ISSN: 0975-766X
CODEN: IJPTFI
Available Online through *Research Article*
www.ijptonline.com

TARGET TRACKING SYSTEM USING EXTENDED KALMAN FILTER BASED ON WIRELESS SENSOR NETWORKS

[1]Laxmi Shrestha, [2]Dr. K Sarat Kumar, [3]Dr. Ch Kavya and [4] K.R.R Mohan Rao
[1]M.Tech student, ECE Department, KL University, Andhra Pradesh -522502, India.
[2,3]Professor, ECE Department, KL University, Andhra Pradesh -522502, India.
[4]Associate Professor, ECE Department, KL University, Andhra Pradesh -525202, India.
Email: laxmi.stha414@gmail.com

Received on: 18-02-2017 *Accepted on: 22-03-2017*

Abstract:

This paper tells about the improvement of a remote sensor arrange based target followed by a number of stages. The stage includes ultrasound sensors for target recognition and Extended Kalman Filter (EKF) for following a solitary target. The inserted application is executed by TinyOS/nesC , and Labview is utilized to build up the GUI. Keeping in mind the end goal to improve the vitality utilization and to drag out the lifetime of the system, a plan of entrusting hub choice is proposed, which gives a tradeoff between target following exactness and vitality utilization. The trial comes about approve the viability of the entrusting hub determination conspire.

Keywords: Wireless sensor network (wsn), Extended Kalman Filter (EKF), Target tracking, Hub, Node.

Introduction:

Wireless sensor networks (WSNs) is considered as a standout amongst the most critical developing innovations in 21st Century [1], where target following is a noteworthy application. WSNs is more requested in steering advancement, security of sensor correspondence and vitality sparing because of its elements of a huge number of sensors, constrained assets, and restricted correspondence data transmission.

WSNs ought to rely on upon collective flag and data handling (CSIP) [2] to powerfully oversee and plan sensor assets and proficiently prepare disseminated sensor estimations, for the huge vitality utilization of focus based media transmission and flag preparing is probably going to separate the middle hub [3]. Along these lines, dispersed following is an extreme answer for vitality disturbs in wireless sensor networks.

At present, examines on wireless sensor networks the target following calculation at primarily approved by programming recreation the cricket indoor location system of MIT. In this stage an indoor area framework, the TODA is connected for separation estimation. It improves the approval to numerous calculations. The other indoor

area frameworks incorporate infrared flag based Active Badge framework created, the active bat framework in view of three measurement estimation, Hiball following framework. Reference [6] consolidates the estimation of Cricket framework and Bayesian separating calculation for finding and following.

Reference [7] composed an EKF based target following framework utilizing Cricket hubs. Reference [8] gathered information in a static arrange by uninvolved infra-red sensors. Following is finished by getting to the system through entryways. In spite of the fact that conveyed framework, all the figuring is performed in a server. Reference [9] utilizes Crossbow Mica2 hubs for target following. The hubs are sent uncommonly by which impedances between hubs will be disposed of. The hubs are modified to give back the objective separation to the focal server at predefined interim. At that point, the server will ascertain the objective state and direction by EKF. Be that as it may, in a huge sensor organize, the intermittent sensor determination plan will debilitate the vitality of hubs quick, lastly neglect to identify the objective. Reference [10] relies on upon DOA (heading of-landing) estimation and utilizing the hub for detecting the target following is done through IDSQ calculation.

In this work, we set up a providing ground for finding a signal and following. here we are using the ultrasound sensor(SRF08) for detection of the object or target estimation of the original signal, the extended Kalman filter and neighborhood versatile entrusting hub choice plan are connected for the following an objective, interim, components, vitality sparing, target misfortune rate and following accuracy are under far-reaching thought.

Introduction for the Test Bed:

Figure 1. Real test bed and client monitoring interface

As above figure 1, the providing ground is made out of nine ultrasound static sensors. Each hub comprises of a Micaz, SRF08 ultrasound sensors with the number comparing to the hub area, and a Crossbow MDACA100 sensor board. The passage which is in charge of transmitting remote information is made out of MIB520 and a Micaz.

