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Quality of Service Supporting Routing Protocol in Wireless Multisensor Network

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***Abstract*—The aim of wireless sensor networks is data collection from physical environment. There in a sensor node having multiple sensors and transreceiver, which is deployed in an area and cooperates with the transmission of data, this network is known as multi-sensor network. The sensor node is capable to collect data from ambient condition like pressure, humidity, lighting condition and temperature. In this paper we focus on improving the QoS as packet delivery within a certain deadline in multi-sensor environment. Here proposed algorithm is based on quality of service supporting routing protocol in wireless multisensor network improving the network lifetime. The network lifetime increases to balance the energy utilization in sensor nodes, to reduce the routing delay in network and minimize the data redundancy. The multi sensor nodes is send and receive data in a network with the help of interface. In this paper also introduces the concept of priority MAC layer.**

***Index Terms*— QoS, MAC layer, Multisensor, Redundancy, Real time Packet, Best effort service.**

I. INTRODUCTION

A wireless network is made of self directed devices such as sensors. The sensor node has a limited battery power. Each sensor senses the environment and consumes lot of energy for event detection and transmission. The main issue in sensor network is save the energy in nodes and improve the Quality of service. The main application of wireless sensor network is environmental sensing, strategical applications and smart systems. In there the Linksys WRT54GL router, from Cisco Systems inc. [1] is modify and implemented a new serial board as based on multisensor concept [2]. The sensor is sense environment and then network aggregation of data packets after that sends to the base station. QoS is based on when the data is sensed it send to the base station with in certain period of time, otherwise it is useless [3]. Therefore, the time-constrained application is bounded latency of real-time data delivery. The delay in a sensor node occurs by congestion in a network. The delays can introduce by delivery of real-time packets. The packet loss affects the reliability of data delivery. Reliability can be increased by sending unambiguous data in the network [4]. Data ambiguity can be occurring due to energy overhead and same type of data generated at routing. Reliability is increased as the successfully send the most critical at the base station or destination. So that we can minimize the conservation of energy and send most critical data in a network with the help increases the network lifetime [3] and its depend how much traffic is

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generated in the network. If more traffic in node then energy is waste, so that we required to reduce the energy waste, it can possible with the help of improve network quality and increase the network lifetime [5]. The QoS is based on network element or node scheduling, techniques of network node coordination and control end-to-end traffic. The network node scheduling is based on queuing model as priority queuing, FIFO queuing. A sensor node coordinates the end-to-end traffic and manages the queuing methods. However, the main issues reduce delay, if reducing the packet delay then limited the delay on MAC layer. This paper is introducing the concept of adaptive prioritized MAC. This technique used for maximizes priority of critical data. It's also minimizing the MAC Delay for real time packets.

II. KEY CHALLENGES IN MULTISENSOR NETWORK

A. Data gathering

Each sensor transmits and receives one data packet per unit time to the sensor or sink. It consumes more 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. 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 pattern value and the actual value numerical measured. Timeliness means how much time is required for receiving a data to sink. It is based on network latency and reliability. Wholeness is a characteristic of a stream, it declare that taken a substantial number of patterns to resurface the measured [6].

