International Journal Of Engineering Research And Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 14, Issue 3 (March Ver. II 2018), PP.29-36

A Neighbourhood Technique To Detect Anomlay in VANET Using History-Based Opportunistic Path Selection

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ABSTRACT:-Vehicular Ad-hoc Network (VANET) facilitates road-side communication through moving vehicles assisted by the fixed base station and access points. Roadside communication enables mobile information sharing over remote places and enables Intelligent Transportation System (ITS). Network traffic in these systems increases delay, improper information dissemination besides additional re-routing process. The major re-routing process is caused due to the anomaly present in the network that is inadvertent at the time of neighbor selection. This manuscript proposes a precise neighbor selection based on communication intensity and distance behavior for detecting and mitigating the influence of the adversaries. Anomaly mitigation aids to improve network performance. Hence a comparative study is made to analyse statistical based and neighbourhood technique. The results are analysed which gives further improvement in detecting an anomaly.
KEYWORDS: -VANET; traffic monitoring; nearest neighborhood technique; an outlier.

Date of Submission: 12 -03-2018 Date of acceptance: 27-03 2018

I. INTRODUCTION

The problem discussed in this manuscript concentrates on detecting an anomaly in vehicular traffic monitoring to improve the performance of the vehicle. The existing works concerns about statistical based and clustering based, anomaly detection that is restricted to certain disabilities. Statistical techniques are model-based[1].The outlier is considered to be avalue of any data which is non-predominant in the database. It uses a parametric approach i.e. data is generated from the known value or historic value [2]. This approach works under spatial correlation of the data dealing with all kinds of issues with dependability on data threshold. This leads to increase in delay and computational cost degrading network performance. Based on this a few of the existing approaches under statistical method with their limitations are considered.

Statistical anomaly detection technique first builds up a data reference model and a data pattern to analyze it with respect to that reference model. The anomaly is considered to be any pattern which deviates from the reference model [3]. Statistical outlier detection technique is essentially model-based, with a small amount of outlier detection through a series of observation. The drawback of this approach is (i) Multivariate data increases computational cost [4]. To overcome the disadvantages of statistical based approach clustering based approach was proposed.

The popular approach within the data mining community includes the clustering based approach that groups the similar data instances into clusters with similar behavior [1]. The anomaly is categorized based on distance, the larger the distance within the clusters is considered to be as anomalous. Each node within the cluster builds a local reference model (LRM) and sends them to the cluster head(CH). By receiving the LRMs from its node, CH builds a global reference model (GRM). Finally, the cluster member receives the GRM and forwards the summary of GRM to the base station. The anomaly is detected locally using the received GRM. Base station utilizes GRM summary to classify normal and anomalous clusters [5]. During traffic monitoring, this approach fails to satisfy (i) increase in communication overhead (ii) uncertain distance measurement for multivariate data [3].

The Nearest neighborhood technique is introduced to overcome the disadvantages of Statistical based technique and Clustering based technique and promotes the performance. It is based on the distance of the nodes from which the communicating vehicles select their precise forwarders. The anomaly is been detected using machine learning and data mining techniques [1]. The history-based optimization method is employed to differentiate normal or anomalous data patterns. The conventional outlier is identified if a node is located far from its neighbor[3]. The major advantage of this technique is once the anomaly is been detected, the awareness is broadcasted to its neighbours. This aids in preventing vulnerabilities at the time of traffic monitoring [2]. Hence the main contribution of this article is to detect an anomaly and then re-routing the vehicle which leads to better performance. It has five important features.

- Anomaly Detection: anomaly is been detected using the nearest-neighborhood method

- Reducing Network Traffic: once an anomaly is been detected, the road with lesser traffic is been suggested for the users where the vehicles have been re-routed which helps in reducing the traffic.
- Promoting feasible path selection: the vehicles which are re-routed takes a feasible road based on the feasible path selection method.
- Minimizing delay: once when an anomaly is been detected the vehicle is been re-routed for better promotion and increases the delay time. Hence the shortest path is been suggested in the proposed model, it detects the anomaly and helps in promoting a flexible solution.
- Recommending shortest path using multipath protocol: the shortest path suggested is based on multipath routing protocol which helps in reducing the delay time.

