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Graph Based Multi-Kernel SVM (G-mkSVM) for Data Transmission in MANET

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Abstract. MANET merges the collaborative networking environment where the dynamic network leads to topological variations. The nodes cooperate efficiently during route establishment and data transmission. The cooperative nature helps to forward data transmission over the network. This work provides the widen concept behind the graph based kernel SVM and explains the graph kernel optimization and multi-graph optimization principle. In this work, a Graph based multi-kernel Support Vector Machine (G-mkSVM) is proposed for MANET. This approach provides the preliminary idea behind the multi-graph kernel, computes the idea behind graph kernel optimization and multi-graph kernels with n-hops. The proposed G-mkSVM applies the shortest path for connecting various CH nodes for transmitting packets. G-mkSVM algorithm performances like packet loss ratio, control packets ratio, and average E2E delay are computed on MATLAB environment. The anticipated model gives better performance than prevailing approaches.

Keywords:Graph based connectivity, optimization, cluster head, MANET, support vector machine.

1. INTRODUCTION

Mobile ad-hoc network is a special kind of wireless networks where the nodes are moving independently with its independent mobility nature [1]. The foremost characteristics of MANET comprises of dynamic features owing to mobility and decentralized networking forms time interval to perform certain task [2]. The decentralized nature specifies network formation during communication nature does not acquire dependencies over prevailing infra-structure [3]. It comprises of extensive range of applications like disaster management, military application and weather forecasting over constrained human regions [4]. Recent investigations in MANET concerned towards the reliable data transmission in a constrained time even in case on unconstrained environment [5]. The intermediate nodes are not chosen during packet forwarding and route establishment among the source and destination [6]. The probability of intermediate node among the neighborhood is increased [7]. Moreover, communication link over the network are extremely increasing with the probability of re-transmission and packet dropping events [8]. The message forwarding strategies influence the throughput and energy of MANET performance. The nodes need to be self-centric with other network component which leads to communication disruption and network performance from security and energy [9]. Thus, the limitations need to be realized to encourage the nodes during data transmission [10] & [11]. Here, graph based model helps to identify the connectivity established among the nodes. The edges and vertices are mapped promptly to enhance throughput with reduced energy consumption. Similarly, the packet delivery ratio is also in-creased with this model. The graph-based kernel computation for data transmission helps to resolve the various limitations that are identified in the prevailing approaches.

The experimental analysis shows that the anticipated G-mkSVM model is more efficient and the performance is more beneficial over the dynamic mobile network environment. The significant contributions of this work are:

1. To measure the shorted path among the neighboring nodes
2. To perform efficient data transmission using G-mkSVM with kernel computation.

2. METHODOLOGY

This section discusses the graph based kernel to predict the efficient data transmission among the network.

2.1 Network connection establishment

Generally, data interactions among mobile nodes are measured to predict the correlation and connectivity among the mobile nodes.

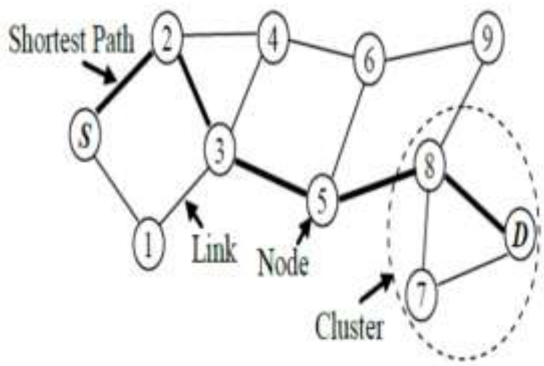

Fig 1. Shortest path graph

When the interaction among the nodes is higher, then the correlation between the nodes is more positive. Similarly, when the interaction among the nodes is lesser, then the correlation among the nodes is negative. Fig 1 depicts the shortest path graph. Consider a graph (undirected) graph $G(V, E)$, where $'V'$ is a node-set over$G, E.$ Assume two diverse mobile nodes (v_i, v_j) with graph connectivity G. The similarity among these two nodes is$S(v_i, v_j) = |\, N_1(v_i) \cap N_2\, (v_2)|$, where $N_1(v_i)$ is a neighbourhood of v_i over G, $N_2(v_j)$ is a neighborhood of v_j over G. The connected nodes are not only affected by the links or other nodes, it is also influenced by links that are not directly connected with it. Thus, the structural information is highly needed for predicting the CH and link in MANET. In a graph, a minimum spanning tree is known as acyclic connected graphs with vertices of minimal weight are being generated. Generally, in MANET, the network connectivity issues are caused due to the dynamic network failures and link disconnection caused in various regions like bad weather, prone regions, and so on.

