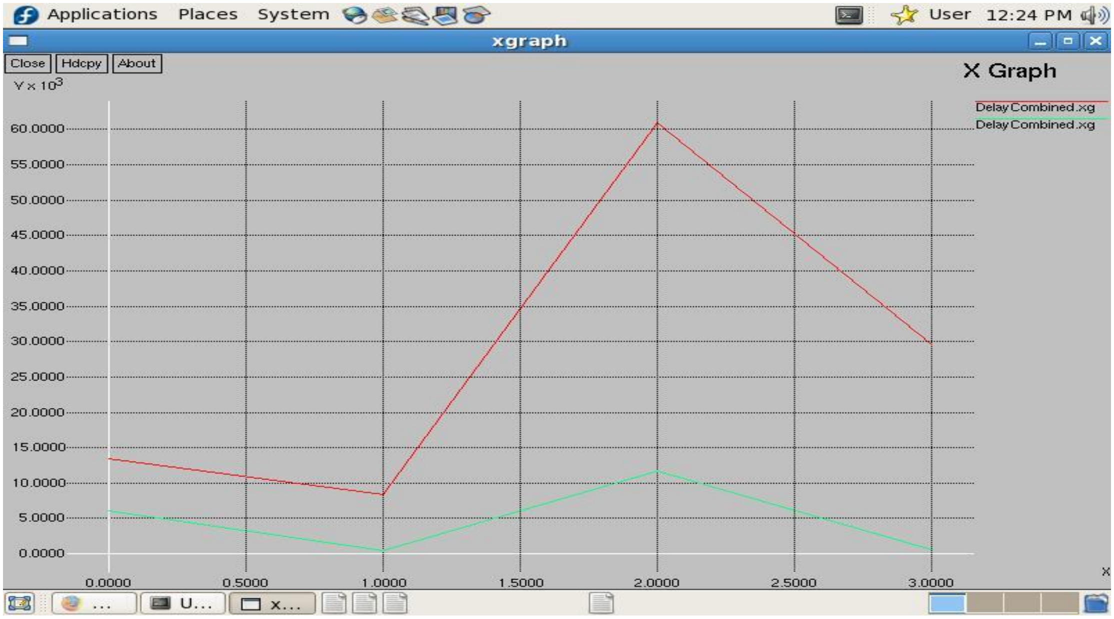


Fig. 5: Delay combined graph

[Red Line: Normal Cost and Green Line: Optimized Cost]
[X axis: Number of Communication and Y axis: Delay Combined Cost]

7.3 Packet loss combined graph

The packet loss combined parameter shows how much packet is been lost in normal cost and in optimized cost. The optimized cost is the specification in which cyclic graph algorithm is been applied and Euclidean distance is been calculated. The normal cost is the specification in which cyclic graph algorithm is not been applied. According to the shortest path optimized cost is been evaluated and packet loss is minimized. The optimized cost minimizes the packet loss. Figure 6 comparisons between packet loss in normal cost and packet loss in optimized cost. In figure 6 X-axis represents number of communications and y axis represents how much packet loss has been occurred. Red line represents packet loss in normal cost and green line represents how much packet loss occurred in optimized cost. The packet loss is reduced in optimized cost is been shown in figure 6. Packet loss is minimized in optimized cost as cyclic graph algorithm is been applied. At point 0.03053 of X-axis, the value of optimized cost is 20 as compared to value of normal cost, which are 27 in Y-axis.

