International Journal of Engineering Research and General Science Volume 3, Issue 5, September-October, 2015
ISSN 2091-2730

Intrusion Detection For Different Distribution In Wireless Sensor Network

Miss. Samidha S. Davari
Department of Electronics Engineering
DKTE's Textile and Engineering Institute
Ichalkaranji
samidhashrikant@gmail.com

Mr. U. A. Patil
Assistant Professor, Department of Electronics Engineering
DKTE's Textile and Engineering Institute
Ichalkaranji
uapatil2002@yahoo.co.in

Abstract – Intrusion detection is one of the basic application in wireless sensor network. Intrusion detection is nothing but a mechanism for WSN to detect presence of incorrect or anomalous activities in the defined network. For intrusion detection a number of sensors are deployed in the area, which will monitored. In this paper there are different types of deployment strategies are discuss. In uniform distribution all the sensors are deployed uniformly and randomly in the network area. In Gaussian distribution sensors are deployed around a central important deployment point. Clustering algorithm is used for partitions the data set points into k-clusters. In this paper the distance between the data points is calculated by Euclidean distance. The results are compared with different model by varying different network parameter.

Key words – Wireless sensor network, Uniform deployment, Sensing range, Intrusion detection.

I. INTRODUCTION

Wireless sensor network (WSN) deals with many of the important fields like civil & tactical (military), health care, environmental monitoring, outdoor habitat monitoring, etc. Intrusion detection having good attention on network so, it is helpful for many application. Hence security of WSN in an important issue especially, if they have important information. The intruder detection is critical application in WSN. Failure in securing WSNs causes harmful effect in different types of application. An intrusion detection system (IDS) is one of an active process, that analyse system activity for unauthorized entry or malicious activity in deployed area. Intrusion detection problem considered into two ways. First, in view of a system component for monitoring the security of a WSN and ensure correct behaviour of the network as well as avoid false alarm. Second one is as monitoring system for detecting a malicious intruder that resides in deployed area [1].

The issue of tracking a moving intruder by power conserving operation as well as sensor collaboration two efficient sleep-awake schemes are developed to minimize the power consumption these are PECAS & MESH [2]. First derived the analysis of target detection and expectation and detection delay for stationary as well as mobile targets. This results are important for designers for energy efficient sensor network for monitoring the network with the help of this formulas prediction of detection performance [3]. Further the study of trade-off between the network lifetime as well as detection quality i.e how fast the intruder can be detected when the intruder will enters in field of interest[FoI]. The sensor coverage had to be designed according to the detection probability. The wave sensing scheduling protocol is proposed [4].

The intrusion detection problem will introduced in both homogeneous and heterogeneous WNS. Two detection models are used-Single sensing and Multiple sensing models for immediate detection of intruder. Characterizing intrusion detection probability with the help of parameters of intrusion distance and also network parameter [5].

Analytically evaluate the detection probability of mobile targets when the n sensors are deployed to monitor a field of interest. Showing the result of detection probability depend on the length of perimeters of the sensing areas of the sensors and not on their shape. Also the evaluation of mean free path whenever a target is first detected [6]. Coverage and Lifetime are two supreme problems in WSN. In the study of coverage and lifetime optimization and WSN with Gaussian distribution two types of dispersion $\sigma x=\sigma y$ & $\sigma x\neq\sigma y$ will considered. The proposed important deployment strategy in WSN & developed two algorithms for compute the optimal deployment strategy [7].

In this paper we proposed the different distribution model & the K-means algorithm for clustering the network. The intruder will be randomly chosen & an Euclidean distance will be calculated between two points. The different distribution model are compared by considering different network parameter. In this paper, we consider only single sensing detection in the network domain. At last comparison on the performance of intrusion detection in an uniform distribution with Gaussian distribution and provide guidelines in choosing a random sensor deployment strategy as well as the correct parameter.

The rest and this paper is arranged as follows. section 2 is network model, section 3 is result analysis, section 4 is conclude the paper.

II. NETWORK MODEL

The network models includes a different network deployment model, detection and sensing techniques, a clustering of network & calculation of Euclidean distance.

