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Quality Estimation based Multi-Sensors Data Fusion in Wireless Sensor Network: Review

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Abstract: The main purpose of wireless sensor networks is data gathering. The sensor is sense environment and then network aggregation (fusion) of data packets after that sends back to the base station. The data fusion is applying on intermediate nodes because of take a deep knowledge about an event. An intermediate node is deciding the sequence of data packet which it sends the neighbours node. The data fusion is used on intermediate nodes when all incoming data packet arrived. At the same time reduce the total traffic on a sensor. Therefore maximize the lifetimes of sensor networks and supporting the QoS. The different sensors in deployed in an area and cooperate transmission of data with each other, this network is known as multi-sensor network. In this review paper is based on maximizing the network lifetime using different algorithm. These algorithm is based on traffic planning, traffic scheduling and traffic management in multi-sensor environment improve the network lifetime.

Keywords: WSN, Routing protocol, QoS, homogeneous WSN, multi sensor, data fusion.

I. INTRODUCTION

QoS of wireless sensor network applications, packet should be send and receive within a certain period of time from the moment it is sensed, or it will be useless. Therefore, limited latency for packet delivery is another condition for time-constrained applications. However, in many applications, conservation of energy, which is directly related to network lifetime, this is depending on quality of data and how much traffic is generated in the network. If more traffic in sensor network then energy is depleted. So that the network quality may be reduce. In order to reduce energy dissipation in the nodes and hence lengthen the total network lifetime [1]. Therefore the energy-aware routing algorithm is required to capture this requirement. A routing algorithm is work as adaptive in certain system parameters as well as controlled in order to adapt to current network traffic conditions and available energy levels. The system consists of two parts: wireless sensor network and access point. Traffic information is generated at the sensor nodes and then transferred to the access point over radio [2]. The wireless sensor network consists of a group of sensor nodes. The main components of a sensor node as seen from the figure.1 are microcontroller, transceiver, external memory, power source and one or more sensors. They generate traffic information such as target tracking, and event detection which is based on processing of the sensor data. The collecting information is then sent to the access point over the radio [2]. The traffic management center collects the information from each access point to analyze traffic conditions and take actions such as adjusting the traffic durations [2].

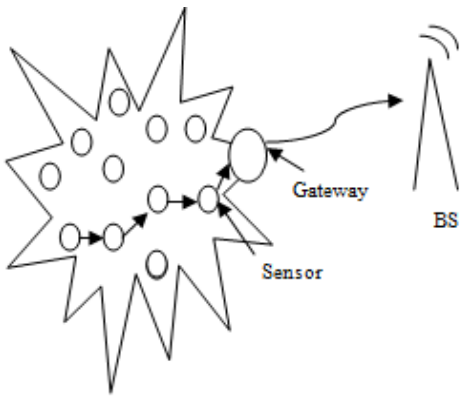

Figure 1. Wireless Sensor network

II. FEATURES OF NETWORKS IN WSN

A. Network Configuration

WSN configured in two ways i.e. Homogeneous and Heterogeneous configuration of network. Homogeneous network can be defined since all the nodes are identical in terms of battery energy and hardware complexity.

B. Distribution of sensor node

As sensors are very tiny devices, and deploy these nodes is prime matter of concern, sensor nodes could be deployed

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in proper location according to the need and criteria specified.

C. Scare Resources

As sensor nodes are small in size and less battery capacity, they have limited power and memory storage and supply of energy. For this to enhance the capacity of battery is a prime concern, as sensor node battery capacity is very and there is also no way to charge the battery in most prominent way.

D. Application specific

The types of applications that can be supported by sensor networks span across many different domains and have varying application requirements. It is unlikely that any particular protocol design or solution is suitable for all the different types of application scenarios [3].

III. KEY CHALLENGES IN MULTI- SENSOR NETWORK

Some of the issues that must be taken into consideration when designing protocols for use in multi sensor networks.