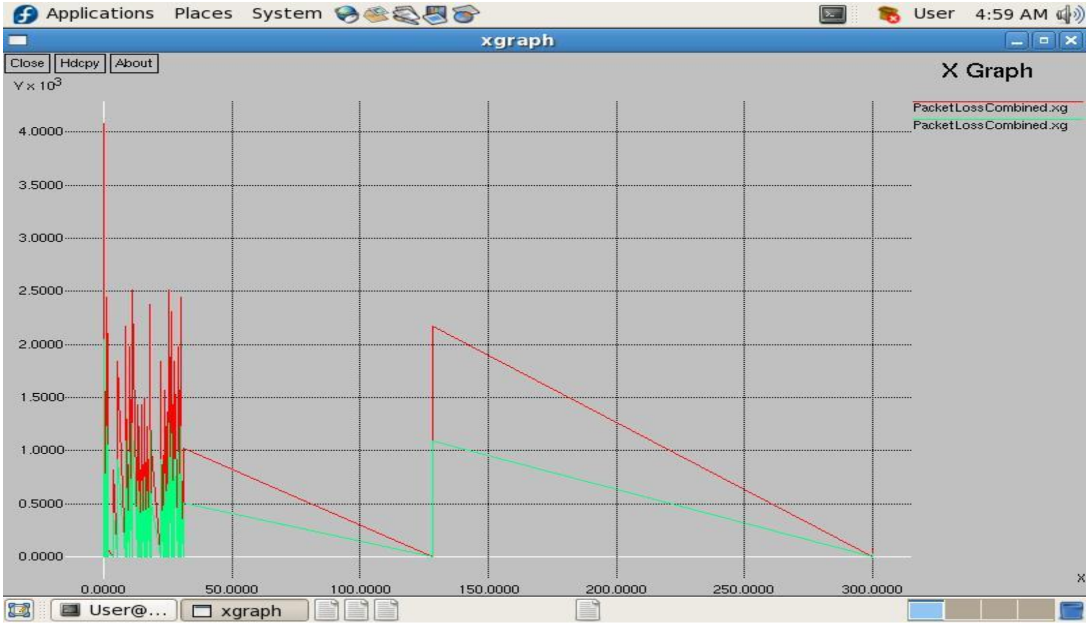


Fig. 6: Packet loss combined graph

[Red Line: Normal Cost and Green Line: Optimized Cost]
[X-axis: Number of Communication and Y-axis: Packet Loss Combined]

7.4 Network load combined graph

Figure 7 shows comparison between network load of optimized cost and network load of normal cost. In figure 7, X-axis represents number of communication and Y-axis represents network load. In network load combined graph, green line represents network load for optimized cost and red line represents network load for normal cost. In figure 7 it can be seen that network load of optimized cost as shown by green line is showing improvement as compared to normal cost as shown in red line. A model is used which is been able to handle more network load of optimized cost as a cyclic graph algorithm is been applied and Euclidean distance formulae by equation (2) is used to find the shortest path in tree topology.

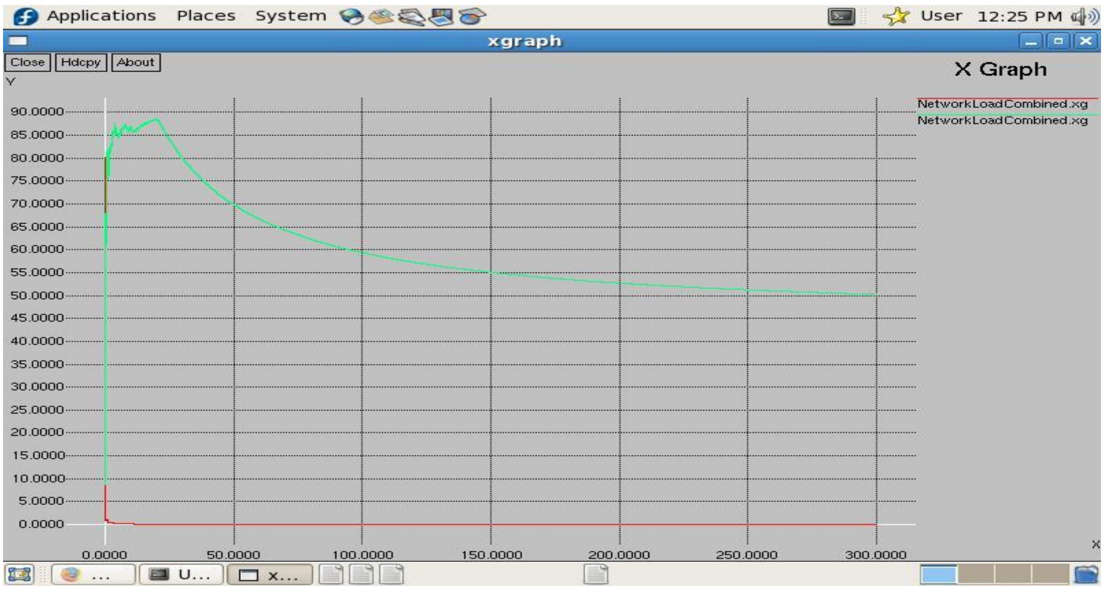


Fig. 7: Network load combined graph

[Red Line: Normal Cost and Green Line: Optimized Cost]
[X-axis: Number of Communication and Y-axis: Network Load Combined]

8. SIMULATION RESULTS

The simulation is been done with the help of NS2. Four modules are been used and then the result is been combined. The results of four output parameters are.