The Nearest neighborhood method is introduced to detect an anomaly. This method works based on intensive neighbor analysis over a time interval. The node which differs randomly from the other nodes is considered to be an as anomalous node. A non real time data is taken into consideration and the data is gone through a series of observation. The anomaly is detected based on vehicle density and communication frequency alongside link connectivity. Anomaly detection is pursued by a feasible path selection process to minimize delay, traffic, and other network issues. This process is carried out using multipath routing protocol which feasibly recommends the shortest distance. The remainder of this paper is organized as follows. Section II Related work, Section III Anomaly detection, Section IV Design of Proposed system, Section V Experimental analysis, Section VI Conclusion, Section VII References.

II. RELATED WORK

Susan Pan [6] introduced DIVERT (a distributed vehicular traffic re-routing system for congestion avoidance) based on the fact how to reduce the congestion in vehicular traffic re-routing in a scalable and privacy-preserving way. This was proposed to overcome the issues within VANET since it is a decentralized network. Privacy is attained by focusing on driver's location by a central server. It works based on two principles 1. Re-routing the path 2. Privacy-aware.

Cahttaraj A. proposed traffic management system based on intelligent transportation system [7]. It has enhanced the connectivity to connect the people, vehicles, and the public infrastructure. Here the electronic equipmentis integrated into the vehicular system for analysing the air quality even in heavy traffic condition. But it faces the issue of scalability and high cost.

David H Roper[8] proposed advance traffic management in California. It is based on looking into an advanced technology method. The aim of this work is to improve the mobility of network by various transportation facilities by balancing the flow of streets and maintaining the traffic information. It helps in preserving the data. Since it deals with advanced technology it suffers from computational cost and flows traffic because this technology cannot be applied to a large number of vehicles.

In [9] Shunsuke Kamijo proposed his work on traffic monitoring and accident detection intersection states. This work is based on tracking the vehicle and monitoring its behavior. It becomes difficult in tracking vehicle; Hence Marko random field model was proposed to overcome the issue and evaluated in real time traffic. It fails in tracking, the images are obtained in grey scale and also fail to assume any physical models, such as the shapeof thetexture of vehicles.

In [10] Tari m Hussain proposed overhead infrared sensor for monitoring the vehicular traffic, Here the infrared optical system was designed to detect the traffic. It works based on infrared sensors, the sensors are placed on roads to monitor the count of vehicles. The database of the vehicles are stored in the centralized system to detect an anomaly

In [11] J. Guevara F. Barrero proposed an approach based on sensor networks. Here an environmental wireless sensor is placed to monitor the traffic. It has enhanced connectivity to connect people, vehicles, and public infrastructure. This system helps in detecting anomaly based on air quality in the atmosphere.

TableI: Previous approaches in VANET for traffic monitoring

Author	Paper	Content	Limitations
Juan (Susan) pan [6]-2013	DIVERT- A distributed vehicular traffic re-routing system for congestion avoidance	Traffic is been detected and the new routes are provided for a feasible solution, but it doesn't work under centralized method each nodeis assumed to be a server and the data is been collected, which leads to high consistency of memory	Scalability of network

J. Guevara F. barrero [11]-2011	Environmental WSN for road traffic application	It is based on the intelligent transportation system. It has enhanced connectivity to connect the people, vehicles, and the public infrastructure. This system actually used in checking the air quality which is also considered to be a reason of anomalous in case of traffic monitoring	Scalability of network
David H. Roper [8]-2008	Advanced traffic management in California	This is mostly based on looking into an advanced technology method. The theme of it is to improve the regional mobility by operating all transportation facilities by balancing the flow of streets and to maintain the traffic information	Flow of balancing
Shunsuke kamijo [9]-2000	Traffic monitoring & accident detection and intersections	It is based on the local behavior of the vehicle at each intersection. It works based on the local analysis of identifying each vehicle and tracking its behavior and to recognize the situation that is likely to differ from a chain of behavior	Flow of traffic
Yongtae park [12]-2000	Counting vehicles- learning from the animal population	WAVE(wireless access in the vehicular environment) has been introduced to reduce the risk of vehicle crashes. It works under the attribute of the count of vehicles	Inadequate in the counting of vehicles
Jie Zhou dashan[13]-2007	Moving vehicles for automatic traffic monitoring	A video based traffic monitoring system for weather forecasting. The images are splitted into various blocks and the one with higher deviation is considered to be as anomalous.	Robustness of image
Angele di febbraro [14]-2006	A new two-level model for multiclass freeway traffic	Traffic is been detected by fusing two different models. The regular traffic condition is monitored using macroscopic multiclass model. The synchronization mechanism is sought using simulation model. These both models are fused to bring out a solution for traffic monitoring	High speed and traffic density
Tari M. Hussain [10]-2009	Overhead infrared sensor for monitoring vehicular traffic	Infrared sensors are used to detect traffic. The sensors collect the data of moving vehicle and anomaly is detected from the obtained data.	Vehicle speed measurements
Subir biswas [15]-2000	V2V wireless communication protocol for enhancing highway traffic safety	This work focuses on collision avoidance process and helps in promoting short-range communication. They also provide safety-critical application such as CCA (cooperative collision avoidance).	Routing of packets
Marc friesen [16]-2014	Vehicular traffic monitoring using Bluetooth scanning over a WSN	This approach is based on Bluetooth processing. Hence only the vehicles within smaller distance could be connected and communication is done using XBee communication	Scavenging for information

