International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 01 | Jan 2022 www.irjet.net p-ISSN: 2395-0072

Optimizing the Packet Routing with Effective Probability Association in Wireless Sensor Network

Lekhana M M[1], Chinnaswamy C. N[2], Dr.T.H. Sreenivas[3]

[1-3]PG Student, CNE, Associate Professor, Professor Dept. of CS&E, "Vidyavardhaka College of Engineering", Mysore, India

---

Abstract– Wireless Sensor Networks play a critical role and have attracted a lot of academic attention in recent years. Sensor nodes have been utilized in a variety of applications, including environmental monitoring, security, and target tracking. The latter entails detecting and tracking the target's movement. We examine well-known target tracking strategies in depth in this work. Metrics including network topology, target recovery, energy efficiency, and security are used to assess existing solutions. We also go through some of the issues that impact tracking scheme performance. Furthermore, present methodologies are thoroughly examined, and future directions are investigated.

Keywords: Wireless Sensor Network (WSN), Sensor Node (SN), Cluster Head (CH), Kalman Filter (KF), Prediction, Energy Efficiency, Security, Wireless Sensor Network (WSN), Sensor Node (SN), Cluster Head (CH), Kalman Filter (KF), Prediction, Energy Efficiency, Security

1. INTRODUCTION

WSNs are critical in the development of smart environments, such as smart cities, smart buildings, smart grids, transportation and shipping systems, and so on. It serves as a link between the actual world and intelligent systems. The number of sensors nodes (SN) in a WSN might range from a few to hundreds of thousands [1], [2]. An SN might be as little as a grain of dust or as large as a shoe size. SNs can cost anywhere from a few pennies to hundreds of dollars, depending on the node's sophistication. SNs perform a variety of duties, including monitoring/sensing, processing, information collection, and communication [3]. Because of their low cost and independence from human meddling, they are utilized in a variety of monitoring applications, including environmental monitoring [4], [11], health monitoring [5], [6], subterranean and underwater systems [7], industrial equipment, and surveillance [8]–[10]. Distributed SNs are linked together in such a way that they function as a single unit. SNs detect or acquire a certain sort of data and, depending on the topology, send it to the sink node or cluster head (CH). SNs perform a variety of duties, including monitoring/sensing, processing, information collection, and communication [3].Because SNs have small batteries that are often irreplaceable and cannot be recharged, effective energy consumption is one of the most important concerns for them.

Moving item locations are likewise tracked and reported using SNs. One of the most common techniques is target tracking (as seen in Fig. 1).

WSN applications in which SNs follow the target and communicate its location to the user's application are crucial. Many domains, including campus monitoring, ecosystem monitoring, health monitoring, illegal border crossing, and war surveillance, can benefit from target tracking.

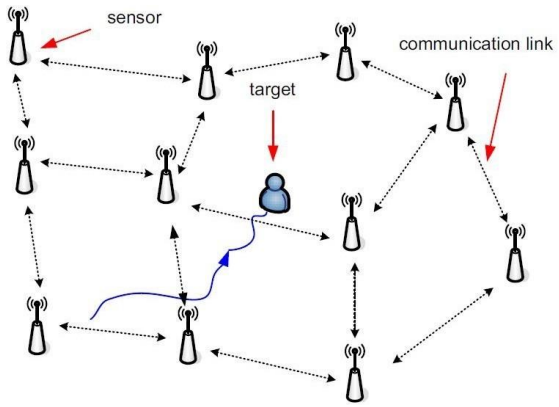

Fig.1.Target Tracking in WSN

However, for a dependable and efficient target tracking, numerous obstacles must be solved, such as energy efficiency, precision, forwarding techniques, load-balancing, prediction, and recovery [43]–[45]. For example, health-related applications demand rapid and reliable data transport, while monitoring applications in smart environments necessitates energy-efficient and resilient ways. Costs, device selection, and connection are also hindrances to effective tracking.

