HIERARCHICAL CLUSTERING BASED MOBILE TARGET TRACKING IN WIRELESS SENSOR NETWORKS

Bharathi S [1], Chandni [2]

M.E Communication Systems[1], Assistant Professor[2]
Department of Electronics and Communication Engineering

Bharathiyar Institute of Engineering for Women
(bharu.sbp @gmail.com)[1], (chandni2289@gmail.com)[2]

ABSTRACT

Nowadays Target tracking is important application in a wireless sensor networks (WSN). Wireless Sensor Network is one of the promptly developing area in which energy consumption is the most important aspect to be considered while tracking, monitoring, reporting and visualization of data. In this method, hierarchical clustering algorithm is used in target tracking mechanisms. This tracking mechanism is used to eradicate the redundancy to improve bandwidth utilization and escalation the energy efficiency of sensor nodes. Cluster based control structures provides more efficient resources for enormous dynamic networks. This clustering algorithm is applied where the nodes are selected for tracking which uses the prediction mechanism to calculate the next location of the moving object. Recovery mechanism needs to be initiated to find the precise location of the lost target. This method for target tracking led to reduce the energy consumption and increase the network lifetime for tracking.

Index terms: Hierarchical Clustering algorithm, Recovery, Target tracking, Wireless sensor network.

I. INTRODUCTION

One of the significant applications of sensor networks is that of tracking mobile targets. This could be used for pursuing an enemy vehicle, intruders, own troops, animals in the wild, etc. Tracking mobile marks involves the recognition and localization of the object of interest by processing the information providing by the sensing nodes beside with the location. The tracking data may then be sent to the base station for additional processing.

Often, it may be essential to send a guided entity or an object to neutralize or interrupt the moving target which would be the future opportunity of the system. This entity can be a vehicle or a person. Due to the localization inaccuracy, the actions of target missing problem often occur, resulting in a momentous energy consumption (e.g., to relocate the missing target). The situation becomes sterner in the case of a WSN that is too dense or sparse, or when there are node failures, exposure holes, obstacles, etc. We enable devices located in a local area near a target moving path to detect the target then compute and store data nearby; they can even reply with queries locally. Target tracking is made addedeffective by manipulating a mobile sink. The sink can always be around the detecting sensors or a little distance away (single to multi-hop).

In practical circumstances similar to the above, the movements of a target are relevant only to local areas and for a short period of time. Such a scenario involves fast tracking operation. An envisioned tracking scheme should offer high quality of tracking in the scenario. If one wishes to cope with these requirements using prior work, we argue that there remains concerns to be addressed for energy constrained WSNs. In general, WSN consists of a large number of tiny sensor nodes dispersed over a large area with one or more influential sink or base stations. Sensors are deployed to sense and record the recognition and localization of a target into the data logger, or to send to a central server (or a sink).

II. TARGETTRACKING ARCHITECTURE

Cluster Formation

In cluster-based approach, whole network is divided into some clusters. Each group has a cluster head which is a selection of cluster members (node). Communication recognized between two clusters can be done based on gateway connection. Cluster-heads do the role of aggregator which aggregate statistics received from cluster members locally and then transfer the result to base station (sink). Christo Ananth et al. [13] proposed a secure hash message authentication code. A secure hash message authentication code to avoid certificate revocation list checking is proposed for vehicular ad hoc networks (VANETs). The group signature scheme is widely used in VANETs for secure communication, the existing systems based on group signature scheme provides verification delay in certificate revocation list checking. In order to overcome this delay this paper uses a Hash message authentication code (HMAC). It is used to avoid time consuming CRL checking and it also ensures the integrity of messages. The Hash message authentication code and digital signature algorithm are used to make it more secure . In this scheme the group private keys are distributed by the roadside units (RSUs) and it also manages the vehicles in a localized manner. Finally, cooperative message authentication is used among entities, in which each vehicle only needs to verify a small number of messages, thus greatly alleviating the authentication burden.

