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Mobility Management for Target Tracking in Wireless Sensor Networks

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ABSTRACT

Wireless Sensor Networks (WSNs) are broadly used in many applications including surveillance. There are many approaches of target tracking in WSN. Generally sensor node needs to move to different location to keep track of signal-emitting target. Time of Arrival with respect to signal is the measurement employed to make mobile sensor moving decisions. Recently Xu et al. proposed a mechanism for target tracking and mobile sensor navigation. Their approach is known as a min-max approximation approach that can effectively estimation the location of tracking using a concept known as semi-definite programming relaxation. They also proposed weighted tracking algorithm to achieve target tracking with accuracy. In this paper we implement target tracking mechanism that leverages the effectiveness of WSN in terms of packet delivery ratio, throughput, and delay performance. The simulations results reveal that the proposed approach is useful in accurate target tracking in secure fashion.

Keywords— Wireless Sensor Network, Time of arrival, Sensor Navigation, Target Tracking, Mobile Sensor Controller, Mobile Target.

I. INTRODUCTION

Wireless Sensor Network (WSN) is a collection of nodes that can collect data or sense data and send to base station or sink. The network is made up of the nodes in two or three tiers based on the configurations. WSNs became very popular in the real world applications. The data is sent from all nodes to sink or base station. Therefore it is known as many to one communication. Very important application area of WSN is target tracking. Before going to actual details about target tracking and which describes an overview of a typical WSN used for target tracking. A collection of sensor nodes linked to sink. In turn sink is made accessible to authorized people who interact with sink through wide area network like Internet. The sink node is there in between the Internet and sensor network.

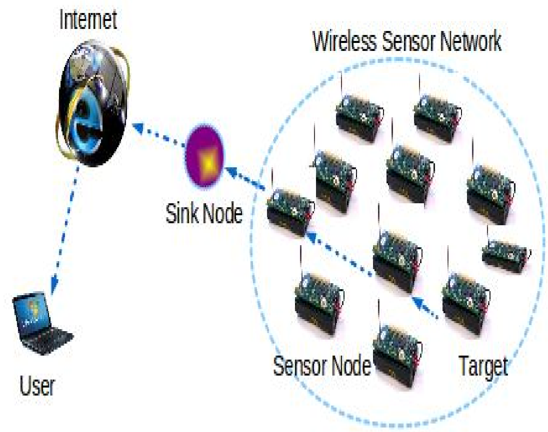

Figure 1 – Wireless sensor network

The authorized users can make queries on the sensed data through Internet. Recently the world witnessed rapid growth in wireless networks including WSN. Target tracking is most significant application in wireless sensor network [1]. Tj here are many applications on mobile target tacking such as surveillance, wildlife monitoring, search and rescue, and robotic navigation. These applications can span to both civilian and military areas. When sensor nodes sense noisy data, they are supposed to predict the positions of target and make use of measurements in order to take decision to move or not to move. It does mean that the nodes can track from their current positions or they can move to a new location in order to track target object. The major purpose of these nodes is to estimate the position of the required target in order to have planning for accurate tracking. Many techniques came into existence in target tracking as explored in related works section. Here we consider both the navigation of mobile sensor and tracking of target and which is based on the TOA measurement approach. Here the weighted tracking algorithm is used to achieve this improved performance by reducing the tracking time between source and destination. Additionally we give some additional mobility freedom to mobile nodes so that they can compute and move accordingly. It reduces the tracking time. This will improve the overall tracking performance of wireless sensor network nodes. Our contribution in this paper is simulation model built to demonstrate the tracking of targets by sensor nodes. The remainder of this paper is structured as given below. Section II reviews literature about target tracking in WSN. Section III presents results the proposed target tracking approach. Section IV presents the experimental results while section V concludes the paper besides providing future directions.