Tracking can be done with the aid of a single SN or by a group of SNs working together. The employment of a single SN results in fast energy depletion, costly computation, and low precision. When compared to a single SN, several SNs provide higher precision, more energy efficiency, and less computation.

Multiple target tracking classes have been proposed in the literature. We examined well-known tracking techniques in terms of security [4], efficient energy usage [5], [8], node clustering [28], and accuracy [12] in this article.

Fig 2: Challenges of Target tracking

I. CHALLENGES IN LOCALIZATION AND TARGET TRACKING

Many difficulties are looked during the confinement and target following as displayed in Figure 2. These snags influence the general following productivity of WSN, for example,

•**Hub Failure**: In WSN, SNs are responsible to disappointment because of battery exhaustion, the event of fiasco, equipment disappointment, and outside assault. This legitimizes the requirement for conventions that can adapt up to these difficulties.

•**Lost and Recovery of Target:** Prediction mistakes, obstacles in the organization, change of way or speed causes the deficiency of target. A strong following calculation is profoundly expected to handle this issue.

•**Information Accumulation**: In bunch based following, SNs forward their information parcels to their related CH. Subsequent to getting these bundles from SNs, CH collects the information and precisely eliminates the redundancy and duplication. During this course of amassing, information dormancy and energy utilization are attempted to keep least as much as can.

•**Energy Consumption**: SNs run on batteries that are non-battery-powered and now and again in a non-inconsistent climate. Because of which energy productivity is an intense issue in WSN explicitly in delicate objective following applications. Such energy proficient calculations are expected to determine this issue and delay the organization lifetime.

•**Network Coverage**: Target following and inclusion of organization region are straightforwardly related and work for hand in hand. The general exhibition of the following calculation relies upon the inclusion of the organization. Assuming the organization contains openings or SNs are meagerly disseminates, the performance of the organization is corrupted. For better precision from target following, the organization should not have any openings or inadequate.

•**Information Flow:** The requirement for information stream change from one circumstance to another like ordinary situation or crisis situation. If there should arise an occurrence of crisis or strategic applications deferral and interference influence the following effectiveness. Thus, such plans ought to be planned in which there is no or negligible interference.

II. CLASSIFICATION OF TARGET TRACKING APPROACHES

In the writing audit, various points of target following are considered. Target following can be described into multiple

Angles: proficient energy utilization, network structure, accuracy, target misfortune and recuperation, etc.

In this segment, we examine the scientific classification of target following and measurements as per which we evaluate the new calculation. Fig. 3 shows the conceivable scientific classification of target following WSNs.

A. Network Structure

In [10], the creator has dispersed the organization structure into three classifications: Tree based construction, group, and pioneer based organization structure. They have coupled every class with pre-style based methodologies to make convention more energy productive and limit chances of target misfortune. In [13], the creator partitions the organization structure into two sorts: various leveled and distributed. The progressive organization further isolated into four structures: enactment based, group based, tree based and mixture. The shared based organization made out of inserted channels: appropriated Kalman sifting (DKF) and disseminated adaptable Sigma-Point Kalman channel (DSPKF).

We separate organization structures into three sorts: Flat design, Tree based and Cluster based organization structure.

•Level Structure It is a kind of no geography or the absence of geography. In a level organization, every SN contributes an equivalent job in network improvement and foundation. In this geography, SNs broadcast information until it arrived at the objective SN. This engineering doesn't think about the productive energy utilization of SNs.

•Tree Structure In tree based organization structure; conveyed SNs develop intelligent tree based engineering. Information head out from leaf SN to root SN. This way energy is saved on the grounds that it saves SNs from parcel flooding and broadcasting.

•Group Structure is molded when the organization is conveyed and its liabilities are characterized, for example, the quantity of SNs, inclusion region and so forth Group

based geography gives us versatility and effective utilization of transmission capacity than different geographies. Assuming CH is chosen through neighborhood network handling less parcels are sent to a base station which brings about proficient energy consumption, effective data transfer capacity utilization, and security. Bunching can be static or dynamic.