2.2 Graph kernel

The shortest path prediction is the baseline functionality of typical graph based kernel applications. The shortest path properties and length among the vertex pairs over the sub-graph needs to be computed. The graph labeling $G(V,E,f)$ with label function $f: V(G) \rightarrow N$over the prior graph $G(V,E)$ where $'N'$ is positive integer. Let $X_{sp}\ (i,j)$ is distance among node $'i'$and $'j'$. The kernel computation of graph is expressed as in Eq. (1):

$$X_{sp}(G) = \sum k(i,j) \qquad (1)$$

The shortest path computation is merged with various graph kernels to enhance the efficiency and accuracy of the model. In MANET, the similarities among the wireless nodes are attained to acquire information among the wireless nodes. In an undirected graph, the node information is specified by sub-graphs. The shortest path distance among the nodes projects the relationship of the nodes among the nodes, shortest distance, stronger relationship among the nodes, distance, and weaker nodes relationship. Henceforth, the shortest path distances among the nodes are utilized to construct sub-graph generation, and nodes over different sub-graphs possess diverse mutual relationships and strength.

Rule 1: If the node degree is $'i'$ is 0, node $'i'$ is removed from $'G'$.

Rule 2: For node $'v'$ in graph $'G'$, then the node comprises of least neighborhood with a degree of 1 which is expressed as $\{u_1, u_2, .., u_i\}$.

Rule 3: If node $'i'$ has two distinct neighbors' $x', 'y'$ of degree 1, then eliminate anyone node $'x'$ or $'y'$.

2.3 Sub-graph generation

In MANET, the information attained from wireless nodes, the similarities among the nodes are evaluated. In the undirected graph, the node information is specified by set of sub-graphs. Shortest path distance among nodes reflects relationship between nodes. When the distance is shorter, then the relationship is stronger; else the distance is weaker. Hence, the shortest distances among the nodes are constructed with the sub-graph generation and the nodes with different sub-graph possess mutual relationships among the nodes.

2.4 Multi-kernel node prediction

Here, the similarity among the nodes and clustering tasks are considered to establish the relationship among the kernel space. The kernel matrix is expressed as in Eq. (2):

$$K = \begin{bmatrix} K(x_1,x_1) & K(x_1,x_2) & \ldots..K(x_1,x_N) \\ K(x_2,x_1) & K(x_2,x_2) & \ldots..K(x_2,x_N) \\ K(x_N,x_1) & K(x_N,x_2) & \ldots..K(x_N,x_N \end{bmatrix} \qquad (2)$$

2.5 Graph-based cluster formation

The CH formation algorithm is significantly used to construct $k - hop$clusters. Moreover, to choose an optimal CH node, a CH selection algorithm with a graph kernel is anticipated in MANET. For every node with essential relative speed, the CH maintenance, and graph kernel selection have to be performed. The former part is accountable for handling the problem related to k-hop and graph kernel situation which fulfils connectivity and stability of CH nodes. Similarly, the node's information is attained to measure the similarity and analyzes the link between the nodes and CH. The input is the node connectivity of the MANET network model where the output is the prediction of CH and link among them.

3. NUMERICAL RESULTS AND DISCUSSIONS

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Various MANET network environments are adopted to compute the performance of the anticipated mode. The nodes are generated randomly with a wireless connection, bandwidth, and transmission capacity. Simulation has been carried out in MATLAB environment with 1000m * 1000m with nodes ranges from 0 to 100 around the transmission range of 250 meters. The performances of G-mkSVM are compared with various typical algorithms for the evaluation of node movement and transmission model. The proposed G-mkSVM model is an algorithm based on node mobility prediction. It helps in rapid node movement and election of CH with certain typical characteristics. The proposed model can construct the adaptive neighborhood kernel and gathers the essential information regarding the nodes' neighbors. This model works effectively and gives a better trade-off in contrast to prevailing approaches. The significant parameters considered for evaluation is defined below:

Control Packets ratio: It is depicted as the ratio of the number of control packets generated for recovering the CH to data generated by CH.

Packet loss ratio: It is defined as the ratio of the number of lost packets sent from source to destination to the total packets transmitted from source to destination.