II. RELATED WORKS

In the literature it is found that many researchers worked on the problem of target tracking in WSN. Effective navigation control method and real time location estimation algorithm are successful solutions found in the literature. The problem of target tracking is able to be understood as sequential location estimation technique. There are many measurement models namely Signal Angle of Arrival (AOA), Time Difference of Arrival (TDOA), Time of Arrival (TOA) and Received Signal Strength (RSS) and the combination of two or more models which are explained in [3] and [2]. In [4] a filter recognized as Kalman filter was anticipated where predictive position estimation algorithm for target tracking appeared efficiently. In paper [5] extended Kalman filter was employed for Time of Arrival measurement for target tracking. In paper [6] high accuracy is achieved by using RSS measurement model. Distributed mobility management was studied in [7] where trade off among parameters like coverage, loss of connectivity and target tracking quality improvement are measured. The communication node cost and movement were measured in paper [8] besides the performance tradeoffs. A proportional navigational strategy was explored in the [10] and [9] with mobile sensors having prior knowledge about target motion. A periodically time-varying algorithm was proposed in [11]. Robot and kinematics were employed in [12] for target tracking. Similar kind of approach was followed in [13] with simple cubic navigation approach. The paper [14] presents the location estimation technique based on the input signal through the (TOA) measurements recently Xu et al. The paper [15] presented the combined approach where mobile sensor navigation and mobile target tracking are considered for solving the problem of target tracking.

III. PROPOSED SOLUTION

We consider a Wireless Sensor Networks where sensor nodes work for the intended use. However, they are able to track targets. They need to estimate the location of target and compute navigation requirements so as to move to different location in order to track accurately. Thus the tracking of target is subjected to the movement of mobile sensor node to different location. Here the cost of moving to different location is also considered. The cost of moving to another location and the cost of tracking are combined considered. For more details of the core functionality reader can read in the paper [20].

As can be seen in Figure 2, it is evident that there are transmitter and receiver. Based on this conceptual diagram the TOA measurement approach is used to know the position of target nodes for tracking effectively. When mobile sensor gets target signal (target is a signal emitting thing) it makes use of TOA measurement model in order to compute the position of the target object. Thus the connection between the target location and sensor location is established. The localization of sensor nodes is not unconditional as it depends on sensor geometry. Both the location of target and determination of the location of mobile sensor node are important for accurate target tracking.

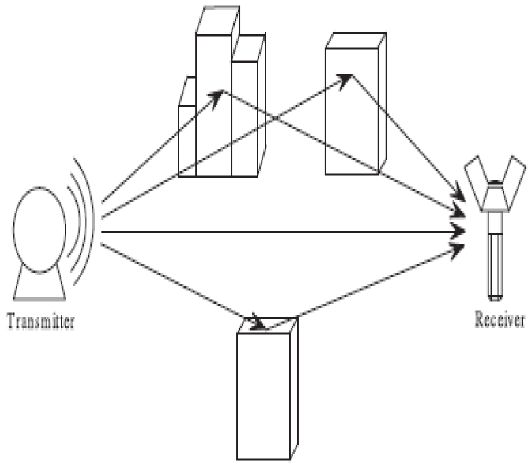

Figure 2 – Illustrates signal transmission path between transmitter and receiver

IV. EXPERIMENTAL RESULTS

Experiments are made with NS2 simulations. The environment used is NS2 running in Ubuntu operating system in a PC with 2GB RAM and core 2 dual processor. The simulations show the nodes creation as part of WSN and then target tracking.

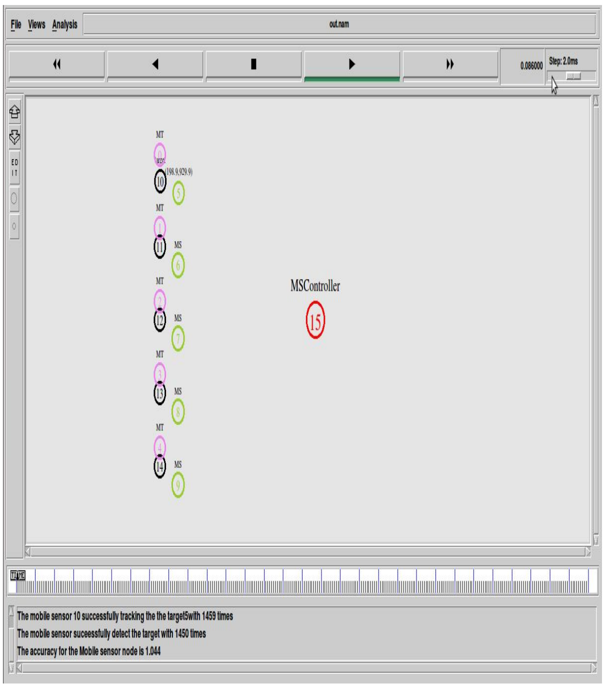

Figure 1 – Shows WSN with sensor nodes

Fig: 1 shows the mobile sensor nodes and mobile target nodes and mobile controller node. These nodes are useful to measure the required measurements of the mobile target. The node 15 works as Mobile Sensor Controller. And the remaining nodes working as targets.

