

## ABSTRACT

Object tracking in Wireless Sensor Networks (WSN) has become an emerging topic of late, due to its wide-ranging applications. The main task of object tracking is to track the moving object and report its newest location in the detection area to the applicant in a timely manner. Most object tracking process use prediction scheme to minimize energy consumption and maintain low missing rate in a sensor network. In the hierarchical network structure, grouping the nodes in to clusters has been widely adopted to achieve higher energy efficiency and prolong network life time in WSN.

Each cluster comprises of a sensing leader as well as member nodes and they usually perform tasks such as fusion and aggregation. In this research work, prediction based scheme is used to minimize the member nodes participating in tracking process and make the rest of the member nodes in to sleeping mode for longest possible period and thus save their energy. Prediction based scheme consists of prediction model, wakeup process and recovery process. The prediction models use wake-up mechanism to wake up the neighboring member nodes before the object leaves its own detection area and enters in to the neighboring area.

There still will be an un-ignorable increase in missing rate when the object changes its moving direction beyond prediction because only the member nodes which are on the predicted route of the object will wake up and monitor the object continuously. Also all the member nodes on the object's travelling route are supposed to be active to monitor the object. In such eventuality, the energy consumption will be higher. If the object missing rate occurs, then the recovery process has to be initiated to localize the missing object and return it to the network for object tracking.

Hence, there is a necessity to identify a solution to trace the missing object and get back to the network for prediction tracking process. It is studied and analyzed that there is a research gap found to accurately locate the missing object in the network. In this context, a novel approach is introduced to recover the missing object by using the optimization techniques such as Particle Swarm Optimization (PSO), Sequential Monte Carlo (SMC) and Simulated Annealing (SA).

When using PSO, the main responsibility of the nodes is to send out signals, so as to identify the missing object location by means of updated object position and velocity. While using SMC, the location of the missing object is estimated as the weighted mean of its samples by using Bayesian filtering approach. Likewise in SA, the location of the missing object is identified by using the edge weight of each node and models of each weight.

Finally based on the Simulation results, it is evident that the average localization error shown by Particle Swarm Optimization (PSO), Sequential Monte Carlo (SMC), Fuzzy Inference System with Simulated Annealing (FIS+SA), multilateration and centroid methods are  $0.79(m)$ ,  $0.84(m)$ ,  $0.97(m)$ ,  $2.29(m)$ ,  $3.48(m)$  respectively. Also from the comparative analysis, it is observed that during the impact of network density, source rate, missing rate, and aggregation ratio, the PSO shows better average network throughput ( $6.43 p/s$ - $8.82 p/s$ ), compared to SMC ( $6.16 p/s$ - $4.55 p/s$ ) and FIS+SA ( $6.21 p/s$  - $8.66 p/s$ ). Similarly during the impact of network density, source rate, missing rate, aggregation ratio, the PSO shows enhanced average energy efficiency ( $1.06 \times 10^5 J$  - $1.51 \times 10^5 J$ ), compared to SMC ( $1.96 \times 10^5 J$  - $2.1 \times 10^5 J$ ) and FIS+SA ( $1.70 \times 10^5 J$  - $1.96 \times 10^5 J$ ). Likewise PSO shows better latency ( $22.83 s$ - $32.16 s$ ), compared to SMC ( $36.16 s$  -  $43.83s$ ) and FIS+SA ( $29.1s$ - $37.1s$ ), during the impact of network density, source rate, missing rate, aggregation ratio.