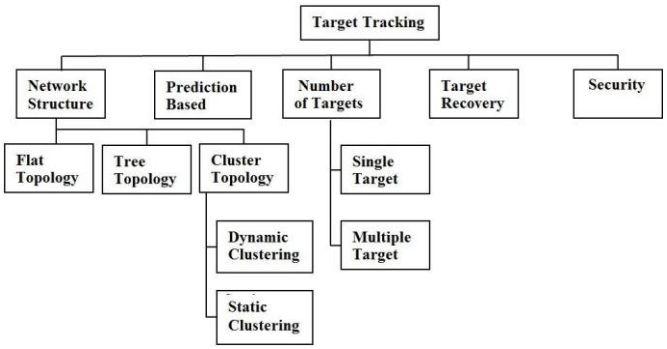

Fig.3.Taxonomy of Target tracking

1) Static Cluster: are framed during network arrangement and stay steady all through the organization's life expectancy. Aside from its accommodation, it has numerous disadvantages, including the way that the whole group's presence is subject to CH, and there is no probability of information dividing or participation between bunches.

2) Dynamic Cluster: The groups from progressively as the objective moves. It is better contrasted with static grouping because of its security. Because of the need, new groups arise. When the objective is entered, the bunch is framed, while different SNs stay sleeping. Only each group is empowered in turn, bringing about energy preservation; notwithstanding, the imperfection in unique bunching is information overt repetitiveness and meddling issues.

B. Prediction Based Tracking

Expectation procedures are utilized in forecast based tracking techniques to foresee the future objective position. SNs are empowered close to the following area, while others stay unconscious, saving the energy of SNs and upgrading the absolute life season of the organization. Various methods and models are proposed to anticipate the following expected place of the portable objective, for example, Kalman channel (KF), broadened Kalman channel (EKF) [29], [30], direct expectation model [17], Unscented Kalman Filter (UKF) [40] and so on

C. Number of Targets

Target following can be isolated into two classes de-forthcoming on the objective: single objective following and different objective following.

•Single Target tracking a solitary objective consumes less power and energy productive. It creates a low traffic load during the objective following.

•Numerous Targets tracking different targets is a troublesome assignment. It turns out to be more troublesome because of the distinctions in target rates and headings. Numerous objective data is gotten by SNs. The most troublesome test is figuring out which information has a place with which target. The information affiliation issue emerges from this impossibility of information.

D. Target Recovery

Expectation based calculation in WSN now and then endures target misfortune because of abrupt speed change, hub disappointment, PC misfortune, mistake in area assessment, forecast blunder, and organization inclusion issues. expectation based calculation. To recover the lost objective, it is important to have a strong recuperation process. Fast, tough and energy-productive recuperation instruments. Around here, a lot of examination has been done to resolve this issue.

E. Security

In target following, security is one of the central points of contention because of specific strategic applications. These SNs can be sent to disagreeable, unfriendly regions in mission-study applications, and interloper/foes can without much of a stretch trade off or catch these SNs. These impacted SNs might cause bogus, counterfeit information transmission, like the specific area of the target, and may make the following dependability questionable.

III. COMPARISON AND ANALYSIS OF EXISTING WIRELESS TRACKING TECHNIQUES

In level geography, every one of the conventions are making an honest effort to track down the streamlined course from source to sink SN, utilizing flooding of some kind. This telecom in the organization causes quick battery exhaustion, bundle overhead and abbreviates the organization lifetime. Some likelihood based procedures are intended to diminish copy bundle flooding and to found steering way like Sensor Protocol for Information by means of Negotiation (SPIN), Rumor directing and so forth

1)SPIN [18]: In Sensor Protocol for Information by means of Negotiation (SPIN) message flooding issue is addressed with the assistance of arrangement. It comprises of three kinds of messages (I) Advertisement (ADV), (ii) Request (REQ), (iii)Data (DA). When, SNs get a few new information, SN sends an ADV message to a neighbor. Intrigued SN sends REQ message to the shipper. Thus, a DATA message is shipped off the intrigued SN. Turn further develop network lifetime by lessening flooding and repetitive information. The defect of SPIN is that it doesn't ensure information conveyance.