The comparative Table.I made to analyze various anomaly detection, with their limitations. Various new technology is been proposed to detect anomaly and traffic, among them, DIVERT (a distributed vehicular trafficre-routing for congestion avoidance) is considered to be as raising technology. Even though it gives a flexible solution it even suffers from serious disadvantages like inadequate travel time, less performance, computational cost etc. The other existing technologies sufferfrom major issues like scalability of the network, the flow of balancing, and the flow of traffic, high speed and traffic density, vehicle speed measurements, routing of packets, and scavenging of information. Hence in this paper, we introduce nearest neighborhood technique to overcome some issues and to provide a feasible solution.

III. ANOMALY DETECTION

This section deals with detecting anomaly based on nearest neighbourhood technique, it's a density based approach where the survival depends upon the count of vehicles. In a first place, an exploration of neighbourhood technique is proposed to detect anomaly based on history based opportunistic path selection method, later its followed by a re-routing process using a routing protocol.

A. Techniques used for anomaly detection

The anomaly is detected based on nearest neighbourhood technique. The node which differs larger in distance from its neieghbor is considered to be as anomalous. A history based opportunistic path selection method is fused to detect an anomaly in an unstationary environment based on the recorded values.

a. Nearest neighborhood technique

Consider the road segment as a graph which consists of edges and vertices, where the vertices represent the intersection of the roads, and edge define the road. Every single road or street is considered to be the neighbor of the other node. The anomaly is detected based on the number of count of the vehicleon the road or the density of the road [17]. If the measure of the count is greater than that of the threshold value then it is considered to be anomalous. This technique mostly depends on the time, the road segment is been monitored for certain interval of time. If the readings get highly deviated from the other then it is considered to be as anomalous. Instead of evaluating the measures singularly or directly as like statistic based techniques, evaluation of values between similar neighbors (road segments) is measured in nearest neighborhood-based technique [18].

In nearest neighborhood technique every edge maintains the record of the historical data, and two road segments injunctiongets compared and these road segments are identified based on the historical similarity. The values are recorded in a table and the table gets adjusted low or high based on the similarity of the value [18].

b. History-based opportunistic path selection

The basis for consistency of Nearest neighborhood technique is historical similarities between road segments [19]. The history-based method is introduced to detect an anomaly in Nearest neighborhood technique. A junction is been divided into four different road segments, the input parameters taken here are vehicle density and distance of the vehicle from its neighbors[6]. The selection of the particular route is done in an optimized manner by selecting the density of the road, once the values are been obtained they are been passed on to the neighboring road [20]. In a practical issue it is worked out based on the attributes d {d1,d2,d3,….,dn} distance from its neighbours, L {L1,L2,L3,…LN} length of the road, R {R1,R2,R3,…..,RN} the current route of the vehicle, and D {D1,D2,D3,….,DN} density of the road. Based on a number of vehicles in particular area, the density of vehicles is measured [8]. Hence a record of this vehicle passing through are taken, they are compared and, theanomaly is been detected. This technique helps in reducing the message loss rate and message delay rate hence it preserves the performance [20].