A. Data gathering:

Each sensor transmits and receives one data packet per unit time to the sensor or base station. It consumes a lot of energy when it transmits or receives a data. Because a sensor having a small battery, limited amount of energy available in one or more sensor node.

B. Energy enhancement efficiency:

Sensor nodes are considered that having of very less energy When the energy of a node depreciates, the node will die and this may cause the network to become partitioned – a situation whereby communication gaps exist in the Sensor network protocols must therefore be energy-efficient so as to extend the network lifetime and usefulness of the network [4].

C. Hardware constraints:

As Sensor node consists of sensor, processor and radio unit and its stringent, this hardware is available at all times according to need of the prospect.

D. Communication media:

Sensor nodes generally communicate over a shared wireless transmission medium because the environment in which they are deployed in does not allow for infrastructure (such as centralized base stations or wires) to be setup easily. Depending on the environment that the sensor nodes operate in, different transmission media may be used.

E. Security:

A WSN are deployed in unattended area where every time quick eye is not there so security and privacy is the prime concern in WSN, some integrity keys are ascertained in order to provide security measures in WSN.

F. Data Quality:

The data quality is mean which type of data is require in network to increases the network life time and consume less energy. The data quality is based on the data consistency, data accuracy, timeliness and completeness. The data Consistency means which data stream is satisfy the user-defined model. This model is based on specific application. Data accuracy means intermediate processing such as difference between the sample value and the true value numerical measured. Timeliness means how much time is required for receiving a data to sink. It is based on network latency and reliability. Completeness is a property of a stream, it reflects if a node has taken a sufficient number of samples to reconstruct the measured.

IV. ROUTING PROTOCOLS DESIGN

A. Design issue[5]

The routing protocols designed for WSN should consider the goal, application area, and architecture of the network. The design of routing protocols is influenced by many challenging factors caused by the nature of the WSNs are:-

1. Node Deployment:

Node deployment can be random, deterministic or self organizing. For deterministic deployed networks the routes are pre-determined, however for random deployed networks and self-organizing networks route designation have been a challenging subject.

2. Energy consideration:

Since the life-time of the WSN depends on energy resources and their consumption by sensors, the energy consideration has a great influence on route design. The power consumed during transmission is the greatest portion of energy consumption of any node. Direct communication consumes more power than multi-hop communication; however the multi-hop communication introduces extra topology management and medium access control.

3. Data Delivery Models:

Data delivery model depends on the application and can be continuous, event-driven, query-driven, or hybrid. In continuous model of delivery, each sensor sends the data periodically.

4. Data Aggregation:

Since the sensors are densely deployed by definition, the data gathered from each node are correlated. Therefore data aggregation or in other words data fusion decreases the size of the data transmitted.

5. Fault Tolerance:

WSNs are prone to failures; some of the nodes may fail or be blocked by physical interference, physical damage, or lack of power. The routing protocol has to be dynamic;

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failures of specific nodes should not affect network operation.

V. ROUTING PROTOCOLS

In WSN accomplished power efficient in traditional networks they focus primarily on the QoS. In WSN is major issues is power awareness, due to the fact that the batteries. Each sensor nodes have a limited battery lifetime and are difficult to be replaced. Therefore, all protocols must be designed in such a way as to minimize energy consumption and preserve the longevity of the network. The classification of routing algorithm is shown in the Table.1.

Table 1: ROUTING PROTOCOLS FOR WSN

No.	Types	Routing Protocols
I.	Flat Protocols	Flooding and Gossiping, SPIN, Directed Diffusion, Energy Aware Routing,
II.	Cluster based Protocols	(Centralized) LEACH-C BCDCP SHPER
		(Non Centralized) LEACH PEGASIS Hierarchical PEGASIS TEEN APTEEN
III.	Location Based Protocols	GAF GEAR SAR

A. FLAT ROUTING

The first category of routing protocols is the multi-hop flat routing protocols. In flat routing, the large number of nodes, each node plays the same role and performs the sensing task. It is not assign a global identifier to each node. It is based on data-centric routing, where the base station is sends queries to certain area and waits for arriving packet from the sensors located in the selected regions. Since packet is being requested through queries, attribute-based naming is used to specify the properties of data packet.