2) RR [19]: The creator proposes a Rumor Routing (RR) convention. RR performed uniquely for little WSN. Nonetheless, on account of huge region WSN the upkeep of

specialists (SNs) and table in every SN is become extremely complicated. Overhead of RR is connected with different elements like chance to live, number of specialists and inquiries. Pioneer SN becomes mindful of target or occasion from occasion specialists. Pioneers SN in the wake of applying the heuristics method choose the course for the following jump determination. The primary benefit of RR is no geography upkeep and great nature of courses, then again, inconveniences of RR is inconsistency, high postponement, and ignorance of new neighbor appearance and dead neighbor.

3)RR [20]: In [20], creators proposed an item following calculation in view of the Fuzzy Sensing Model in correspondence with RSSI (Radio Signal Strength Indicator) to follow the objective. In the wake of following the objective, SN finds its area by means of GPS and sends the determined objective area to the sink SN. They proposed a tree structure based following called "caravan tree", which will be made when the objective is followed. All hubs close to the objective are associated with the tree. Subsequently giving us 100 percent inclusion and far hubs will stay in rest mode, brings about saving energy. The proposed calculation works better in term of energy proficiency and versatile objective following.

4)ETX-NH [21]: The creator proposed a novel steering supportive of tool in view of Neighborhood Heuristics (NHs) model for tree organized WSN. NH coupled SNs steering metric with its neighbors (like energy, distance) to highlight accessible courses. This extra data in regards to neighbors aids the determination of the course and fundamental tains the in general directing quality. The proposed directing plan is energy productive and performs better even in a lossy organization climate.

5**)DLSTA [22]:** Dynamic Look forward Spanning Tree Algorithm (DLSTA) is proposed in [22] to limit the odds of an objective lost by pre-building look forward group alongside the objective anticipated direction before it shows up. The SN nearest to the objective is picked as root SN in DLSTA Root SN builds the tree group; work out the area, next anticipated position, speed. The formation of a pre-developed tree relies on the speed of the objective. Numerous channels like broadened channels Kalman (EKF) and molecule Filter (PF) in DLSTA are utilized to guarantee precise expectation. This exact earlier information helps with saving the energy of SN and further develops the general organization lifetime.

6) DHSCA [23]: A clever Dual Head Static Clustering Algorithm (DHSCA) is proposed in [23] to further develop the general organization lifetime and energy utilization. In DHSCA; the organization is involved static groups in view of the geophysical area of SNs to eliminate the bunch development overhead like in unique bunching. Two hubs are chosen as CH; one for information conglomeration called Aggregating Cluster Head (ACH) and the other for information transmission called Transmitting Cluster Head (TCH), in view of remaining energy and distance from different SNs. DHSCA keeps up with the equilibrium of energy utilization among SNs and further develops the WSN lifetime by choosing progressively CH.

7) BCTT [24]: In [24], another objective following calculation; Boundary Static Clustering Target Tracking (BCTT), is proposed. BCTT tackle the limit following issues by permitting the limit sensor to turn into an individual from however many groups as they need. BCTT additionally permit SN to team up and share data, by permitting this the general following productivity is expanded. The proposed conspire is superior to dynamic and crossover since there is no overhead of bunch arrangement and annihilation.

8) SCDCH [25]: A Static Cluster and Dynamic Cluster Head (SCDCH) calculation is proposed in [25]. Author coupled SCDCH with Newton-Gaussian calculation to foresee the objective direction and blunder assessment. SCDCH is utilized to gather the information from dynamic SN and forward it to the CH. This convention gives high precision and lessens energy utilization; subsequently draw out the organization lifetime generally speaking.