III. DATA FLOW DIAGRAM

In this paper, a tracking protocol was offered based on a new clustering method and new rescue mechanism with virtual grid had Base Station (BS) tracking as the basis for accomplishment tracking application of moving targets in wireless sensor networks. Dynamic clustering procedures problem is that when target frequently modifications its location, reclustering must be invoked. The nodes can be distributed in to the area for forwarding the data from one node to another by using a WSN. The nodes can be grouped into the cluster for spreading the information from one cluster to another cluster. Each Cluster consist of one cluster head which is used to control or provide the command to other nodes in the cluster (see Fig 1). If the target can be detected in one cluster it can be predicted and also it determine the exact location for determining the target and it send to the base station.

Whenever reclustering is needed, BS broadcasts a command message to declare the new CH and cluster members (CMs). In this method, BS evaluations target location. Nearest sensor to target's estimated location is the applicant of being CH, though its combined weight value must be lower than a predefined weight level we call it W_v here. If candidate node combined weight level doesn't satisfy then the subsequent adjacent node to target will be applicant of being CH.Then, BS frights to examine candidates one by one to find the proper CH. Also, BS takes the farthest sensors to appraised location of the target as cluster members (CMs).

Since BS accomplishes the clustering and recapture mechanism, it has a good knowledge of nodes energy levelTarget tracking use the distance parameter for assembling algorithm, but our protocol uses two parameters, distance and energy, for clustering algorithm, and also, it improves essential grid ideas to split each network into 100×100 square area then uses the

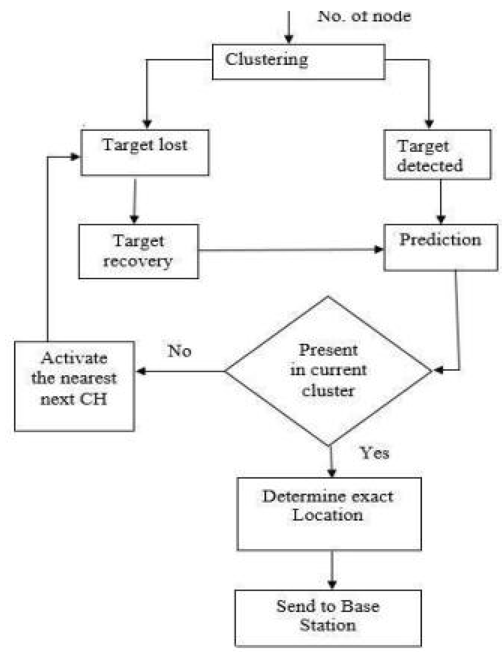

Fig1. Flow Chart of Target Tracking

nodes in each grid, so that the less number of sensors can be recycled in recovery operations.

Overview

When a mobile target enters into the area of analysis, the sensors will sense and detect the target first. At this moment it measure the present position of the target. As soon as a sensor detects the target it estimatesthe target's next predicted location from its current location.

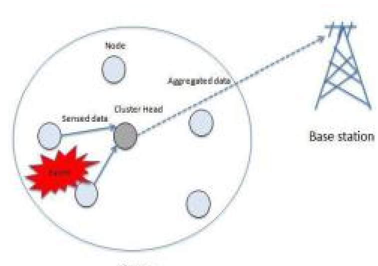

Fig 2. Cluster Based Target detection

The cluster based target detection is described in fig 2. which shows each and Every node can be spread into to the surveillance region, where the target can be entered. In this method we had to categorize the cluster members and cluster head for perceiving the target. The base station can give the grasp to one cluster. The target move from one cluster to additional cluster is predicted by this method.

If the target is present on that cluster, the cluster head can well-versed to the base station otherwise if it move to other cluster it can be recuperated by this method. The sensor nodes send a wake up message to the sensor nodes. Now discretely of these sensor nodes measures the extant location of the target and also intellects additional information like target's heat, humidity, pollution etc. and leads this information to the base station. Now the sensor nodes will in prospect perform the same steps that were earlier performed by the nodes to predict the next location of the goal. Atlast the statistics can be send to the base station.