1. NETWORK DEPLOYMENT

1.1 UNIFORM

Wireless sensors are continuously report the sensed data to its main station. Study of Intrusion detection, gives the result for completely monitoring on the network and ensure the correct behavior of the network. For determining an intrusion detection capability of a Wireless sensor network a sensor deployment strategy is very much important. A random sensor deployment is usually adopted because of it having fast deployment strategy, easily scalable. In uniform distribution, the sensors are deployed randomly as well as uniformly in network domain. The intruder can be detected instantly after it enters in the field of interest (FoI) i.e. a network domain. ξ is the maximum allowable intrusion distance (MAD) is specified.

Suppose the intruder moves in the distance D. If $D<\xi$, the WSN gives good performance, otherwise, reconfiguration of the network will takes place.

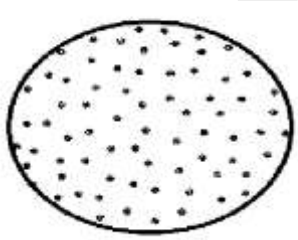


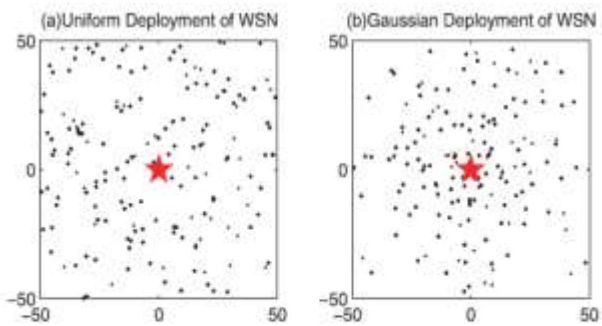
Fig. 1. Uniform distribution in circular area.

If the sensors are deployed in circular area. As shown in fig 1. Then the area is

$$A = \pi R^2$$

[1]

Intrusion detection means how instantly the intruder can be find out form the deployed sensor network. In fact, it shows the result that the intrusion detection capability of the WSN is rich means as early as the detection of intruder form the network domain.



(a) (b)

Fig . 2. Uniform & Gaussian deployment in WSN

Fig.2. (a) shows the uniform deployment in WSN. In that the sensors are uniformly & randomly deploy in area is

$A = L \times L$ because, square in shape.

1.2 GAUSSIAN

If all of the sensors are deployed randomly and uniformly, in the network, that conforms to a uniform distribution. Also on the other hand, if all sensors are to protect an important entity as well as sensors are distributed to near great consequence, the resulting sensor network conforms to a Gaussian distribution [1]. Fig 2 (b) shows the Gaussian distribution. This distribution allows the placement of sensors in unbounded area. We assume the co-ordinates of the target point as G = (0, 0) and the standard deviation ($\sigma x = \sigma y = \sigma$). Then the probability density function (PDF) for point (x, y) is given by [7].

$$\mathbf{f}\,(\mathbf{x}, \mathbf{y}, \boldsymbol{\sigma}) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

[2]

In uniform sensor deployment, shows the detection probability is the same for any point in a WSN. But, some applications may require different degrees of detection probability at different locations. The Gaussian-distributed WSNs can provide differentiated detection capabilities at different locations. So we focus on the Gaussian distribution of the network.

Using MATLAB R2013a Simulink, area A=100 X 100 is predefined for the sensor deployment .The MATLAB simulink gives the better results as compare to WSN simulator developed in C++ [1].

1.3 SENSING & DETECTION TECHNIQUES

All sensors are assumed to be equipped with the same sensing range SR, and their sensing coverage is assumed to be circular [8]. In a WSN, there are two ways to detect an intruder: 1) single-sensing detection and 2) multiple-sensing detection [5]. In this paper our focus is on single-sensing detection, the intruder can be successfully detected by a single sensor when entering in sensors sensing range (SR). ξ is the maximal allowable distance. If $\xi = 0$, is called as immediate intrusion detection, that means the intruder has to be detected before it can travel some distance inside the network. On the other hand if, $\xi > 0$,the intruder is allowed to move some distance within the network.