B. Re-routing

Once the anomaly is been detected the vehicles are re-routed in the the shortest path for the betterment of the work, this is implemented using the routing protocol

a. Routing protocol

In case to increase the performance of the work, the vehicle is been re-routed in the shortest path. Hence the protocol used is an Ad-hoc on-demand multipath distance vector (AOMDV). This protocol focuses on computing multiple loop-free paths (hop count) and link disjoint paths (flooding). The performance is increased by providing multiple paths to the desired destination[21]. This can be done by reducing routing overheads. Here finding the shortest path is the major goal of AOMDV. Once the anomaly is been detected the vehicle is been re-routed in the shortest path to attain better performance[21]

IV. DESIGN OF PROPOSED SYSTEM

In this section, we introduce a design process to detect an anomaly in VANET, based on the density of vehicles. This flow of work is proposed to reduce traffic in VANET by detecting an anomalous node. Further work is been promoted by re-routing the anomalous node using routing protocol.

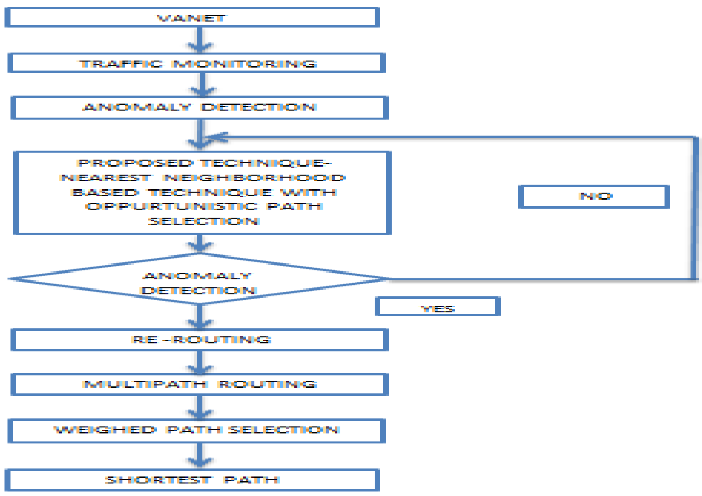

Fig.1:Flow diagram to detect Anomaly

Fig 1. Shows the flow diagram to detect an anomaly. The anomaly is detected based on various level and the work is been promoted by diverting the anomalous node in the shortest path

Traffic monitoring is considered to have one of the major tasks in VANET. Traffic can occur due to the presence of anomalous node. Hence this work focuses on detecting anomaly [18]. Here first the traffic is been monitored, later anomaly is been detected using nearest neighbourhood technique by history based opportunistic path selection method. Once the anomaly is detected the work is been further proceeded by re-routing the vehicles in the shortest path using routing protocols or else the traffic is been monitored again to detect an anomaly. [22]. The node which varies from its neighbor is considered as anomalous. The anomaly is detected based on history based opportunistic path selection. In this technique, the random values are collected based on the certain time period. To promote the work shortest path is suggested using multipath protocol. This technique prevents traffic by increasing the packet delivery factor and decreasing the delay when compared to the existing technique.

The anomaly is calculated based on the series of an experiment conducted. Based on the distance of the nodes, the anomalous node is calculated using history-based opportunistic path selection. In this technique, the random values are collected on the certain time period and the values are evaluated to detect anomalous node. Hence this is considered a better solution when compared to other techniques where it doesn't depend upon any real time value

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \ldots\ldots\ldots\ldots (1)$$

If d< b then deviation is found to increase

$$d = \sqrt{(x_2 - x_1)^2 \cos\theta + (y_2 - y_1)^2} \sin\theta \ldots\ldots\ldots\ldots (2)$$

Hence distance of each node is calculated based on the above formula. Hence this repository provides the history of each neighbor based on the distance provided.

A. **Detecting distance using history-based opportunistic path selection**

The distance of each neighbor is calculated based on the history based opportunistic path selection. The output from this method will be used as an initial estimation to detect an anomaly. The distance of the neighbor is detected using the multiple steps

[**Detecting distance using history-based opportunistic path selection**]

Step 1: Initializing routing path between the source to destination.

Step 2: Once the number of transmission vehicles is equal to the set of original vehicles (i.e.)TxV Є V then
- start the transmission

- get TxC (get the number of transmission count)
- get link access time for all TxV (get the link access time for all transmission vehicles)

Step 3: TxC! =0; Once the transmission count is not equal to zero then
- check TxC is idle or not (check whether the transmission count of thevehicle is idle or not)
- compare the delay (TxC) and LAT (TxC) with TxV (i+1……i+n, i+1≠ TxV) (compare the delay and access time of transmission count with no.of transmission vehicle)

Step 4: Once the transmission doesn't end (i.e.) if! EOF Tx then
- compute delay, LAT for all TxV (delay is computed based on access time for all transmitted vehicle)