Communication between clusters

Link establishment of target detection is shown in fig 3. Due to the target movement, a cluster member may be a good control candidate and can be a leader for the tracking task. Indicate a sensor with tracking responsibility as an active sensor. Otherwise, a sensor is obvious as an inactive sensor. Suppose each sensor is an inactive sensor with the initial deployment. The tracking chore is triggered when the target broadcasts a message.

Thus, when sensor receives the message sent from the target, it will announcement a Hello message and become an active sensor, which tolerates itself to estimate how many neighboring active sensors it has. Then, BS forms a command packet including collecting information such as CH and CMs IDs and transmits the packet over the WSN through a long group transmission.

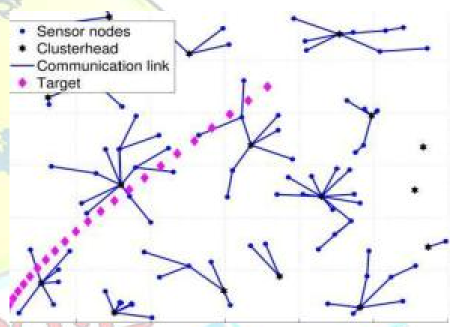

Fig 3. Link Established for Target Detection

However, any catastrophe needs to be handled. In this case presented recovery action is invoked. If BS flourishes to internment the target, then tracking process starts from the establishment, otherwise BS does recovery progression until it finds the target or reach to end the of the link lifetime. Being triggered by BS, devices change their state to sensing state and wait to collect command message. After receiving command message, they check to see if they have been broadcasted as CH or not. If a sensor is not announced as CH, then it is CM.

CM show sensed information and CH receives the evidence from all CMs.

Then, CH computes exact location of the target, then CH sends target location to BS.

Fig 3.explains the target detection of cluster based approach. The target present in the current cluster is informed to sink otherwise it predicted to nearest cluster head. If the predicted location is located out of the current cluster, energetic CH selects nearest CH to that scene as next active CH and gives the tracking task to the new active CH. After the target detected by the cluster can transmit the information to the Base station.

PREDICTION OF NEXT LOCATION

When a mobile target enters into the area of coverage, the sensors will sense and detect the target first. Based on the target motion the cluster can be formed because of dynamic clustering method. In this target present location is (x_t, y_t) and the next location is denoted as (X_{t+1}, Y_{t+1}) which is calculated by using the formulae of

$$X_{t+1}=X_t + v_t \cos d_v$$

$$Y_{t+1}=Y_t + v_t \sin d_v$$

v_t is the target current speed anddv is the angle of motion of the node.

Considered if the target can be present at one cluster, and if the target can be moved to another cluster then it can be activated neighbor cluster to invoke for detect the target. The cluster now has to stimulate the sensors which are adjoining to the predicted location of the target. For this it selects a circular area everywhere the target's next predicted location with degree Δ_v, and where target's next projected location is taken to be the identified. The CH nodes send a wake up communicationto the sensor nodes.

Now each of these sensor nodes measures the current location of the target and also senses added information like target's temperature, humidity, pollution etc. and sends this quantifiable to the base station. Now the sensor nodes will in opportunity perform the same steps that were previously performed by the nodes to calculate the next location of the target.

The only change here is that since more than one sensor is now distinguishing the target, the average of all the locations, predicted exclusively by each of these sensors is taken as the new predicted location value. The above process remains until the predicted location of the target is found to be exterior the area of coverage, in which case no more sensors will be stimulated. The target node element is the travelling target that can emit various forms of indicators and has mobility function.

In addition to the agility function, the tracker element is equipped with a communication transistor to interact with the WSN. The communication element of a sensor node interact with bordering nodes and the tracker. The element follows the rules of energy-efficient state conversion and its duty-cycle. The WSN planarization is carried out after its arrangement. Once the WSN starts tracking operation, target detection element embarks.

Recovery Mechanisms

Recovery mechanism needs to be initiated to find the exact position of the lost target. They are recommending an efficient repossession mechanism. In this method, the sensor network location is divided with dimensions of 100 × 100. Each sensor node is placedin the interiorfield, resulting in one of these nodes. The BS estimates target location and retains which nodes is the target location. Using our recovery process causes that less number of nodes participates in recovery operations, therefore, nodes consume less energy and will increase the network lifetime.