Portable PC customer has introduced GUI created by Labview, with the goal that it can show target data, for example, area and speed et cetera. Inserted application on stationary hubs is produced by componentization modules

of TinyOS. We alluded to the hypothesis of Finite State Machine[13] and significantly lessened the program improvement time by exchanging sensor states and embracing modularization planning strategy. Figure 2 exhibits the procedure of static sensor inserted application calculation.

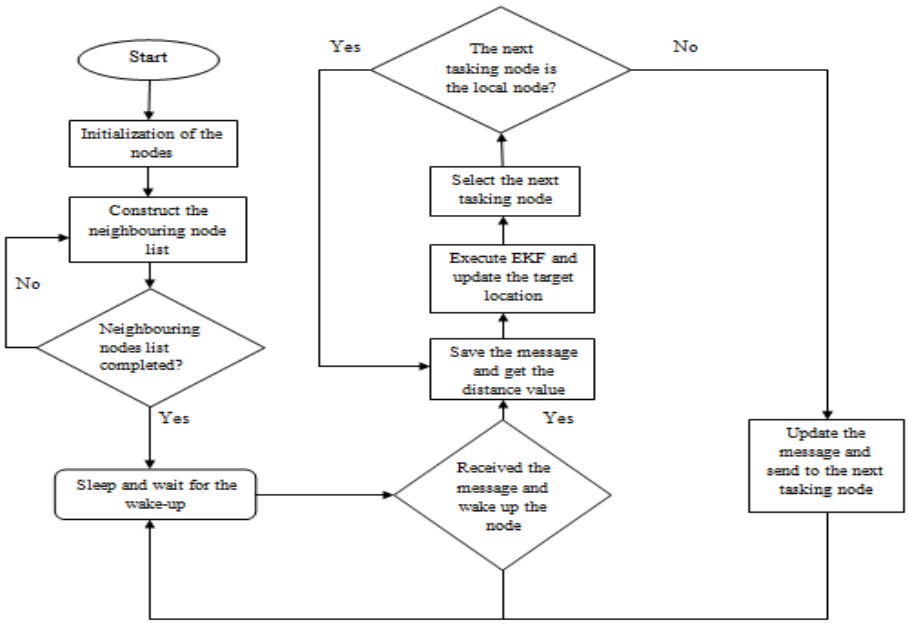

Figure 2: Flowchart of embedded application in static node.

Key Problems and Technologies:

This paper considers single-target following issue. With a specific end goal to draw out the life of the entire system, many of dynamic sensors in the meantime ought to be kept insignificant, because of constrained force of a solitary hub. So we assume amid an inspecting period, one and the only static hub is chosen as entrusting hub. Entrusting hub is in charge of separation estimation, EKF expectation and overhaul, next entrusting hub determination and saving applicable data, for example, evaluated target area, speed and remaining vitality of nearby hub in neighborhood hub and transmitting them to the assigned hub or the portal by AM bundle.

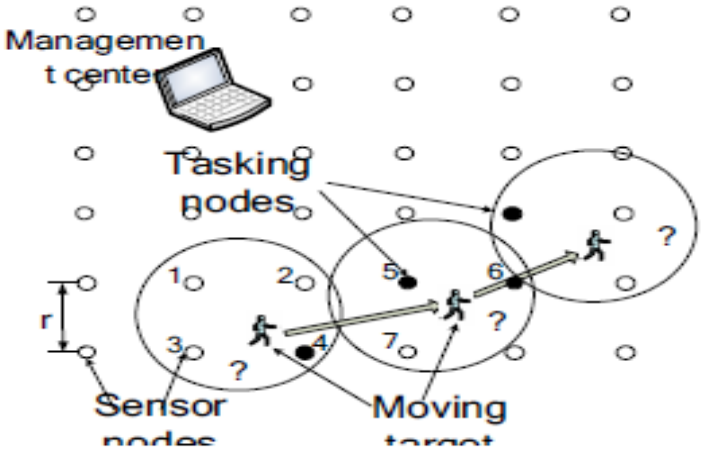

Figure 3. Single target tracking

There are two essential issues to be comprehended two essential issues to be comprehended. Firstly, the ideal choice of entrusting hub, appeared in Figure 3, when the moving target is in Area I, how could the entrusting hub be chosen from Node 1,2,3,4? Furthermore, selecting the time of entrusting hub, that is, the point at which the objective moves into Area II from Area I, how could the entrusting hub be changed from Node 4 to 5?