Step 5: Transmission is of one to n number of vehicles (i.e.) Tx = 1 to n do
- compute the weight of (i); compute the weight of wt (i) = {delay similar to LAT} (where theweight of theinitial vehicle is equal when delay and access time is similar)

Step 6: The weight of theinitial vehicle is greater than the weight of next vehicle (i.e.) wt (i) > wt (i+1) then
- ov = i else (optimal vehicle is the initial vehicle or else)
- ov = i +1 (optimal vehicle is the next vehicle)
- best {ov} to sv (best of theoptimal vehicle is selected to source vehicle)

Step 7: The transmission range of optimal vehicle set of thevehicle is not equal to zero (i.e.) v [T_R (ov)] ≠ null then
- best {ov} to all V Є T_R(ov) (best optimal for all set vehicles belong to optimal vehicle transmission)
- multipath (sv, ov, dv) (multipath is selected for source vehicle, optimal vehicle, destination vehicle)
- end the function

TxV	Transmitting vehicle
Tx	Transmission
TxC	Transmission count
LAT	Link access time
ov	Optimal vehicle
v	Vehicle
V	Set of vehicles
sv	Source vehicle
dv	Destination vehicle
EOF	End of
wt	Weight
i	Initial vehicle

B. **Anomaly detection on history based optimization method**

In tableII, a record of values are plotted to detect anomalous node, the neighbor 29 is considered to be as the anomalous since its distance is larger when compared to other neighbors. Similarly, in Fig.2 and Fig.3, agraph is been plotted based on the comparison made between the statistical technique and the nearest neighbourhood technique.

Table II:Record of value based on the history based optimization method

S.no	Source	Destination	Neighbor	Distance factor
1	20	38	21	0.14
2	20	38	22	0.19
3	20	38	27	0.23
4	20	38	28	0.28
5	20	38	29	0.04
6	20	38	30	0.38
7	20	38	40	0.52

C. **Comparison of Statistical technique and Nearest neighborhood technique**

The comparison is made between the statistical technique and nearest neighborhood technique. The graph fig.2 and fig.3are plotted based on the delay time and packet delivery ratio. Table of values is considered based on which the graph is been plotted. Based on the observation the fig 2 shows that the delay time is lesser in neighbourhood technique when compared to statistical based. Similarly in case of packet delivery factor in fig. 3 the delivery of packets is considered to be higher in neighbourhood based technique, where a large number of packets are delivered with less delay time. Hence nearest neighbourhood technique is proven to be effective when compared with statistical based.

In general, the test result demonstrates that the nearest neighborhood technique detects an anomaly in an effective manner than the statistical based technique with less delay time and high packet delivery ratio.The delay time is calculated based on the record of the data from Table III, and a graph is been plotted. Similarly a graph is been plotted for Packet delivery ratio based on the recorded values of Table IV.

V. EXPERIMENTAL ANALYSIS

The anomaly is detected through the series of an experiment conducted and tested using NS2 simulator. A four arm road junction was monitored for various time periods where the system readily detects the passage of vehicles. The data is been recorded using history based optimization method. Later, based on the recorded values anomaly is been detected, an anomalous node is the one which differs largely in distance from the neighbour node. To prove that the neighbourhood technique is better, it is been compared with statistical based technique. The comparison is made on two different factors (i) delay and (ii) packet delivery ratio. Based on the observation there is an increase in packet delivery factor and decrease in delay time which in turn increases the successive detective rate of an anomaly in neighbourhood technique. Hence, neighbourhood technique is highly robust in detecting anomaly when compared to statistical based technique.

A. Comparison of Statistical technique and Nearest neighborhood technique

Once the anomaly is detected they are been compared with the statistically based approach. Nearest neighbourhood technique is found to be highly effective when compared with statistical based. data's are collected based on the recorded values of statistical and neighbourhood based. Based on the historical values the graph is been plotted. the experiment is conducted based on two important factors in traffic monitoring they include (i) delay and (ii) packer delivery ratio. In the series of experiment statistical is found to be less successive when compare to the neighbourhood. The neighbourhood technique randomly decreases the traffic by high detection of the anomalous node, thus it increases the performance.