- Cost Combined Graph Result
- Delay Combined Graph Result
- Packet Loss Combined Graph Result
- Network Load Combined Graph Result

Table 2 shows comparison between optimized cost and normal cost. In table 2 below it can be seen that optimized cost is 125 and normal cost is 225 at point 0.The optimized cost is more efficient as compared to normal cost as cyclic graph algorithm is applied and Euclidean distance is been calculated.

Table 2: Cost combined graph result

Normal Cost		Optimized Cost	
Communication Number	**Normal Cost**	**Communication Number**	**Optimized Cost**
0	225.00	0	125.05
1	220.00	1	120.00
2	221.06	2	101.02
3	235.05	3	100.00

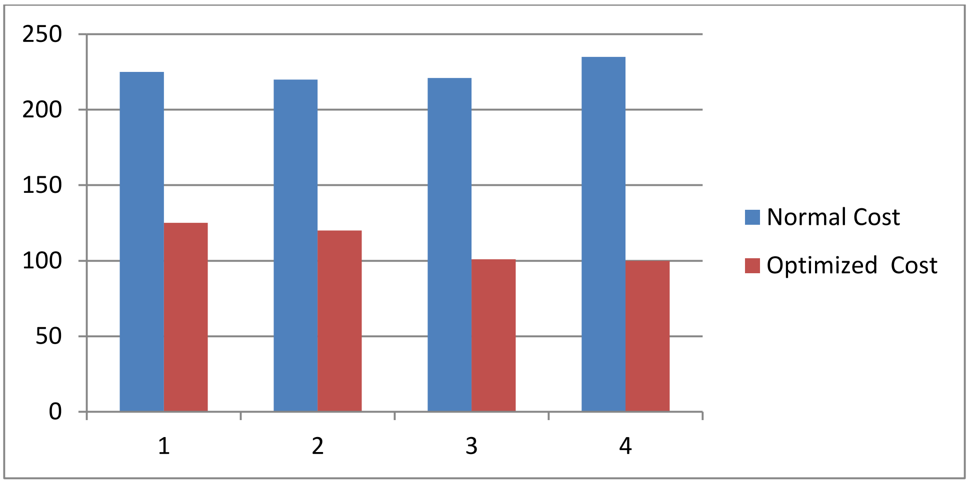


Fig. 8: Cost combined graph result

Table 3 below shows delay in optimized cost and delay in normal cost. In table 3 below it can be seen that delay in normal cost is 42 and delay in optimized cost is 31 at point 0. The delay in optimized cost is efficient as compared to delay in optimized cost as cyclic graph algorithm is applied.

Table 3: Delay combined graph results

Delay in Normal Cost		Delay in Optimized Cost	
Communication Number	**Delay in Normal Cost**	**Communication Number**	**Delay in Optimized Cost**
0	42	0	31
1	86	1	18
2	58	2	38
3	36	3	21

