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A framework for Safeguarding Network Aggregation in Wireless sensor Networks

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Abstract:

A wireless sensor network (WSN) of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. Wireless sensor networks are installed in a lot of intimidating and unfriendly atmospheres and countenance numerous security issues. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.Sensor nodes are also resource-constrained.

In present wireless networks are using in many applications. In The security issues for example, information honesty, secrecy, and freshness in information collection get to be significant when the WSN is conveyed in a remote or unfriendly environment where sensors are inclined to hub disappointments and bargains. There is right now scrutinizing potential in securing information collection in the WSN. The most existing aggregation algorithms and systems do not include any provisions for providing security, and consequently these systems are vulnerable to a large variety of attacks.

However such aggregation is known to be highly vulnerable to node compromising attacks.Generally, WSNs are highly susceptible to such attacks due to absences of tamper resistant hardware. Iterative Filtering technique simultaneously aggregate data from multiple sources, usually in a form of corresponding weight factors. Iterative Filtering is introduced which are more robust against collusion attacks than the simple averaging methods. IF, not only collusion robust but also more accurate and faster converging.

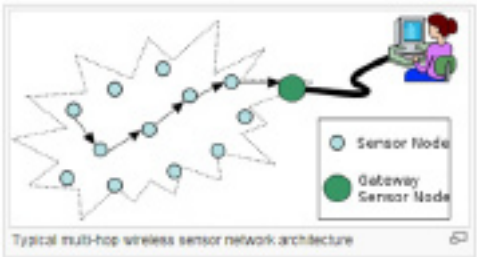
Keywords:

Wireless Sensor networks, aggregation, security, Cryptography, sensors, energy consumption, Authentication, Keys, Communications.

Introduction:

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created.

The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.



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The main characteristics of a WSN include:

•Power consumption constraints for nodes using batteries or energy harvesting.

•Ability to cope with node failures (resilience).

•Mobility of nodes.

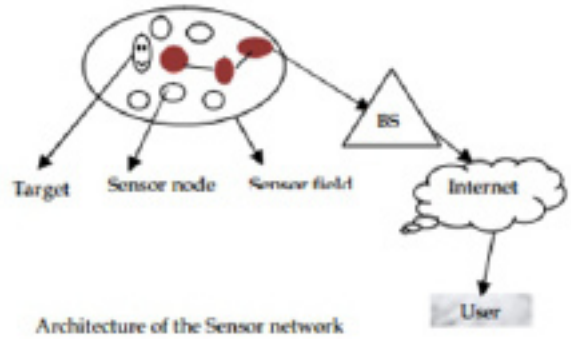
•Heterogeneity of nodes.

•Scalability to large scale of deployment.

•Ability to withstand harsh environmental conditions.

•Ease of use.

•Cross-layer design.



Architecture of the Sensor network

Clustering In WSN:

Sensor node are densely deployed in wireless sensor network that means physical environment would produce very similar data in close by sensor node and transmitting such type of data is more or less redundant. So all these facts encourage using some kind of grouping of sensor nodes such that group of sensor node can be combined or compress data together and transmit only compact data. This can reduce localized traffic in individual group and also reduce global data. This grouping process of sensor nodes in a densely deployed large scale sensor node is known as clustering. The way of combing data and compress data belonging to a single cluster called data fusion (aggregation). Issues of clustering in wireless sensor network:-

1. How many sensor nodes should be taken in a single cluster.Selection procedure of cluster head in an individual cluster.

2. Heterogeneity in a network, it means user can put some power full nodes, in term of energy in the network which can behave like cluster head and simple node in a cluster work as a cluster member only. Many protocols and algorithm have been proposed which deal with each individual issue.

Nowadays, wireless sensor networks (WSNs) are increasingly used in critical applications within several fields including military, medical and industrial sectors. Given the sensitivity of these applications, sophisticated security services are required.