9)DCTT-PCTT [26]: The creator proposed two algorithms; (I) Distributed Cluster-based Algorithm for Tar-get Tracking (DCTT) and Prediction-based Clustering calculation for Target Tracking (PCTT), for vehicular following in a Vehicular Ad-hoc Network (VANET). DCTT is a powerful grouping calculation wherein CH is answerable for target area data, collection of information got and sending it to sink hub called Command and Control Center (CC). A Target Failure Probability (TFP) is kept up with and shared by SNs among one another. TFP is a measurement intended for the choice of CH. On the off chance that CH is lost, the best hub with the base TFP is chosen as a CH.

PCTT is a brought together VANET based grouping algorithm. In PCTT, CH is answerable for the administration of group and target following. Authorization to join the group, computation and determination measures for CH, principle tenance choices all are executed by CH.

10) ACDF [27]: A powerful grouping based versatile filtering plan is proposed for target following in a WSN. A two-stage progressive information conglomeration method by remembering energy productivity. At the primary stage, SN ascertains their assessed separation from the portable objective and offers it with all bunch individuals and CH. Aside from getting the SN assessed distance computation, CH likewise ascertains its distance from the objective and total it with the got information from SNs. CH will be chosen in light of the of remaining energy. The proposed plot gives us better and exact objective following in an energy productive manner.

11) RSSI-LPM [28]: A plan is proposed to follow and foresee the following area of the objective. The organization is isolated into static bunches. CH will be chosen whether in

view of leftover energy or distance from the base station. Trilateration system is utilized to follow the objective and bring together this following instrument with a Linear Prediction model to foresee the following area of the objective. Just SN, nearest to the following area will be dynamic while the rest will stay sleeping. This component keeps up with high exactness, further develop network lifetime.

12) ARIMA-UKF [29]: An energy effective following plan is proposed by bringing together two calculations; Auto Regressive Integrated Moving Average (ARIMA) and Unscented Kalman Filter (UKF). ARIMA is a period series based factual technique in which subsequent to noticing the objective in equivalent spans, its future area is anticipated in view of its past with the most un-conceivable mistake. UKF gives the assessed target position. This utilization of ARIMA and UKF safeguard the general energy of SN and further develop the organization lifetime.

13) LSA-RCAM [30]: An exact and energy productive target following plan in view of expectation is proposed. The Least Square Algorithm (LSA) is utilized to follow the portable objective area and Random way and Constant Acceleration Model (RCAM) for target versatility boundaries like speed, bearing, and speed increase. The proposed forecast strategy has great objective exactness, decline the quantity of dynamic SN; the just closest to the objective will be dynamic while the rest will stay sleeping, this will further develop the general organization lifetime.

14) DPR [31]: The creator proposed a Dual Prediction based Routing (DPR) calculation. This calculation further develops net-work lifetime by keeping most hubs in rest mode. The assessed next area of the objective is anticipated twice, (I) at hubs level (ii) at sink level. On the off chance that the distinction between them is under the edge, the sink isn't refreshed which results in decrease the bundle transmission. Target is followed by sensors through trail alteration calculation then, at that point, advances the data to their particular CH called "pioneer", which total the information and forward the data to sink. The proposed conspire gives better outcomes in term of normal energy utilization, network lifetime. Following different targets has different applications like boundary observing, war zone checking, observation, and airport regulation. The fundamental difficulties are multi-target following tracks, the exact area of targets, partner the messiness and boisterous estimations accurately.

15) SJPDA-PUESRF [32]: In [32], to follow the different targets coordinate turn model is taken on with a non-straight turning rate. Test based Joint Data Association (SJPDA) is utilized to partner or dispose of the get calculations with the relative objective. A variation of Ensemble Square root Filter called Particle astute Update form of Ensemble Square root Filter (PUESRF) is utilized because of it doesn't depend on Gaussian circulation and gives a low root mean square mistake. This combination of SJPDA with PUESRF brings about exact and exact information relationship just as steady targets following.