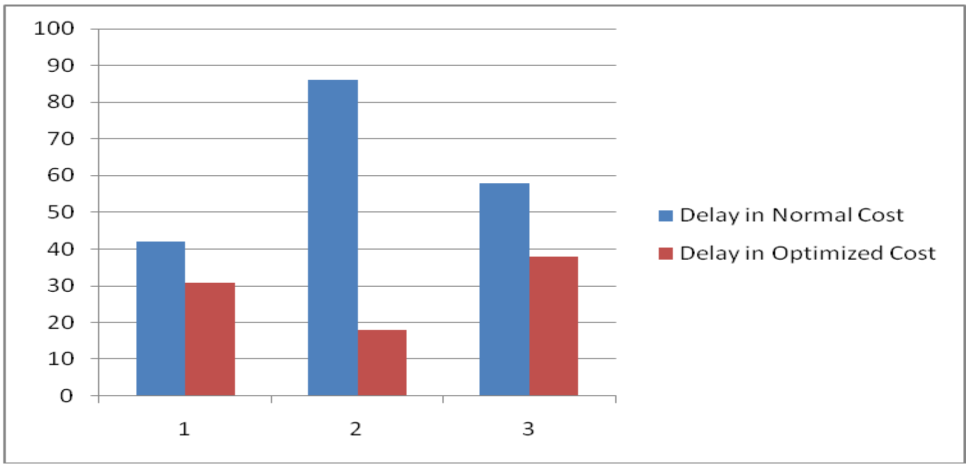


Fig. 9: Delay combined graph results

Table 4 below shows comparison between packet loss in optimized cost and packet loss in normal cost. In table 4 below it can be seen that packet loss in normal cost is 42 and packet loss in optimized cost is 31 at point 0. The packet loss in optimized cost is efficient as compared to packet loss in optimized cost as cyclic graph algorithm is applied.

Table 4: Packet loss combined results

Values in Packet Loss in Normal Cost		Values in Packet Loss in Optimized Cost	
Communication Number	**Packet Loss in Normal Cost**	**Communication Number**	**Packet Loss in Optimized Cost**
0	27	0	20
1	34	1	28
2	28	2	18
3	37	3	25

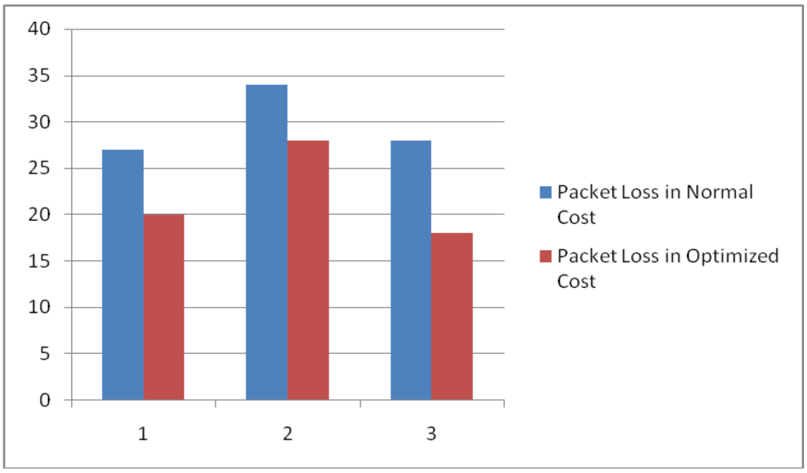


Fig. 10: Packet loss combined results

Table 5 shows network load in normal cost and network load in optimized cost. In table 5 below it can be seen that network load in normal cost is 12.518 and network load in optimized cost is 38.666667 at point 0.001175. The network load in optimized cost is efficient as compared to network load in optimized cost as cyclic graph algorithm is applied.

Table 5: Network load combined results

Network Load of Normal Cost		Network Load of Optimized Cost	
Communication Number	**Network Load of Normal Cost**	**Communication Number**	**Network Load of Optimized Cost**
0.001175	12.518519	0.001175	8.666667
0.001176	76.050000	0.001176	39.61900
0.001200	53.664091	0.001200	45.15789
0.001201	50.631104	0.001201	47.27272