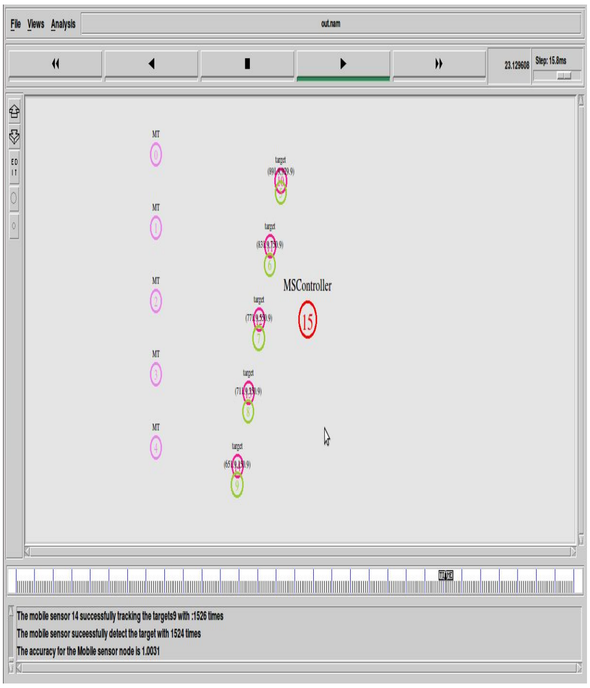

Fig: 2 shows the mobile sensor node 14 successfully tracking the target node 9 and also we can see the sensor node detect target node.

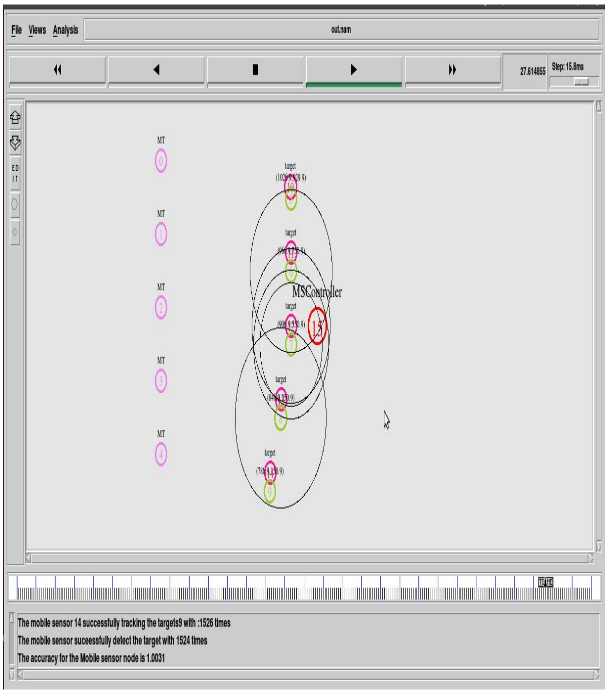

Fig: 3 show the propagation of wireless sensor network routing protocol. The propagation in circle shapes.

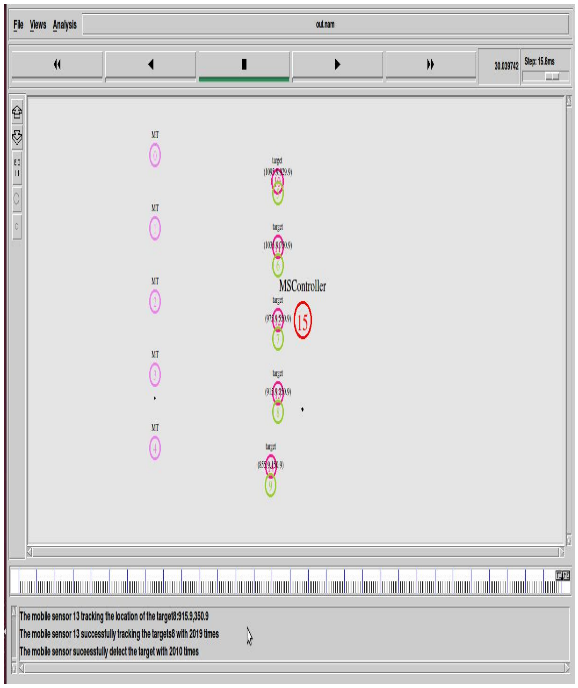

Fig: 4 shows the mobile sensor node 13 successfully tracking the target node 8 and also we can see the sensor node detect target node.