Flooding and Gossiping [5] does not based on any routing algorithms or topology maintenance. In Flooding, each sensor node will broadcast its information. Each receiving node will then pass the message on, until the message reaches the sink node. Gossiping is an alternative of Flooding. The sending node will select a neighbour at random to send its data to. This way the information travels around the network with the hopes that the message will reach the sink at some point, after a possible delay. Some of the problems that are faced by these protocols are implosion as Node A floods its data to node X and Y. After that X and Y sends this data to D and so D receives redundant data and overlap as two sensors cover an overlapping predefined region and Y gets same copy of data from these sensors. Implosion is caused by redundancy being sent to the same node, and overlap deals with two nodes sensing the same region and both reporting their values. In Gossiping, the gathered data is not broadcasted but sent to randomly chosen neighbor node until the specified maximum number of hops for packet is reached or the packet delivered to the destination. In this way it avoids the problem of implosion. But, the delivery of the data takes so much time. Both of these protocols suffer from resource blindness [6]. Resource blindness is consumption of large amount of energy without consideration of energy constraints.

The advantage of this process is that implosion, overlap and resource blindness.

SPIN a significant energy saving [6], topological changes are limited to immediate neighbors. There is the less knowledge of the nodes awareness of the network. If all neighbors are interested in the packet broadcasting then SPIN generates a number of messages, but this is based on application. In comparison to flooding SPIN halves the redundant data. But this broadcasting mechanism does not guarantee the delivery of packet. For example, if a node that is interested in data is far away from the source and the nodes between source and destination are not interested then the data will never reach to the interested node. So, SPIN is not suitable for applications where reliable data delivery is needed.

Directed Diffusion [7] is recognized as being an important milestone for routing in WSNs. Many other protocols are built on its foundation [8]. An interest for specific data is “diffused” through the network, where a naming scheme is used for the data [8]. Directed Diffusion differs from SPIN since it uses on demand data querying mechanism. Whereas, in SPIN the nodes itself advertises about its data when it have and then interested node sends and request message to node from advertisement has come, in order to retrieve the data.

Directed diffusion has many advantages, it does not need any node address mechanism since all the communication is neighbor to neighbor. Each node has capable to aggregate and caching in addition to the sensing capability. Also this is highly energy efficient because it use on demand data query mechanism. On the other side, this routing algorithm is not suitable for that application which needs continuous data delivery to the sink since it is based on query-driven data delivery model.

Energy- Aware Routing [9] is designed to choose sub optimal paths using a probability function, which depends on the energy consumption of each path. By doing this, the

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hope is that the network lifetime will be extended to its fullest. One assumption that the protocol places on the overall network is that the nodes themselves are addressable via a class based addressing scheme, which includes the location and type of the node.

B. HIERARCHICAL ROUTING ARCHITECTURE

Hierarchical or cluster-based routing methods, basically proposed in wire line networks, these techniques related to scalability and efficient communication. The concept of hierarchical routing is utilized to perform energy efficient routing in WSNs. Its mainly define as class of protocols where each sensor node is grouped along with some other of its neighboring nodes rather that to constitute a particular cluster. In a cluster all sensor data collected by the sensor node which is belonging to a cluster are not directly transmitted to the base station. A node of the cluster is known as cluster head, its collect information to the neighbor node and forward to the base station after possibly having performed appropriate data aggregation. In this way, the number of transmitted data to the base station is reduced and maximizes the power conservation. Hierarchical routing can be further two types as Centralized and non-centralized hierarchical routing [10-16]. In centralized type of hierarchical routing base station takes this responsibility Table.2. Whereas, in non-centralized type of each node self configures for the cluster head in Table.3.