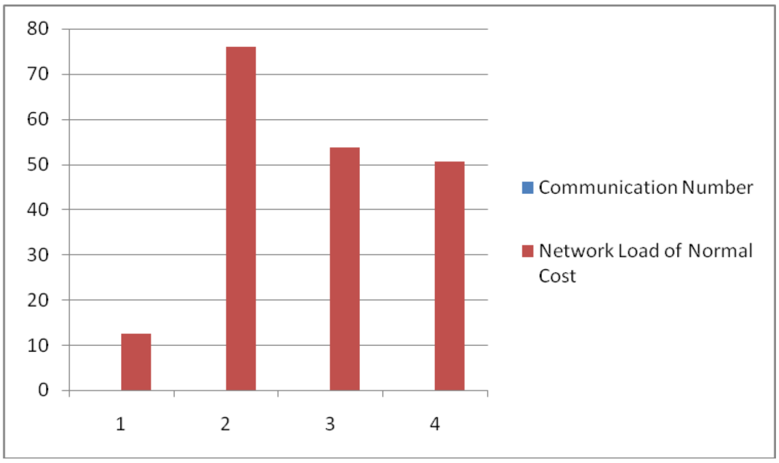


Fig. 11: Network load of normal cost

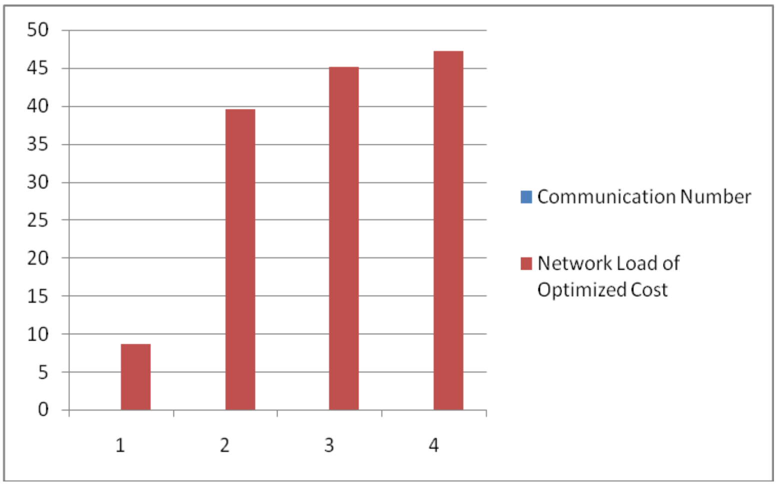
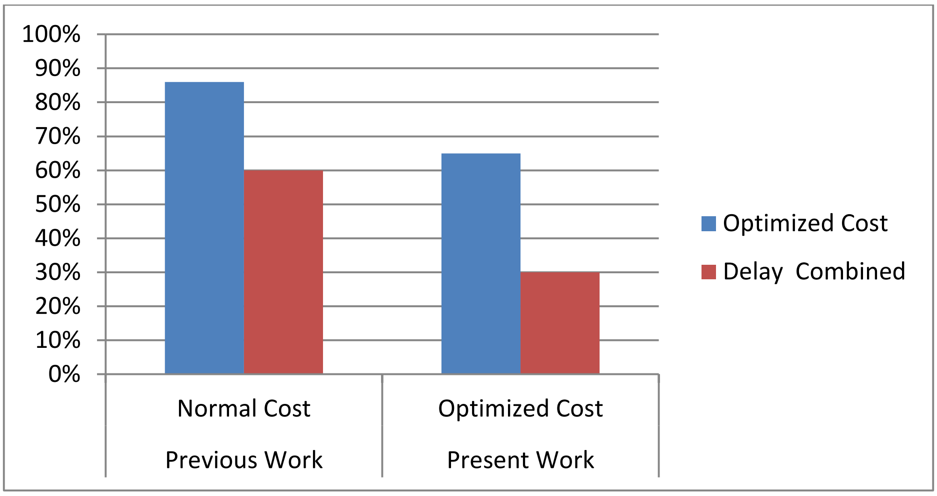


Fig. 12: Network Load of Optimized Cost

Table 6 below shows comparative analysis of optimized and normal cost. It can be seen that the values of optimized cost is more efficient to values of normal cost as cyclic graph algorithm is applied.

Table 6: Comparative analysis

S no.	Parameters	Previous Work	Present Work
		Normal Cost	Optimized Cost
1	Optimized Cost	86%	65%
2	Delay Combined	60%	30%
3	Packet Loss Combined	More	Less
4	Network Load Combined	Less	More



9. CONCLUSION

In the work, the TBF (Transferable Belief Model) extended to a distributed multivalent context based on tree topology. Two different scenarios, namely, static scenario and dynamic scenario, are considered. A cyclic graph algorithm designed to converge of basic belief assignment based on transferable belief model. A Multiagent approach offers several advantages such as a larger range of task domains or a higher robustness and flexibility. The inherently distributed nature of these systems makes the design of effective algorithms very challenging as the overall performance depends significantly on issues arising from the complex interactions among the agents. Tree like topologies represents interaction among static sensors; the use of cyclic structures better describes the interaction among mobile units. Multiagent systems represent an ideal abstraction of actual networks of mobile robots or sensor nodes that are envisioned to perform the most various kind of tasks.

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