At the commencement of this algorithm, all nodes are in sleep mode excluding the tracking nodes. When a cluster node catches a target in its sensing range, it waits for a arbitrary time called back off time to evade collision. Then, the cluster node sends its identified data to the BS.

VI. RESULT

Simulation Environment

- System with N nodes on a 100x100 grid
- Velocity of nodes were varied uniformly between 0 and 10m/s
- Transmission range of nodes was varied between 0 and 70m
- Ideal degree was fixed at 10^{0}
- Weighing factors: $w_1 = 0.7$, $w_2 = 0.2$, $w_3 = 0.05$ and $w_4 = 0.05$

Nodes Distribution in WSN

Numbers of sensor nodes are randomly deployed with known location.Some of the total nodes can wake up at any instance when it wants to communicate by using this method, where each node opportunistically forwards a data to the first neighboring node that wakes up among multiple candidate nodes shown in fig 4.

Number of nodes: 100

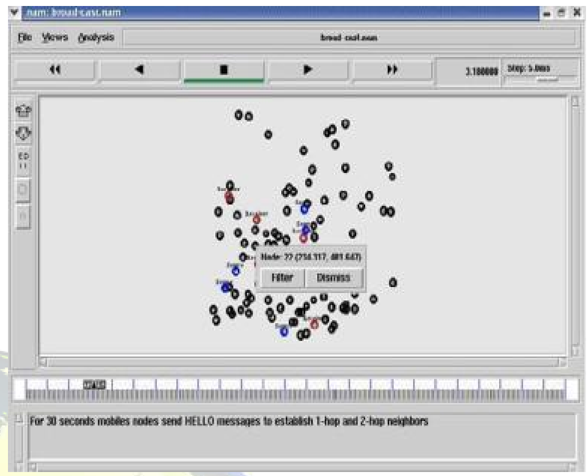

Fig 4. Node distribution in WSN

Nodes transmission in WSN

Number of node transmissions through tracking process in the field of WSN is an imperative factor for Mobile tracking (see fig 5). Transferred packets is an usual number and shows the ratio of definite transmitted packets to network life time.

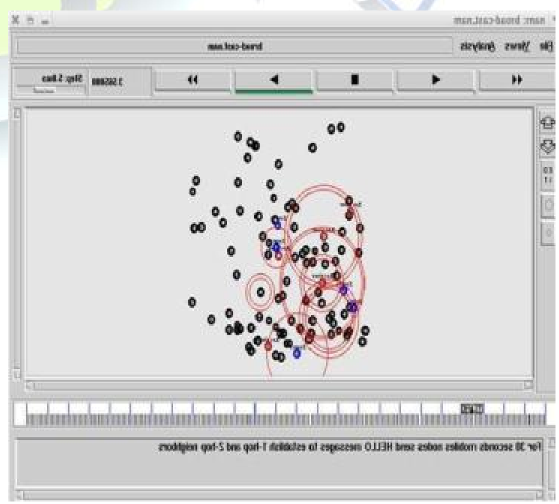

Fig 5. Node transmission in WSN

Cumulative Utility

Cumulative utility replicates the effects of a node's comportment on its own. All nodes prefer higher utilities Furthermore, since a useful trade brings anaccelerating node a positive utility, the nodes always prefer increasing cumulative utilities is shown in fig 6.The cumulative utility is increase if the number of node increase.