A. Communication Protocols of TinyOS and WSNs

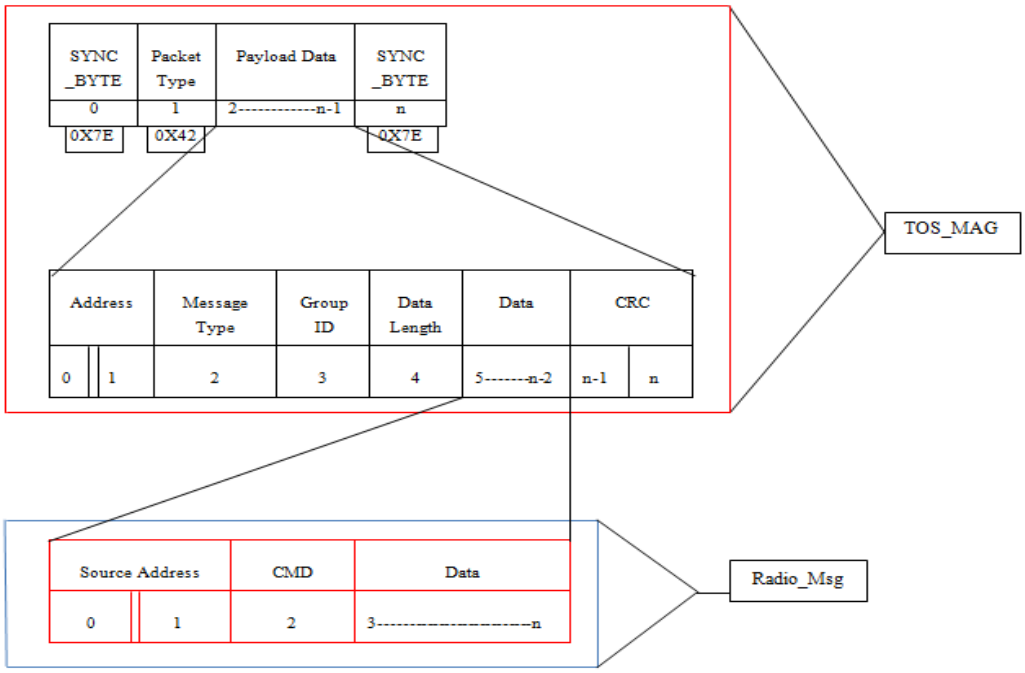

Figure 4: Communication Protocols of TinyOS and WSNs.

Figure 4 exhibits the correspondence conventions of TinyOS and WSNs, where the enormous square outline finishes up default correspondence convention of TinyOS; the little piece indicates correspondence convention characterized in this work. In this defended convention, the initial 2 bytes are for Source Address, putting away the ID of transmitting hub; accompanying byte remains for request sort, which controls the hub to execute the comparing request; alternate bytes amasses applicable data objective, which is transmitted among static hubs in dispersed preparing. The structure is characterized as takes after:

```
Typedef struct Radio_Msg_Token
{ float X_hatk[row];
float  P_k[row][col];
float T;
float R1;
uint32_t energy;
```

} Radio_Msg_Token;

B. Establishing neighborhood nodes list:

The reason for characterizing neighborhood hubs is to clarify the arrangement of applicant hubs for entrusting hub choice. The arrangement of competitor hubs is changing with target development, so building up the area hubs rundown can decrease the entrusting hub determination time and energy consumption. Each hub has neighborhood hubs in WSNs. In the event that the separation between a typical hub and entrusting hub is within the setting range, it will be characterized as an area hub.

At that point, the separation between the objective and each area hub is figured by area organizes in the evaluated data of present target position and arranges of the area hubs. After that, those area hubs whose separation is inside a setting extent will be considered as competitor hubs for entrusting hub choice.