Table 2. Centralized hierarchical data aggregation protocols

Protocol	**Scope**	**Structure type**	**Characteristics**
LEACH-C	**Lifetime-** that require less energy for data transmission than increases network lifetime	Cluster	Base station utilizes its global knowledge of the network to produce better clusters.
BCDCP	Improve network lifetime and average energy savings	Cluster	Centralized, distributes the energy dissipation evenly among all sensor nodes, utilizes a high-energy base station to set up clusters.
SHPER	Highest residual energy, in each cluster, maximize lifetime	Cluster	Base station asks each node to send their residual energy initially, predefined percentage of cluster heads.

Table 3. Non-centralized hierarchical data aggregation protocols

Protocol	**Scope**	**Structure type**	**Characteristics**
LEACH	Lifetime: number of nodes that are active	Cluster	Non-uniform energy drainage across different sensors , cluster head rotation random,
TEEN	Network lifetime outperform LEACH	Cluster	Reactive networks, respond for the sudden changes in the sensed attributes. This makes it appropriate for the time critical application
APTEEN	Network lifetime and energy dissipation is better than LEACH	Cluster	Periodic data collections and is more receptive to time-critical events depending on the type of the application
PEGASIS	Lifetime: node is expended by average energy	Chain	Network is required of Global knowledge for sensor node, energy savings compared to LEACH
Hierarchical PEGASIS	Energy delay between a node	Chain	Binary chain based scheme is eight times better than LEACH and the three level scheme is five times better than PEGASIS[4]

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C. LOCATION BASED ROUTING ARCHITECTURE

This routing is based on geographical locations of sensor nodes are addressed. The basis of incoming data signal can be estimated between neighboring nodes distance. The information between neighbors exchanging from relative coordinates. The nodes are equipped with a small low-power GPS receiver which is directly communicated to a satellite using GPS. To save energy, some location-based schemes demand that nodes should go to sleep if there is no activity. More energy savings can be obtained by having as any sleeping nodes in the network as possible. In the rest of this section, we review most of the location or geographic-based routing protocols.

Table. 4. Comparison between Hierarchical and Flat Routing Protocol

Hierarchical routing	Flat routing
Reservation-based scheduling	Contention-based scheduling
Collisions avoided	Collision overhead present
Reduced duty cycle due to periodic sleeping	Variable duty cycle by controlling sleep time of nodes
Data aggregation by cluster head	Nodes on multihop path aggregates incoming data from neighbors
Simple but not-optimal routing	Routing can be made optimal but with an added complexity
Requires global and local synchronization	Requires global and local synchronization
Overhead of cluster formation throughout the network	Routes formed only in regions that have data for transmission
Lower latency as multiple hop network formed by cluster heads always available	Latency in waking up intermediate nodes and setting up the multipath
Energy dissipation is uniform	Energy dissipation depends on traffic patterns
Energy dissipation cannot be controlled	Energy dissipation adapts to traffic patterns
Fair channel allocation	Fairness not guaranteed

D. COMMUNICATION PROTOCOL

In WSN a radio is consumed lot of battery energy. The energy is required in network's communication protocol; operate radio, and decisive influence on battery lifetime. Therefore used a MAC protocols for channel utilization and minimize the traffic in a sensor node or network. Existing MAC protocols as SMAC [17], TMAC [18] and DMAC [19] as so on.

VI. CONCLUSION

This paper based on comprehensive survey of quality estimation based multi-sensors data fusion in wireless sensor network. Therefore maximize the lifetimes of sensor networks using a data-aggregation routing algorithm. Compare routing techniques in bases of network lifetime, energy delay and traffic management in the intermediate sensor node or base station. Traffic management means how to send a packet in the intermediate node and base station in the network and increase the network lifetime.

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