The comparison is made between the statistical technique and nearest neighborhood technique. The graph fig.2 and fig.3 are plotted based on the delay time and packet delivery ratio. Table of values is considered based on which the graph is been plotted. Based on the observation the fig 2 shows that the delay time is lesser in neighbourhood technique when compared to statistical based. Similarly in case of packet delivery factor in fig. 3 the delivery of packets is considered to be higher in neighbourhood based technique, where a large number of packets are delivered with less delay time. Hence nearest neighbourhood technique is proven to be effective when compared with statistical based.

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Table III: Comparison of statistical and neighborhood technique based on delay factor

Time	Statistical	Neighbourhood
2	82.29	94
4	123.5	138
6	328.69	202
8	533.89	246
10	616.1	290

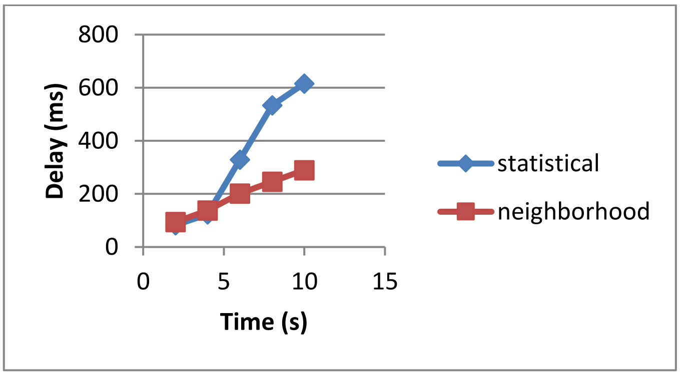

Fig.2:The comparison made between Statistical based technique and neighborhood technique based on Delay

Fig 2. Shows the comparison between statistical and neighbourhood technique based on delay factor. As the time increases the delay factor increases in statistical when compared to neighbourhood

b. Comparison of statistical and neighborhood technique based on packet delivery

Table IV:Comparison of Statistical and Neighbourhood technique based on packet delivery

Density	Statistical	Neighbourhood
5	0.0819	0.5048
10	0.1539	0.4378
15	0.1185	0.2951
20	0.0904	0.2256

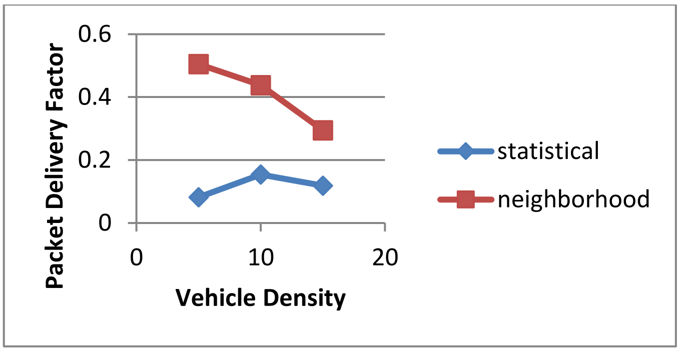

Fig.3:The comparisons made between Statistical technique and Neighbourhood technique based on Packet delivery factor

Fig 3. Shows the comparison of statistical and neighbourhood technique based on packet delivery factor. Here in neighbourhood technique the packet delivery factor is higher when compared to statistical

In nearest neighbourhood technique anomaly is detected based on two difeerent factors (i) delay and (ii) packet delivery factor. In the series of experiment conducted anomaly is obtained based on the distance of neighbours as in table II. Later the nearest neighbourhood technique is compared with the statistical based to prove its more successive in detecting an anomaly. In fig. 2 the delay factor is reduced by 20% when compared with the statistical model, thus decrease in delay promotes less traffic. On the other hand in fig.3 the packet delivery factor is increased by 15% when compared with statistical based. Hence the communication between the neighbors become high which reduces the traffic level. Based on the results obtained nearest neighbourhood technique is highly successive when compared to the statistical based on detecting anomaly with less delay factor and high packet delivery ratio.

VI. CONCLUSION

This paper discusses outlier, the existing work used to detect outlier and their limitation etc. Nearest neighborhood technique is introduced to detect outlier. The non-real time data's are taken into consideration and a comparative study is made to detect a victim using history-based optimization method. Various existing techniques and their limitations are compared. The anomaly has been detected with history-based opportunistic path selection and nearest neighborhood technique. Further planning to promote the work using multipath protocol.

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Kanimozhi J." A Neighbourhood Technique To Detect Anomlay Using History-Based Opportunistic Path Selection " International Journal Of Engineering Research And Development , vol. 14, no. 03, 2018, pp. 29–36.