2. CLUSTERING OF DEPLOYMENT SENSORS

For clustering the k- means clustering algorithm is used, which is aims to partition the n number of sensors into the k-clusters .In this paper. We considered 4 clusters that are shown by different colour. The uniform deployment of sensors is in 2D. In this paper we choose the sensors number. For the clustering algorithm we need the set of observations (x_1 ,x_2 ,……x_n) and also we choose randomly the value for k. Where the $k < n$. In the k-clustering algorithm the resulting clusters intra cluster similarity is high & inters cluster similarity is low. k-means algorithm follows following steps:

1. Arbitrarily generate k points (cluster centres),k being the number of clusters Desired.

2. Calculate the distance between each of the data points to each of the centres ,And assign each point to the closest centre.

3. Calculate the new cluster centre by calculating the mean value of all data Points in the respective cluster.

4. With the new centres, repeat step 2 If the assignment of cluster for the Data points changes, repeat step 2.3 else stop the process.

The distance between the data points is calculated using Euclidean distance as follows. The Euclidean distance between two points ,

X1 = (x11; x12: x1n)

X2 = (x21; x22: x2n)

$$\text{Distance}(X_{1i}, X_{2i}) = \sqrt{\sum_{X=i}^{n}(X_{1i}-X_{2i})^2} \quad [3]$$

$$E_{TX}(K,d) = KE_{elec} + K\epsilon_{fs}d^2, \text{ if } d<d_0 \quad [4]$$

$$= KE_{elec} + K\epsilon_{mp}d^2, \text{ if } d>d_0 \quad [5]$$

$$E_{RX}(d) = KE_{elec} \quad [6]$$

Where, E_{TX} is total energy used in transmitter of source node. E_{RX} represents energy used in receiver of destination node. ϵmp and ϵfs gives energy needed by transmit amplifier in case of multipath and free space. The energy consumption for transmitting K-bit packet over distance d. Where

$$d_0 = \sqrt{\epsilon_{fs} / \epsilon_{mp}} \qquad [7]$$

III .RESULT ANALYSIS

The results in single-sensing detection cases indicate that the intrusion detection probability in a given Uniform and Gaussian-distributed WSN is determined from sets of network parameters that is Sensing range. The number of sensor N=500.The energy is fixed 2J. Using MATLAB R2013 simulink, the result for Uniform, Gaussian distribution is shown in fig. 3.The area is100 × 100 is selected. Partition of the distributed network into 4 cluster. So, here K=4. The Euclidean distance is calculated between two points in the network.

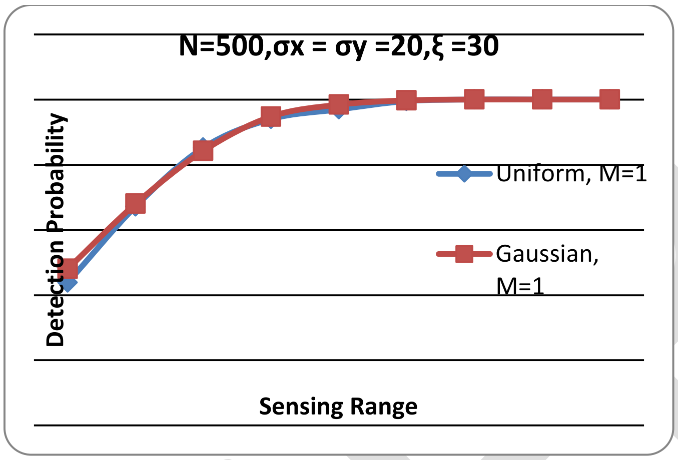


Fig. 3. Effect if sensing range SR on the detection probability in a distribution model. When $\xi > 0$.

We analyze the effect of sensing range and we set the number of deployed sensor maximal allowable intrusion distance, standard deviation and rounds as $N = 500$, $\xi = 30$, $\sigma = 20$, $R = 50$, respectively.

Fig. 3 shows the impact of sensing range on the intrusion detection probability in one-sensing detections in both Uniform and Gaussian WSNs. The detection probability is observed to improve as the sensing range increases, as a larger sensing range improves the network coverage, and higher network coverage tends to a quicker detection of the intruder in field of interest. The Gaussian WSNs are shown to outperform their uniform counterparts in one-sensing detection.