The accompanying figure indicates how the area hubs are characterized:

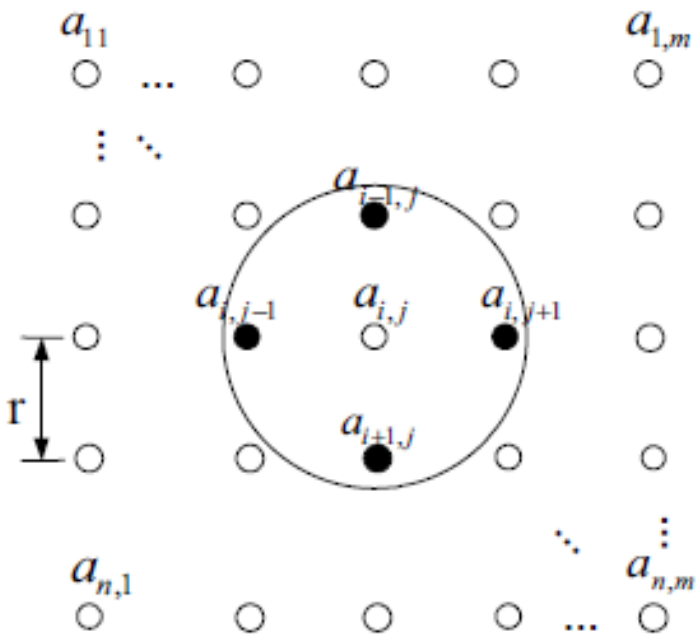

Figure 5: Determination of neighborhood nodes.

As shown in Figure 5, supposed that the nodes are in square arrangement, neighborhood nodes are defined according to Equation

$$N(a_{ij}) \in \left\{ a_{k,l} \mid r \langle r_s \langle \sqrt{2}r, k \neq i, l \neq j \right\}$$

CALCULATION1.NEIGHBORHOOD NODES LIST ESTABLISHING ALGORITHM:

1. Begin and instate the settings (ultrasound checking extent is set rs);

2. Communicate ID of the neighborhood hub, its area

3. Listen the rebroadcast,

4. Get there broadcast and store it up in the list.

5. Switch (order)

6. {

7. Arrange 1#;

8. On the off chance that (separation <rs)

9. Upgrade neighborhood hubs;

10. Communicate ID and x, y of the communicate is 2#;

11. Else

12. Dispose of the data of that hub;

13. Order2#;

14. In the event that (separation<rs)

15. Else

16. Dispose of data hub;

17.}

Where, Order 1# requires the neighborhood nodes to return their information, such as ID, coordinates (X, Y); Order 2# signals that information of the node has been returned.

Implementing EKF algorithm:

Kalman filter is a direct ideal estimation. It is reached out to nonlinear ideal separating issues by linearization of the state and estimation capacities.

That is called Extended Kalman filter (EKF).

Three favourable circumstances lie in EKF target following calculation:

(1) The target area can be reconsidered through stand out estimation.

(2) Compared with the trilateration calculation, it decreases blunders came about because of measure commotion adequately and makes the following yield smoothing.

(3) EKF just requires the figured result last minute each emphasis. So the memory asked for is little, which is exceptionally essential for the restricted registering ability of sensor hubs.

The procedure of the EKF calculation is as per the following:

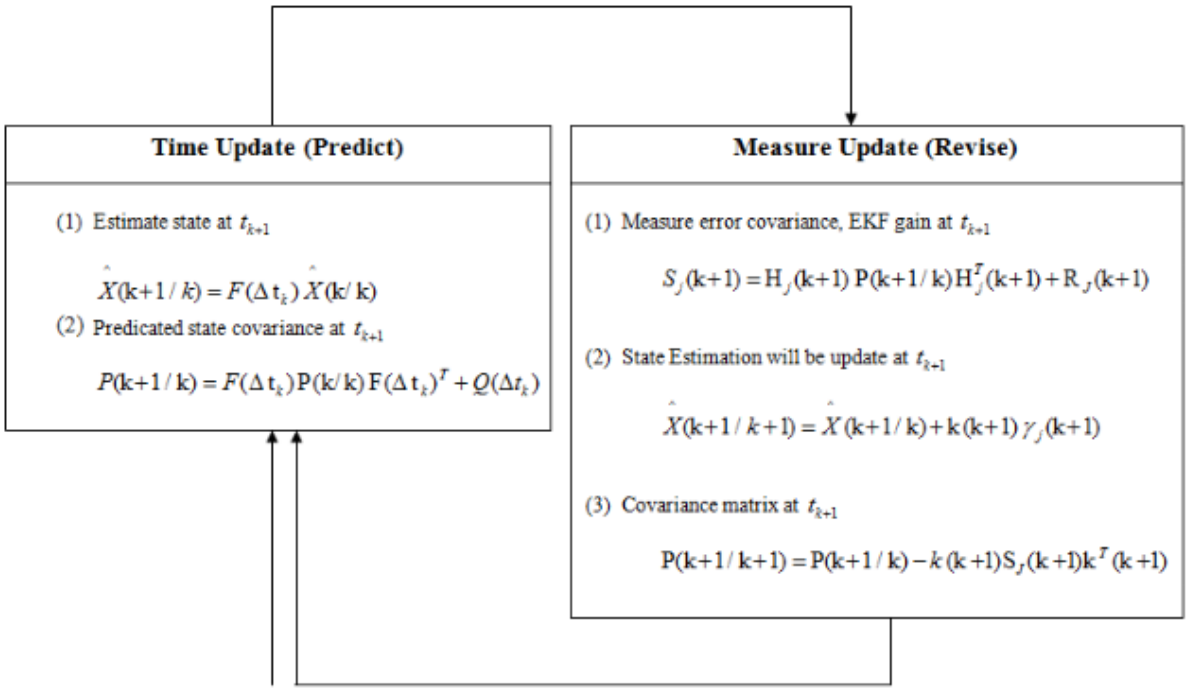

Figure 6: Flow chart of EKF algorithm.

Tasking node selection scheme: entrusting hub choice plan

In the EKF target following procedure, the hint of blunder covariance grid speaks to the following accuracy. The littler the follow, the more exact the following procedure. In this works, we propose another entrusting hub determination conspire which gives a complete thought on both following accuracy and remaining vitality of the hub.

$$value = \left(\alpha \frac{\phi(k+1)}{\phi_{max}} + \beta \frac{E_{max}}{E(k+1) + E_{max}}\right) \times threshold$$

In above equation α, β indicate for the weights of following exactness and remaining vitality in the choice plot individually,

$$\alpha + \beta = 1$$

The estimation of α and β can be adjusted in the accompanying methodology. Φmax demonstrates a setting indication of assessed, Emax is starting vitality of a hub. The limit is a given edge value.

Step 1: Instate parameters, for example, α,β, Φmax, Emax limit.

Step 2: Appraise the area of focus by EKF calculation, and compute the separations between hopeful hubs and the objective by:

$$d_i = \sqrt{(X(k) - X_i)^2 + (y(k) - y_i)^2}$$

Step 3: To observe the estimation of the d_i. Where the d_i is the ultrasound measuring range and it exhibits the arrangement of applicant hubs is out of the normal following location.

Step 4: look at an estimation of every applicant hub by condition4, and then pick the hub with negligible esteem as the following entrusting hub. At that point, the booking is over furthermore, swing back to step 1.

MATLAB Simulation:

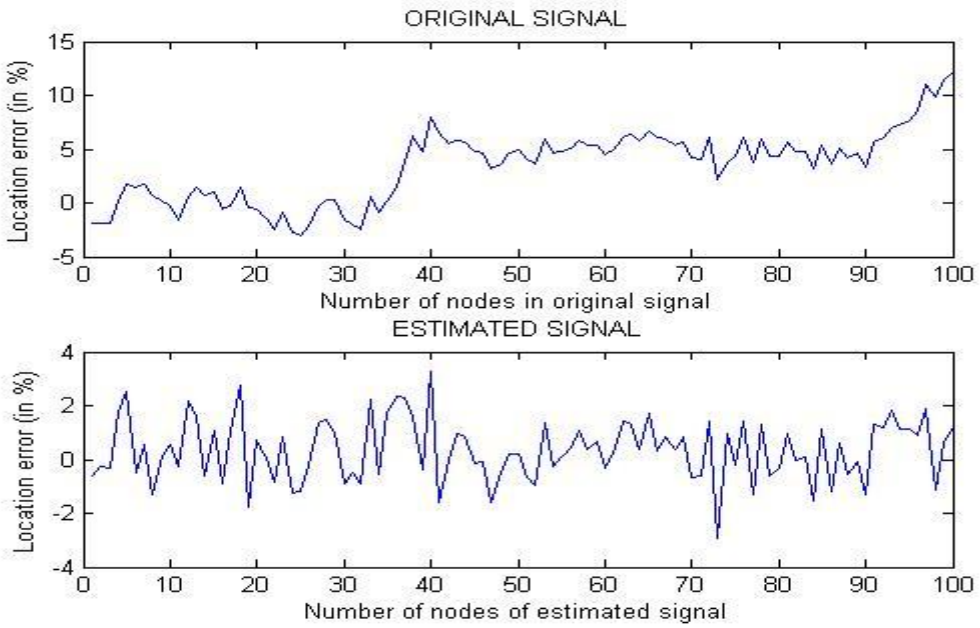

Figure 7: The original signal and estimated signal nodes verses the location percentage.

Describes the proposed scheme in which object estimation model is used for distance calculation. The algorithms within target tracking estimation signal node include Kalman filter. Kalman filtering is a powerful framework for solving data assimilation problems. Kalman filter, which clearly has better accuracy and consistency than the extended Kalman filter (EKF).

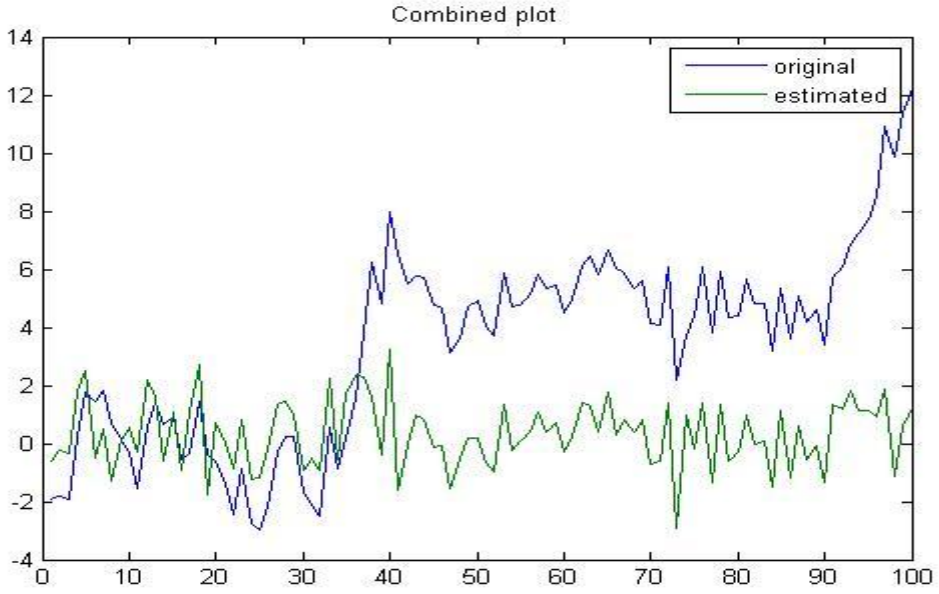

Figure 8: Combined plot of original and estimated signals.

Figure 8, the number of nodes verses to location percentage in the combined plot.