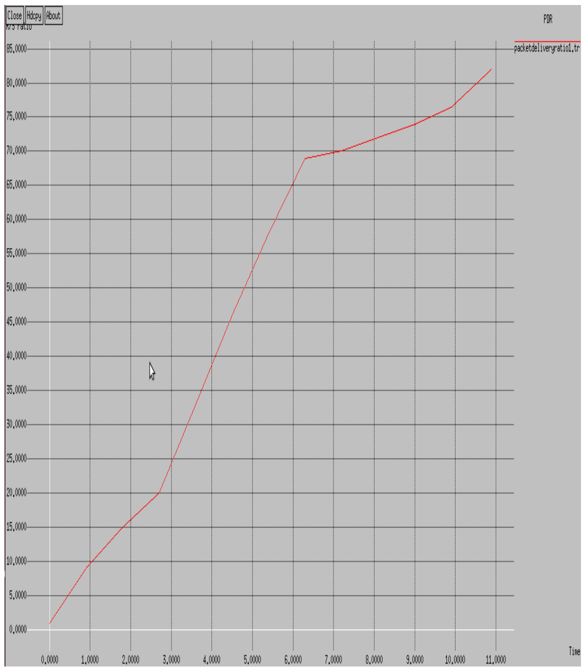

Fig: 5 show the throughput curve of the wireless sensor network. In the Xgraph on X-axis we took simulation time in seconds and on Y-axis we took number of packets received in bytes. The simulation time increases the receiving of packets will increase. Finally we got maximum throughput.

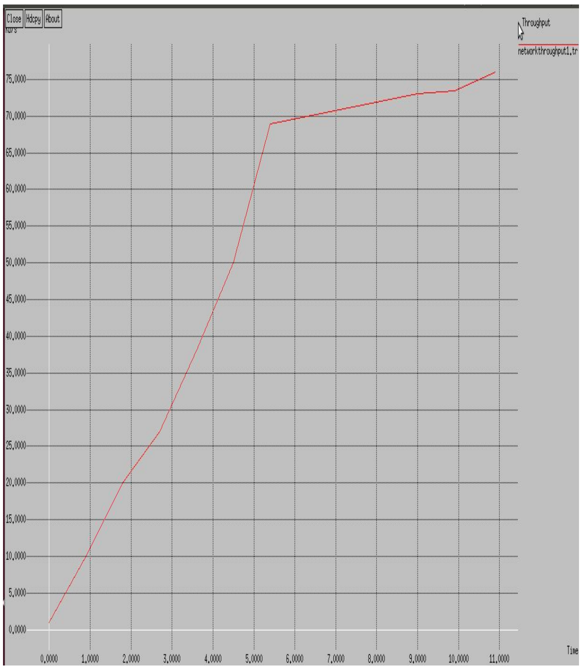

Fig: 6 show the packet delivery ratio curve of the wireless sensor network. In the Xgraph on X-axis we took simulation time in seconds and on Y-axis we took packet delivery ratio in percentage. The simulation time increases the ratio of receiving of packets will increase. Finally we got maximum packet delivery ratio.

V. CONCLUSION

We study the problem of target tracking using navigated mobile sensors by adding mobility to the respected mobile sensor in wireless sensor networks. The main intention of this work is to improve target tracking performance which is done by the mobility management. In target tracking if we want to improve the tracking performance first we need to reduce the tracking time between source and destination. And if we want reduce the tracking time we need to reduce the distance between source (mobile sensor) and destination (mobile target) and also if we want to reduce the distance between mobile sensor and mobile target we need to track the required target at optimal time. Which done by mobile management that is by giving mobility to the respected mobile sensor. Initially each and every mobile sensor has some fixed mobility but the problem is during navigation of mobile sensor for tracking the target some mobility consumption will be occurred. So this can utilize thirty to forty percent mobility only. So that here we are providing some additional mobility to that respected mobile sensor for optimal target tracking at optimal distance. And for mobile sensor navigation the mobile sensor controller will be used to control the overall mobile sensor movements throughout the network. Finally the simulations results expose that the proposed approach is useful in accurate target tracking in secure manner.

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