Moreover, Fig. 4 shows simulation outcomes for immediate intrusion detection. The immediate detection probability is much poor than if the intruder is allowed to travel some distance like 30 meters. So, in actual practice the implementation of full sensing coverage i.e an immediate detection of the intruder is not possible.

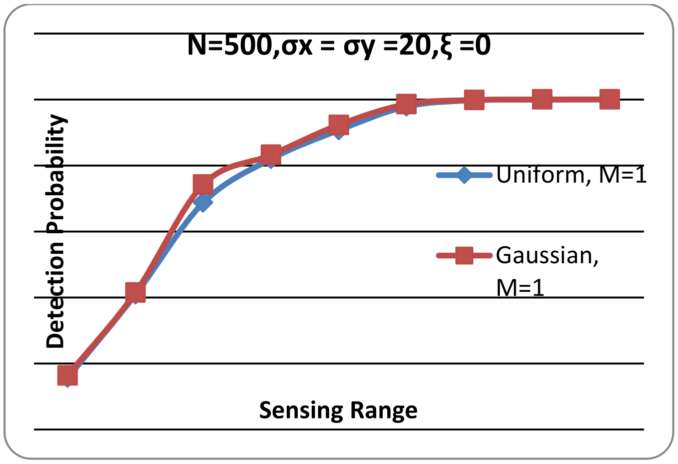


Fig. 4. Effect of sensing range SR on the detection probability in a distribution model. When $\xi = 0$.

We showing the network distribution for gaussian if N = 500, $\sigma x = \sigma y = 20$, $\xi = 30$ .The intruder is shown by astric sign in network domain. The four clusters are shown by different colours. The base station is at (0,0) position is shown in fig. 5

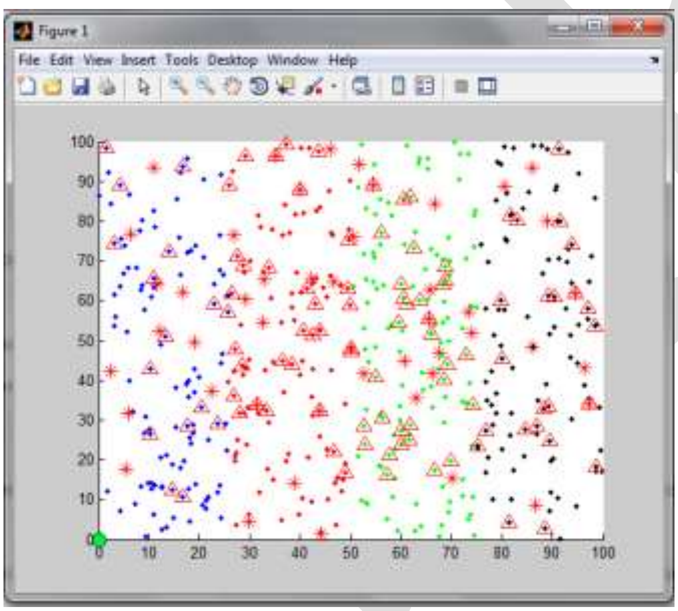


Fig. 5. Snapshot of Gaussian distribution for N = 500, $\sigma x = \sigma y = 20$, $\xi = 30$.

IV. CONCLUSION

This paper examines a uniformly and randomly deployment of the network, we call is an uniform distribution.

If all sensors are to protect an important entity as well as sensors are distributed to near great consequence, the resulting sensor network conforms to a Gaussian distribution. If the intruder can detect as early as possible, then the resulting intrusion detection probability is very rich. Using k- means clustering algorithm the randomly deployed network is divide into k cluster. In the k-clustering algorithm the resulting clusters intra cluster similarity is high & inters cluster similarity is low. Using single sensing detection, by varying network parameter like sensing range of sensor the result shows that the detection probability increases in both cases. While Gaussian distribution shows good results as compare to uniform distribution. Also the relaxed intrusion detection perform better as compare to immediate intrusion detection.

FUTURE SCOPE

We can focus on another sensing and detection techniques i.e. multiple sensing detection of sensors. Also we consider another network parameter like Standard Deviation, Number of sensors in both relaxed and immediate intrusion detection.

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