Key management is a corner stone for many security services such as confidentiality and authentication which are required to secure communications in WSNs. The establishment of secure links between nodes is then a challenging problem in WSNs. Because of resource limitations, symmetric key establishment is one of the most suitable paradigms for securing exchanges in WSNs.

On the other hand, because of the lack of infrastructure in WSNs, we have usually no trusted third party which can attribute pairwise secret keys to neighboring nodes, that is why most existing solutions are based on key predistribution. Over the last decade, a host of research work dealt with symmetric key pre-distribution issue for WSNs and many solutions have been proposed in the literature.

Nevertheless, in most existing solutions, the design of key rings (blocks of keys) is strongly related to the network size, these solutions either suffer from low scalability (number of supported nodes), or degrade other performance metrics including secure connectivity, storage overhead and resiliency in the case of large networks.

Data Aggregation :

In typical wireless sensor networks, sensor nodes are usually resource-constrained and battery-limited. In order to save resources and energy, data must be aggregated to avoid overwhelming amounts of traffic in the network. There has been extensive work on data aggregation schemes in sensor networks, The aim of data aggregation is that eliminates redundant data transmission and enhances the lifetime of energy in wireless sensor network. Data aggregation is the process of one or several sensors then collects the detection result from other sensor.

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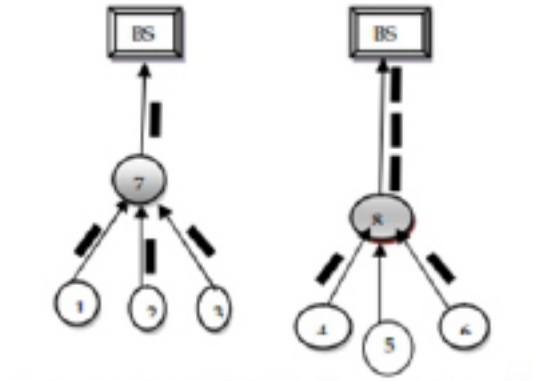
The collected data must be processed by sensor to reduce transmission burden before they are transmitted to the base station or sink. The wireless sensor network has consisted three types of nodes. Simple regular sensor nodes, aggregator node and querier.

Regular sensor nodes sense data packet from the environment and send to the aggregator nodes basically these aggregator nodes collect data from multiple sensor nodes of the network, aggregates the data packet using a some aggregation function like sum, average, count, max min and then sends aggregates result to upper aggregator node or the querier node who generate the query.



Data aggregation model and Non data aggregation model

It can be the base station or sometimes an external user who has permission to interact with the network. Data transmission between sensor nodes, aggregators and the querier consumes lot of energy in wireless sensor network.

Figure contain two models one is data aggregation model and second is non data aggregation model in which sensor nodes 1, 2, 3,4,5,6 are regular nodes that collecting data packet and reporting them back to the upper nodes where sensor nodes 7,8 are aggregators that perform sensing and aggregating at the same time. In this aggregation model 4 data packet travelled within the network and only one data packet is transmitted to the base station (sink).

And other non data aggregation model also 4 data packet travelled within the network and all data packets are sent to the base station(sink), means we can say that with the help of data aggregation process we decrease the number of data packet transmission. And also save energy of the sensor node in the wireless sensor network.With the help of data aggregation we enhance the lifetime of wireless sensor network.

Sink have a data packet with energy efficient manner with minimum data latency. So data latency is very important in many applications of wireless sensor network such as environment monitoring, health, monitoring, where the freshness of data is also an important factor. It is critical to develop energy-efficient data-aggregation algorithms so that network lifetime is enhanced. There are several factors which determine the energy efficiency of a sensor network, such as network architecture, the data-aggregation mechanism, and the underlying routing protocol. Wireless sensor network has distributed processing of sensor node data. Data aggregation is the technique.