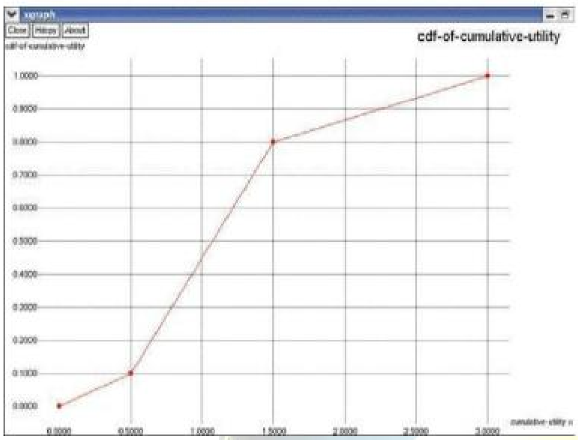

Fig 6. Cumulative utility

Energy Consumption

The energy consumed is seriously take into account by sensor nodes in every time step of tracking and sensor node duty cycle. The tracking heavily relies on high accuracy of localization and the energy efficiency of Wireless Sensor Networks.

Therefore the lifetime of a sensor node is strongly dependent on its battery lifetime and the lifetime of a WSN is directly related to the energy consumption of its sensor nodes is shown in fig 7. The total amount of energy consuming is reduced the number of nodes increases.

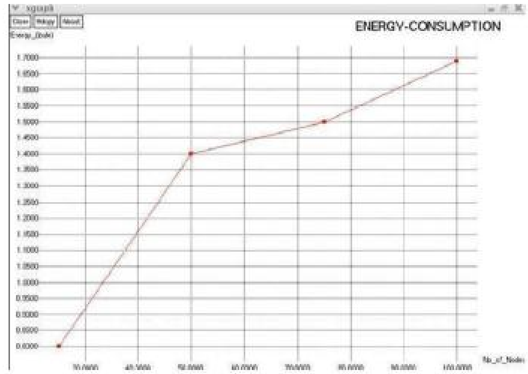

Fig 7. Energy Consumption

Latency

With this hierarchical clustering method, the end to end latency is decreased according to the increase in number of nodes is shown in Fig 8.

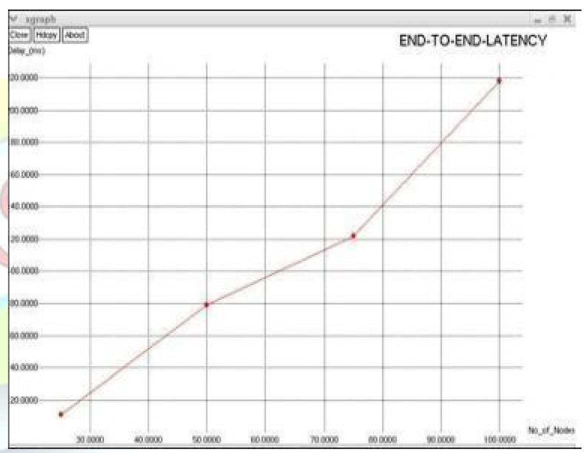

Fig 8. Latency

VII. TARGET TRACKING IMPLEMENTATION

Target tracking will be implemented using a popular discrete event simulator i.e. OMNeT++. It is not a WSN simulator, nor even a network simulator, but a ridiculous simulation podium on which various self-regulating groups can build their own simulators. An OMNeT++ based simulator is built from elements called modules. Simple module is a basic unit of performance and is written in C++. Compound module consists of other components (simple or compound) that are linked by connections. Top-level composite module is called network module. Modules communicate via communications that are sent via connections or directly from module to module. Topology (i.e. structure of compound elements and network module) is defined using declarative language called NED.

Scenarios and various simulation limitations are defined in INI files, and thus are separated from copies and topology. OMNeT++ includes an integrated development environment (IDE) that enables C++ programming and restoring of simple modules, as well as graphical and textual editing of NED files. Tkenv is a GUI tool for observing simulation flow, featuring animation of message flow on network charts, visualizing node state fluctuations, displaying debug output of modules or element groups, viewing and yourselfexchanging state of simulation objects etc. Tools for visualizing vibrant interactions among modules and for results analysis and visualization are also provided.

VIII. CONCLUSION

In this project, a hierarchical clustering based mobile target tracking in Wireless sensor network is proposed. This method can effectively solve the target missing problem caused by the node failures and also predict the next location where the target can be moved. The recovery process causes less number of nodes to participate in recovery operations, therefore, nodes ingest less energy and will rise the network lifetime.Recovery mechanism needs to be initiated to find the exact location of the lost target. The cumulative utility is increased and the latency is decreased with respect to the increase in number of nodes. Therefore, this method for target tracking led to reduce the energy consumption and increase the network lifetime for tracking.