16) ASMT [33]: A clever calculation is proposed for Augmented Specified Multipurpose Tracking (ASMT). ASMT is a unified Bayesian calculation in light of shortsighted appraisals. This data is recognized by the SN to CH and sent to CH. CH is liable for information affiliation and the objective position and close by local not set in stone and sent to the sink hub by utilizing the Bayesian assessment estimation. ASMT offers high-accuracy multi-target following, less estimation and resolves the issue of the WSN information mix adequately utilizing area and speed status.

17)PPHD-MMA [34]: The writer has proposed the Multi-way to Measurement Association approach (MMA) and joins it with the Probability Hypothesis Density utilizing a multi-target Particle Filter (PPHD) in metropolitan regions. The PPHD-MMA framework need not know about the number of targets are so that objectives can change over the long haul. K-mean bunching is utilized to group and to process at some random time the quantity of targets. PPHD-MMA works out the likelihood way at each stage, so the likelihood for all ways is distinguished, and the way that is no doubt chosen. Because of the utilization of PPHD and regarding the got targets data as irregular limited set (RFS) estimation to follow affiliation issue is kept away from.

18) SSN-AUKF [35]: A clever plan is proposed to re-cover the lost objective with least SN awaken. An Adaptive Unscented Kalman Filter (AUKF) calculation is coordinated to improve the strength and precision of the recuperation component. The creator proposed conspires a static bunched agreeable organization which consists of some static SN (SSN) and a couple of versatile SN called portable hub (MN) to follow the objective. Unscented Kalman Filter (UKF) is utilized to anticipate the objective next area. When the objective is announced lost because of its shifting pace or because of openings in WSN, MN will proceed with tracking. AUKF tweaks the commotion covariance network to further develop the recuperation component's precision and strength. This overwhelming booking of MN and SSN further develops following likelihood while consuming less energy than just SSN.

19) VGTR [36]: A successful camera sensor based plan called Virtual Grid Target Recovery (VGTR) is proposed in which just essential cameras are initiated to convey valuable data about the versatile objective. Cameras participating in versatile objective following are chosen with dynamism relying upon portable objective speed. VGTR partition the entire checking region into a virtual lattice and level, vertical lines. The crossing points of these lines are called Virtual Nodes (VN). Every sensor knows the area of its nearest VN. Assuming that the objective is lost because of an abrupt course adjustment or speed, to recuperate the lost portable objective all cameras are initiated.

DISCUSSION

A lot of exploration has been directed to make WSNs brilliant and energy productive. A framework that consumes a ton of energy is unsatisfactory for most of utilizations. Therefore, energy utilization stays one of the main difficulties as far as brilliant climate and target following. It is likewise straightforwardly connected to the idleness Furthermore execution of following. The quantity of hubs and transmission range are two significant boundaries. The quantity of SNs occupied with target following significantly affects precision and energy use. The more the cooperation of SNs in limitation, the more prominent the restriction precision and energy utilization. Be that as it may, Machine Learning (ML) brought together with energy reaping strategies can be appropriate possibility to improve and delay SN lifetime.

To further develop target following, diverse expectation calculations are executed. Nonetheless, these energy-starved strategies abbreviate the existences of SNs. Lately; scientists have proposed different low obligation cycle expectation calculations in which SNs near the objective stay working while others are kept in a rest state.