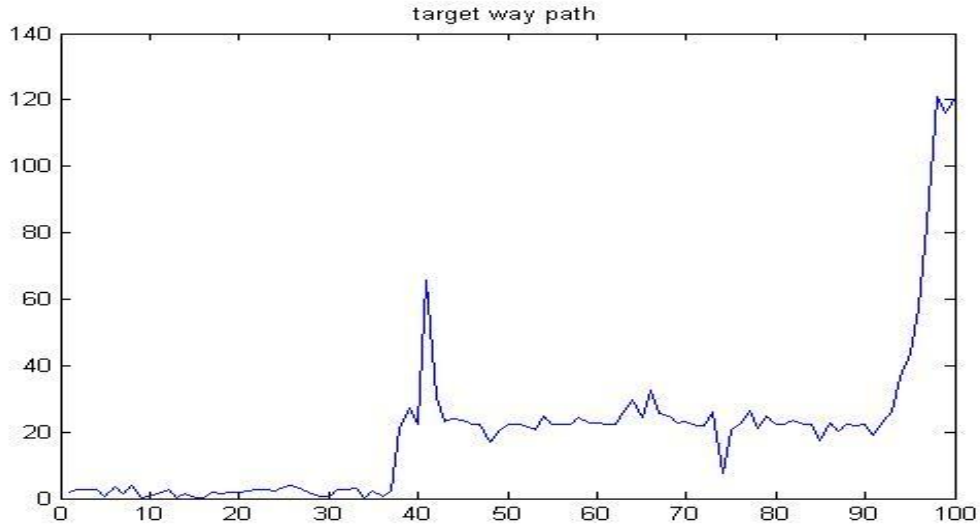

Figure 9: Target tracking signal pathway.

Figure 9: Number of nodes verses number of location percentage.

Conclusion:

The following and finding elaborated in this work to fulfill the plan necessities of Wireless Sensor Network. It approves the viability of EKF target following calculation. Moreover, another entrusting hub determination plan is proposed, and our proposed approach is to estimate the single target tracking system in wireless sensor networks to estimate the single target to the location of the signal which thoroughly considers target following exactness and vitality utilization and to determine the location of the target.

References:

1. Chong C Y, Kumar S P. Sensor Networks: Evolution, Opportunities, and Challenges[C]//Proceedings of the IEEE, USA: IEEE, 2003, 1247-1256.
2. F.Zhao, J.Liu, L.Guibas, and J.Reich. "Collaborative Signal and Information Processing: An Information Directed Approach" Proceedings of the IEEE, 2003, 91(8):1199-1209.
3. Chong C Y, Zhao F, Mori S. Distributed Tracking in Wireless Ad-hoc Sensor Networks[C]//Proceedings of the Sixth International Conference on Information Fusion, Australia: IEEE, 2003, 1247- 1256.
4. Roy Want, Andy Hopper, Veronica Falcão, and Jonathan Gibbons, "The Active Badge Location System, " ACM Transactions on Information Systems,1992,10(1):91-102
5. Greg Welch, Gary Bishop, Leandra Vicci et al. The HiBall tracker: High-performance wide-area tracking for virtual and augmented environments//Proceedings of the ACM Symposium on Virtual Reality Software and Technology. London, UK, 1999, 1-10

6. C. Taylor, A. Rahimi, J. Bachrach, H. Shrobe, and A. Grue, "Simultaneous localization, calibration, and tracking in an ad hoc sensor network," in IPSN, 2006,27 – 33.
7. Adam Smith et al, "Tracking Moving Devices with the Cricket Location System," Proc. ACM MobiSys,2004, 190-202.
8. Prabal Dutta, Jonathan Hui, Jaein Jeong, et al. Trio: enabling sustainable and scalable outdoor wireless sensor network deployments[C] PPIPSN. New York: Springer, 2006:4072415.
9. XIAO Wendong, WUJiankang, Louis Shue, et al. A prototype ultrasonic sensor network for tracking of moving targets [C]PP ICIEA. Orlando, Florida: IEEE Press, 2006: 151121516.
10. LIUJuan, James Reich, ZHAO Feng. Collaborative in-network processing for target tracking [J]. Journal of Applied Signal Processing, 2003, (4):3782391.
11. XIAO Wendong, WU Jiankang, XIE Lihua. Adaptive sensor scheduling for target tracking in wireless sensor network[C]PP Proc of SPIE. Jena , Germany : SPIE , 2005 , 5910 : 59100B2129.
12. Yue Khing Toh, XIAO Wendong2, XIE Lihua, "A Wireless Sensor Network Target Tracking System with Distributed Competition based Sensor Scheduling", JOURNAL OF SHANDONGUNIVERSITY,2009,39(1),50-56
13. T.S. Chow, "Testing Software Design Modeled by Finite-State Machines," IEEE Transactions on Software Engineering, 1978, 4(3), 178-187.