Average E2E delay: It is defined as the average value of time the data packets take to reach the destination from the source.Here, integrity, normalization network information, and accuracy are used for computing the clusters of mobile nodes. These parameters are extensively for appropriate correlation

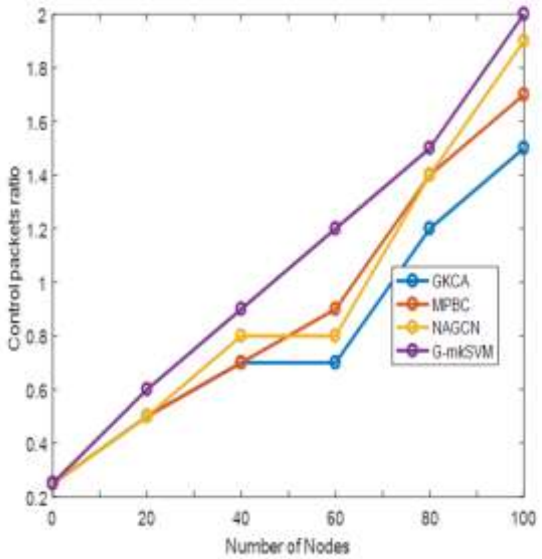

Fig 2. Graphical representation of control packets ratio Vs network size

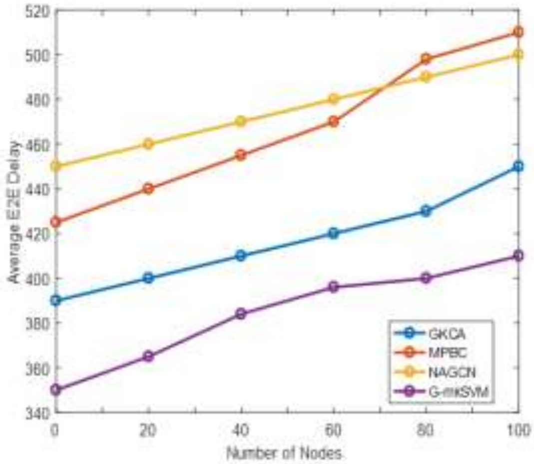

Fig 3.Graphical representation of average E2E delay Vs network size

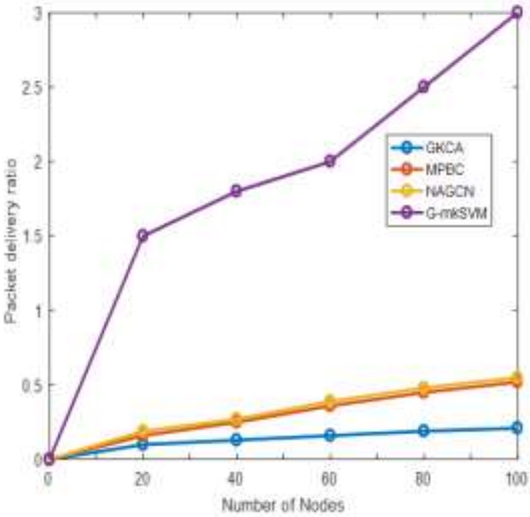

Fig 4.Graphical representation of packet delivery ratio Vs nodes movement speed (m/s)

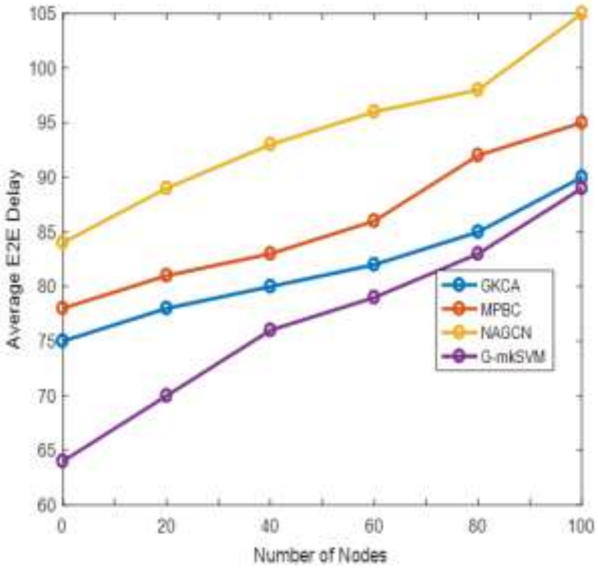

Fig 5.Graphical representation of average E2E delay Vs nodes movement speed (m/s)

From the figures, it is known that the anticipated G-mkSVM gives better control packets ratio and Packet Delivery Ratio concerning Graph Kernel-based Clustering Algorithm (GKCA), Mobility Prediction based Clustering Scheme (MPBC), Neighborhood Adaptive Graph Convolution Network (NAGCN) respectively. Therefore, it is proven that the proposed model fulfills the basic requirements of the MANET network model effectually in terms of network connectivity, route establishment, and data transmission.

Fig 2shows the performance comparison of G-mkSVM with existing algorithms like GKCA, MPBC, and NAGCN respectively in control packets ratio while the network size (the number of nodes) increases. When the size of the network is higher, the cluster and CH selection based control packets are also higher. The control packets ratio is higher than other approaches while selecting the CH and the corresponding cluster nodes. The node values range from 0 to 100 (network size). At the initial level, the control packet ratio is 0.25 for all the models; however when the node size increases, the efficiency of handling the control packets ratio of G-mkSVM is also higher with values like 0.25, 0.6, 0.9, 1.2, 1.5, and 2 respectively.