In strategic applications, for example, front line keep an eye on spear and far off wellbeing observing, security is additionally a pivotal issue. Regularly, SNs are sent in a threatening climate, where they are inclined to ruin and took advantage of by interlopers. A few creators reason the utilization of cryptography or advanced mark based security. Moreover, it is one of the least examination regions among this field. Notwithstanding, this region needs consideration since when a client uses such applications which uncovers its personal data can have critical outcomes. Compromising client area for specific administrations and applications, for example, the wellbeing, industry and safeguard can be unsafe and hazardous

CONCLUSIONS

The thorough and inborn nature of Wireless Sensor Net-work makes them effectively deployable wherever in the field like terrible areas, metropolitan urban communities, enterprises, submerged and homes. Among various utilizations of WSN,

for example, more extensive observing, natural life territory checking, transport meant checking, medical services, and security observation, target following is considered as the main one. It is essential to follow various occasions at soonest before a major harm and go to the remedial lengths. The huge examination in target tracking and complex application regions propelled us to completely break down and think about the exhibition of existing strategies in light of organization structure, energy effectiveness, and forecast ac-curacy, number of targets, target recuperation and security. After this broad relative investigation we reason that current strategies are lingering behind explicitly in following different targets, target recuperation and security. In this way there is still need to propose such procedures which can resolve these issues and increment its versatility.

REFERENCES

[1]M. Safaei, A. S. Ismail, H. Chizari, M. Driss, W. Boulila, S. Asadi, and M. Safaei, “Standalone noise and anomaly detection in wireless sensor networks: A novel time-series and adaptive Bayesian-network- based approach,” Software: Practice and Experience, vol. 50, no. 4, pp. 428–446, 2020.

[2]M. Safaei, S. Asadi, M. Driss, W. Boulila, A. Alsaeedi, H. Chizari,

R. Abdullah, and M. Safaei, “A systematic literature review on outlier detection in wireless sensor networks,” Symmetry, vol. 12, no. 3, p. 328, 2020.

[3]SlavisˇaTomic. Target localization and tracking in wireless sensor networks. 2017.

[4]Yashwant Singh, Suman Saha, Urvashi Chugh, and Chhavi Gupta. Distributed event detection in wireless sensor networks for forest fires. In Computer Modelling and Simulation (UKSim), 2013 UKSim 15th International Conference on, pages 634–639. IEEE, 2013.

[5]Abdul Saboor, Rizwan Ahmad, Waqas Ahmed, Adnan K Kiani, Yannick Le Moullec, and Muhammad MahtabAlam. On research challenges in hybrid medium access control protocols for ieee 802.15. 6 wbans. IEEE Sensors Journal, 2018.

[6]K. Ramya, K. Praveen Kumar and D. V. Srinivas Rao, “A Survey on Target Tracking Techniques in Wireless Sensor Networks”, International Journal of Computer Science & Engineering Survey, vol. 3, no. 4, pp. 93-108, 2012.

[7]Khan, Muneeb A.; Saboor, Abdul; Kim, Hyun-chul; Park, Heemin. 2021. “A Systematic Review of Location Aware Schemes in the Internet of Things” Sensors 21, no. 9: 3228. https://doi.org/10.3390/s21093228.

[8]Khan, Muneeb A., Muazzam A. Khan, Anis U. Rahman, Asad Waqar Malik, and Safdar A. Khan. ”Exploiting cooperative sensing for ac- curate target tracking in industrial Internet of things. International Journal of Distributed Sensor Networks 15, no. 12 (2019) DOI: 1550147719892203.

[9]A. Oracevic and S. Ozdemir, “A survey of secure target tracking algorithms for wireless sensor networks”, World Congress on Computer Applications and Information Systems XWCCAIS), 2014.

[10]O. Demigha, W. Hidouci and T. Ahmed, “On Energy Efficiency in Collaborative Target Tracking in Wireless Sensor Network: A Review”, IEEE Communications Surveys & Tutorials, vol. 15, no. 3, pp. 1210- 1222, 2013.

[11]K. Hazra and B. N. Bhramar Ray, "Target Tracking in Wireless Sensor Network: A Survey", International Journal of Computer Science and Information Technologies, vol. 6, no. 4, 2015.

[12]A. Kaswan, K. Nitesh and P. Jana, "Energy efficient path selection for mobile sink and data gathering in wireless sensor networks", AEU - International Journal of Electronics and Communications, vol. 73, pp. 110-118, 2017.