REFERENCES

[1] B. Athanasios . Vasilakos , Md Zakirul Alam Bhuiyan, Guojun Wang, " Local area prediction based mobile target tracking in Wireless sensor networks", IEEE transactions on computers, VOL. 64, NO. 7, July 2015

[2] J. Zheng, M. Z. A. Bhuiyan, S. Liang, X. Xing, and G. Wang,"Auction-based adaptive sensor activation algorithm for targettracking in wireless sensor networks," Future GenerationComput. Syst., vol. 39, pp. 88–99, 2013.

[3] K. Han, J. Luo, Y. Liu, and A. V. Vasilakos, "Algorithm designfor data communications in duty-cycled wireless sensor networks:A survey," IEEE Commun. Mag., vol. 51, no. 7, pp. 107–113, Jul. 2013.

[4] M. Ding and X. Cheng, "Fault tolerant target tracking in sensor networks," in Proc. IEEE 10th ACM Int. Symp. Mobile Ad Hoc Netw. Comput., 2009, pp. 125–134.

[5] P. Vicaire, T. He, Q. Cao, T. Yan, G. Zhou, L. Gu, L. Luo, R. Stoleru, J. A. Stankovic, and T. F. Abdelzaher,

"Achieving longterm surveillance in VigilNet," ACM Trans. Sens. Netw.,vol. 5, no. 1, pp. 1–39, 2009.

[6] R. Sarkar and J. Gao, "Differential forms for target tracking and aggregate queries in distributed networks," IEEE/ACM Trans. Netw., vol. 21, no. 4, pp. 1159–1172, Aug. 2013.

[7] S. Misra and S. Singh, "Localized policy-based target trackingusing wireless sensor networks," ACM Trans. Sens. Netw., vol. 8,no. 3, pp. 1–30, 2012.

[8] C.-Y. Lin, W.-C. Peng, and Y.-C. Tseng, "Efficient in-network moving object tracking in wireless sensor networks," IEEE Trans. Mobile Comput., vol. 5, no. 8, pp. 1044–1056, Aug. 2006.

[9] E. Amaldi, A. Capone, M. Cesana, and I. Filippini, "Design of wireless sensor networks for mobile target detection," IEEE/ACM Trans. Netw.,vol. 20, no. 3, pp. 784–797, Jun. 2012.

[10] E. Xu, Z. Ding, and S. Dasgupta, "Target tracking and mobile sensor navigation in wireless sensor networks," IEEE Trans. Mobile Comput., vol. 12, no. 1, pp. 177–186, Jan. 2013.

[11] H. Zhu, M. Li, Y. Zhu, and M. N. Lionel, "HERO: Online realtime vehicle tracking," IEEE Trans. Parallel Distrib. Syst., vol. 20, no. 5, pp. 740–752, May 2009.

[12] J. Jeong, Y. Gu, T. He, and D. H. C. Du, "Virtual scanning algorithm for road network surveillance," IEEE Trans. Parallel Distrib. Syst., vol. 21, no. 12, pp. 1734–1749, Dec. 2010.

[13] Christo Ananth, M.Danya Priyadharshini, "A Secure Hash Message Authentication Code to avoid Certificate Revocation list Checking in Vehicular Adhoc networks", International Journal of Applied Engineering Research (IJAER), Volume 10, Special Issue 2, 2015,(1250-1254)

[14] G. Y. Keung, B. Li, and Q. Zhang, "The intrusion detection in mobile sensor network," IEEE/ACM Trans. Netw., vol. 20, no. 4, pp. 1152–1161, Aug. 2012.

[15] G.Wang,M. Z.A. Bhuiyan, J.Cao, and JieWu "Detecting movementsof a target using face tracking in wireless sensor networks," IEEETrans. Parallel Distrib. Syst., vol. 25, no. 4, pp. 939–949, Apr. 2014