Fig 3 shows the performance comparison of G-mkSVM with existing algorithms like GKCA, MPBC, and NAGCN respectively in average E2E delay while the network size (the number of nodes) increases. When the size of the network is higher, the cluster and CH selection based E2E should be lesser. The E2E delay is lesser than other approaches while selecting the CH and the corresponding cluster nodes. The delay should be lesser when the network size increases.

Fig 4shows the performance comparison of G-mkSVM with existing algorithms like GKCA, MPBC, and NAGCN respectively in packet delivery ratio with nodes' movement speed (m/s). The link changes when the node's mobility is relatively higher along with the selection of CH. The PDR of the proposed G-mkSVM is higher than other approaches with the adoption of graph kernel methods for selecting the appropriate clusters by maintaining the stability of the clusters. The PDR of the proposed G-mkSVM model. The PDR value ranges from 0, 1.5, 108, 2.0, 2.5, and 3 during node movement. The PDR should be substantially higher when there is a change (mobility) in the nodes.

Fig 5shows the performance of the average E2E delay of the proposed G-mkSVM is lesser than other approaches with the adoption of graph kernel methods for selecting the appropriate clusters by maintaining the stability of the cluster. The average E2E delay of the proposed G-mkSVM model. Similarly, when the node's mobility is higher, the delay should be reduced. It works in a vice-versa manner. The delay is reduced to 64, 70, 76, 79, 83, and 89 which are comparatively lesser than other models. Therefore, the reliability and the stability of the network model are increased gradually with the anticipated G-mkSVM model.

4. CONCLUSION

Due to better network adaptability and stability, the proposed G-mkSVM model can be adopted in any MANET environment and also deployed over any changing network conditions (disaster condition, prone region, and so on). The primary concept behind the anticipated model is to establish the clustering strategy among the nodes with a maintenance mechanism along with a graph kernel-based selection process to deal with metrics like PDR, E2E delay, and control packets ratio. The performance evaluation is achieved effectually with the MATLAB simulation process. The outcomes demonstrate that the anticipated model provides better stability towards the dynamic changing mobile network. The proposed G-mkSVM model shows a better trade-off in contrast to other approaches.

5. REFERENCES

[1] Khan, B. U. I., Olanrewaju, R. F., Anwar, F., Najeeb, A. R., Yaacob, M.: A survey on MANETs architecture, evolution, applications, security issues and solutions. Indonesian Journal of electrical Engineering and Computer Science, vol. 12, no. 2, pp. 832-842, (2018).

[2] Kumar, S., Saini, M. L.: A survey Swarm based routing algorithm towards improved quality of service in MANET. International Journal of Management, Technology And Engineering, vol. 8, no. 5, pp. 311-322, (2018).

[3] Jamal, T., Butt.,S. A.: Malicious node analysis in MANETS. International Journal of Information Technology, vol. 11, no. 4, pp. 859-867, (2019).

[4] Bisen, D., Sharma, S.: Fuzzy based detection of malicious activity for security assessment of MANET. National Academy Science Letters, vol. 41, no. 1, pp. 23-28, (2018).

[5] Rajesh, M.: A review on excellence analysis of relationship spur advance in wireless ad hoc networks. International Journal of Pure and Applied Mathematics, vol. 118, no. 9, 407-412, (2018).

[6] Tembine, Altman, E., El-Azouzi, R.: Delayed evolutionary game dynamics applied to medium access control. IEEE International Conference on Mobile Adhoc and Sensor Systems, Pisa, Italy, (2007).

[7] Xie, Y., Zhang, Y.: A secure, service priority-based incentive scheme for delay tolerant networks," Security Communication Networks, vol. 9, pp. 5-18, (2016).

[8] Nobahary, Babaie, S.: A credit-based method to selfish node detection in mobile ad-hoc network. Applied Computer Systems, vol. 23, no. 2, pp. 118-127, (2018)

[9] Qin, X., Wang, L., Wang, Lin, Y.: An efficient probabilistic routing scheme based on game theory in opportunistic networks," Computer Networks. vol. 149, pp. 144 153, (2019).

[10] Zhang, Y., Fang, Y.: SPREAD: improving network security by multipath routing in mobile ad hoc networks. Wireless Networks, Vol. 15, No. 3, pp.279– 294, (2009).

[11] S B Manoojkumaar and C Poongodi, A Novel Method for Node Connectivity with Adaptive Dragonfly Algorithm and Graph-Based m-Connection Establishment in MANET Computers, Materials & Continua CMC, vol.65, no.2, pp.1649-1670, 2020