[13]T. Semong, S. Anokye, Q. Li and Q. Hu, "Rumor as an Energy- Balancing Multipath Routing Protocol for Wireless Sensor Networks", International Conference on New Trends in Information and Service Science, 2009.

[14]S. Bhowmik and C. Giri, "Convoy Tree Based Fuzzy Target Tracking in Wireless Sensor Network", International Journal of Wireless Information Networks, vol. 24, no. 4, pp. 476-484, 2017.

[15]D. Delaney, R. Higgs and G. O'Hare, "A Stable Routing Framework for Tree-Based Routing Structures in WSNs", IEEE Sensors Journal, vol. 14, no. 10, pp. 3533-3547, 2014.

[16]A. Alaybeyoglu, A. Kantarci and K. Erciyes, "A dynamic look ahead tree based tracking algorithm for wireless sensor networks using particle filtering technique", Computers & Electrical Engineering, vol. 40, no. 2, pp. 374-383, 2014.

[17]T. Panag and J. Dhillon, "Dual head static clustering algorithm for wireless sensor networks", AEU - International Journal of Electronics and Communications, vol. 88, pp. 148-156, 2018.

[18]S. Rouhani and A. Haghighat, "Boundary static clustering target tracking in wirless sensor networks", 6th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2015.

[19]M. Wahdan, M. Al-Mistarihi and M. Shurman, "Static cluster and dynamic cluster head (SCDCH) adaptive prediction-based algorithm for target tracking in wireless sensor networks", 38th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2015.

[20]S. Khakpour, R. Pazzi and K. El-Khatib, "Using clustering for target tracking in vehicular ad hoc networks", Vehicular Communications, vol. 9, pp. 83-96, 2017.

[21]H. Zhang, X. Zhou, Z. Wang, H. Yan and J. Sun, "Adaptive Consensus- Based Distributed Target Tracking With Dynamic Cluster in Sensor Networks", IEEE Transactions on Cybernetics, pp. 1-12, 2018.

[22]P. Joshi and A. Joshi, "Prediction Based Moving Object Tracking In Wireless Sensor Network", International Research Journal of Engineering and Technology, vol. 4, no. 7, 2017.

[23]M. Alishahi, A. Hossein Mohajerzadeh, S. Aslishahi and M. Zabihi, "Adaptive Target Tracking Using Prediction in Wireless Sensor Net- works", 2016.

[24]M. Mirsadeghi and A. Mahani, "Low Power Prediction Mechanism for Wsn-based Object Tracking", Procedia Technology, vol. 17, pp. 692- 698, 2014.

[25]V. Dayan and K. Vijeyakumar, "Target Tracking in Sensor Networks Using Energy Efficient Prediction Based Clustering Algorithm", Procedia Engineering, vol. 38, pp. 2070-2076, 2012.

[26]R. Jinan and T. Raveendran, "Particle Filters for Multiple Target Tracking", Procedia Technology, vol. 24, pp. 980-987, 2016.

[27]K. Xiao, R. Wang, L. Zhang, J. Li and T. Fun, "ASMT: An augmented state-based multi-target tracking algorithm in wireless sensor networks", International Journal of Distributed Sensor Networks, vol. 13, no. 4, p. 155014771770311, 2017.

[28]M. Zhou, J. Zhang and A. Papandreou-Suppappola, "Multiple Target Tracking in Urban Environments", IEEE Transactions on Signal Processing, vol. 64, no. 5, pp. 1270-1279, 2016.

[29]H. Qian, P. Fu, B. Li, J. Liu and X. Yuan, "A Novel Loss Recovery and Tracking Scheme for Maneuvering Target in Hybrid WSNs", Sensors, vol. 18, no. 2, p. 341, 2018.

[30]J. Amudha and P. Arpita, "Multi-Camera Activation Scheme for Target Tracking with Dynamic Active Camera Group and Virtual Grid-BasedTarget Recovery", Procedia Computer Science, vol. 58, pp. 241-248, 2015.