It describes the processing method that is applied on the data received by a sensor node as well as data is to be routed in the entire network. In which reduce energy consumption of the sensor nodes and also reduce the number of transmissions or length of the data packet. Elena Fosolo et al in describe “In network aggregation is the exclusive process of collecting and routing information through a multi hop network. Processing of data packet with the help of intermediate sensor nodes.

The objective of this approach is increasing the life time of the network and also reduces resource consumption. There are two type of approach for in network aggregation. With size reduction and without size reduction .In network aggregation with size reduction. It is the process in which combine and compressing the data received by a sensor node from its neighbors in order to reduce the length of data packet to be sent towards the base station.

Example, in some circumstance a node receives two data packets which have a correlated data. In this condition it is useless to send both data packets. Then we apply a function like MAX, AVG, and MIN and again send single data packet to base station. With help of this approach we reduce the number of bit transmitted in the network and also save a lot of energy. In network aggregation without size reduction is defined in the process of data packets received by different neighbors in to a single data packet but without processing the value of data. This process also reduces energy consumption or increase life time of the network.Providing security to aggregate data in Wireless Sensor Networks is known as Secure Data Aggregation in WSN.were the first few works discussing techniques for secure data aggregation in Wireless Sensor Networks. Two main security challenges in secure data aggregation are confidentiality and integrity of data.

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While traditionally encryption is used to provide end to end confidentiality in Wireless Sensor Network (WSN), the aggregators in a secure data aggregation scenario need to decrypt the encrypted data to perform aggregation.

This exposes the plaintext at the aggregators, making the data vulnerable to attacks from an adversary. Similarly an aggregator can inject false data into the aggregate and make the base station accept false data. Thus, while data aggregation improves energy efficiency of a network, it complicates the existing security challenges.

Existing System:

Several secure hierarchical aggregation schemes follow an aggregation-commitment-attest framework.During the in-network aggregation, each node computesthe hash as commitment over the input of its aggregationcomputation, intermediate results, and data commitmentsfrom its children, and then sends the hash to its parent.Based on the commitments, interactive attest is performedbetween the base station and sensor nodes when aggregationcompletes.

Some researchers propose a secure hop-by-hopdata aggregation protocol SDAP. The tree topology ispartitioned into multiple logical subtreegroups, and sensordata are aggregated in every subtree separately to reducethe trust on high-level nodes.

Disadvantages:

1.By using of asymmetric techniques there is a chance to leak data.

2.By using of level aggregation techniques the total process of broadcasting become very complex to base station.

3.Authentication methods are not much strong to verify users.

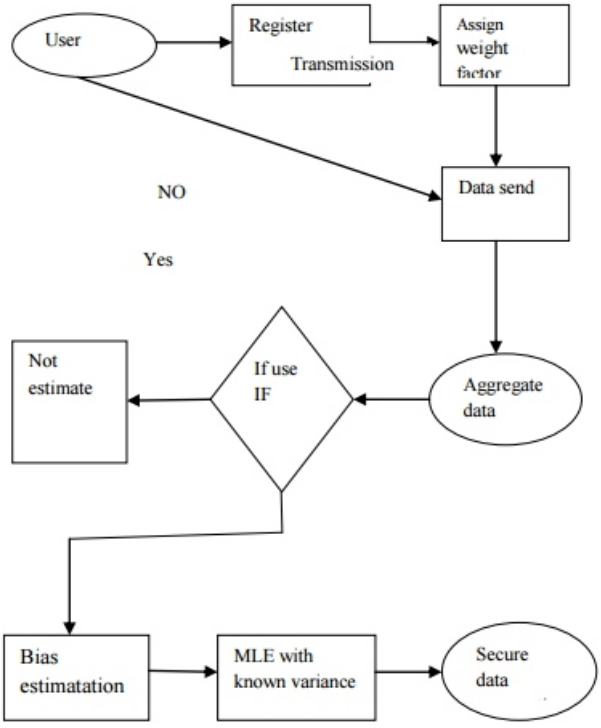
PROPOSED SYSTEM:

The main goal of data aggregation algorithm is to gather and aggregate data in an energy efficient manner so that network life time is enhanced. Wireless Sensor Network offers an increasingly, attractive method of data gathering in distributed system architectures and dynamic access via wireless connectivity. Iterative Filtering technique provides a solution for a major problem regarding with data aggregation in WSN.IF, simultaneously aggregate data from multiple sources and provide trust assessment of these sources, usually in a form of corresponding weight factors assigned to data provided by each source. By demonstration it is proved that iterative filtering techniques are more robust against collusion attacks than the simple averaging methods, to a novel sophisticated collusion attack. To address this security issue, an improvement for iterative filtering techniques is done by providing an initial approximation for such technique which makes them not only collusion robust, but also more accurate and faster converging.

A. Advantages:

1. IF based reputation system which reveals a severe protection against any non- stochastic errors, such as faults and malicious attacks.
2. IF schemes able to protect against sophisticated collusion attacks by providing an initial estimate of trustworthiness of sensors.
3. IF improves accuracy and faster while aggregating data.
4. IF raises performance in the presence of non-stochastic errors, such as faults and malicious attacks.

SYSTEM ARCHITECTURE:



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A. System Description:

The architecture diagram for the proposed system is shown in Fig . After registration in the network if the user is valid they can enter into the existing network topology. The user must register their login credentials and to select the assigning weight factors depending on the number of data have to be used. By using IF, the sensor error is estimated in a wide range of sensor faults and not susceptible to the described attack. It utilizes an estimate of the noise parameters obtained from sensor nodes. The enhanced IF schemes able to protect against sophisticated collusion attacks by providing an initial estimate of trustworthiness of sensor using input. The aggregated data is performing a filtering operation. If any error occurs on the filtering process, first estimate the errors and calculate the new variance of data using MLE and finally transmit the aggregated data in a secured way.

MODULES DESCRIPTION:

The four modules for secure data aggregation using IF are:
A. Node creation with weight factors assigned to source.
B. Data aggregation in multiple sources.
C. Find bias and unbiased readings using IF.
D. Secure data aggregation using IF.

A. Node creation:

In this module the weighted factor is assigned to each source in the network. The individual id specifies the node location by allocating weight factor to each node. Each node is specified by their location by assigning weight factor. The allocation of weight factor is based on the computational energy need in any form of network. In this module the number of nodes connected into the network can also be identified.

B. Data aggregation in multiple sources:

This module specifies the data aggregation from multiple sources. Data aggregation is any process in which information is gathered and expressed in a summary form, for purposes such as statistical analysis. A common aggregation purpose is to get more information about particular groups. The network is formed and the aggregate node collects many data from multiple nodes. It is also reduce the data traffic.

C. Find bias and unbiased readings using IF:

To find bias and unbiased readings using Iterative Filtering method is specified. To propose a solution for such vulnerability by providing an initial trust estimate, this is based on a robust estimation of errors of individual sensors. When nature of error is stochastic, such errors essentially represent an approximation of the error parameters of sensor nodes in WSN such as bias and variance.

D. Secure data aggregation using IF:

This module specifies the secure data aggregation using Iterative Filtering technique. It is a tool for maximum likelihood inference on partially observed dynamical systems. Stochastic reputations to the unknown parameters are used to explore the parameter space. Compare the different iterative value to provide the rank for each iteration. The highest rank iteration occurs more error and then this error is avoided using IF technique.

CONCLUSION:

In wireless sensor network computational cost and energy need high level for transmitting the data. So that the data aggregation technique is used in WSN. This technique is done by using various simple methods such as averaging but this data aggregation is highly vulnerable. The Iterative Filtering algorithm in secure data aggregation is used to resolve a number of important problems, such as secure routing, fault tolerance, false data detection, compromised node detection, secure data aggregation, cluster head election, outlier detection, etc. This algorithm not only for collusion robust but also more accurate and faster converging.

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