III. RELATED WORK

There is most of research work related to increasing lifetime of a sensor network. The network lifetime is directly dependent to battery life. Therefore lot of research work is done to increase the battery life with help of aggregation technique. On network correlated data gathering [7], the main goal of the paper is to reduce the total transmission in a routing tree. In paper efficient routing from multiple sender nodes to multiple receiver nodes in wireless sensor networks [8], the proposed scheme is based on routing data accuracy from multiple sources to multiple sinks. This proposed algorithm is based on decentralized scheme. It works as certain periodic of time of the message routes. There is a problem the overlapping of source–sink paths. The child node is locally deciding the source–destination route by changing its parent. So there the parent switching delay is occur which is not recognize by authors. On target coverage in wireless heterogeneous sensor networks with multiple sensing units [9], is based on heterogeneous sensor networks (WHSNs) having multiple sensing node covered maximum target using wireless interface. In this paper introduce the concept of REFS and EEFS, two heuristic but distributed schemes. These schemes are improve the network life. But this paper is not focused on the number of different sensing node is increased than the network lifetime is decrease. So the problem is idle listening for the main reason of energy consumption. This problem is overcome with the help of MAC protocol. S-MAC [10], introduce the based on a low power duty cycling or low power RTC-CTS, it is used for loose synchronization between sensing nodes to transmission of data. The sensor node is awake period, transmit packets using RTS-CTS and exchanges information after enter sleep mode with the help of information exchange reduce latency in immediate nodes. T-MAC [11] improve S-MAC design, it is used synchronization phase for awake short period when the channel is idle and if node is not received any data than node going to sleep mode. So that duty cycling reduces energy and increased latency. Sift [12] is based on contention slot assignment algorithm, event-driven sensor network environments.

IV. PROPOSED ALGORITHM

This algorithm is based on sensor nodes having multiple sensors and transmitters. This design of the node decreases the energy consumption as multi sensors consume more energy thus reducing the life of a network. The propose algorithm has been designed for application where there is transition of data sensor1 in a node is real time and sensor2 in the node a best effort service.

A. Proposed Assumption

The entire node knows their packet deadline and energy of intermediate node. It also introduces to decreases data redundancy **(duplicate data packets)** at the source node to increases reliability. The basic assumptions of this scheme are:

1. Each sensor nodes are having a GPS so that they know its geographic location.
2. All sensor nodes are densely deploy in a large region.
3. All nodes are having a unique ID.
4. Each sensor node knows its energy.
5. Transceiver energy is similarly distributed in a network.
6. The IEEE 802.11 MAC to use for reliable wireless communication.
7. All nodes are assumed radio range of to be equal to r. It is not change by change in the energy of the nodes as time progresses.
8. Initially each sensor having same energy level and its affected any traffic is routed through them.

B. Overview of the Proposed Approach

This proposed approach is based on the tree where each sensor is sensing the event and sends to its parent node. Each sensor node is work as aggregating node. The aggregating node send most critical packet to its parent node or sink. Each sensor node is having two sensors and two transmitters. The sensor1 is collecting the reading of one parameter and sensor2 is collecting the reading of other parameter. There the sensor1 and sensor2 is detect the event, if the event is detected by the sensor1 at this time the sensor2 is in sleep mode and if the sensor2 is detecting the event at that time sensor1 is in sleep mode. The aggregation in a sensor node is based on comparison of two subsequence generated event. A sensor1 is sense a event and store a reading in a queue and send packet to their parent node or sink node, the aggregation is take as if in a queue a data is same as previous generated data then this data is discard store new reading and at this time sensor2 is send packet which is store in sensor2 queue after sending packet to its parent node it go on sleep mode and sensor1 is again transmitted packet. With the help of this method we can remove redundancy, remove traffic in a network and send more critical packet to sink. Also increase the network lifetime to save energy.

1. Network Design

There is using a tree approach to discriminate the packet processing as in figure.1. There each sensor device is work as the best data aggregator. Each nodes having knowledge about its location and sent data to its parent's node. We are assume all nodes known predefine range r. All nodes communicate to each other with in its range. If a given range node having more energy this node becomes a parent node and its nearest node is child node. The child node sends the data to parent node which is most nearest to sink and it's make a tree. As in this figure.1 it is a tree based wireless sensor network diagram. All the node maintain a routing table to exchanges beacon messages (HELLO) and forward a data packet based on the routing table as

<Node, u, v, E, timestamp, Frame-bit>

The HELLO packet contains geographic location (u, v) of the node, E denote the energy of the node [4] and Frame-bit which is identify the receiving packet is sensor1 packet or sensor2 packet. Each node has knowledge about their neighbouring location and form an aggregating tree.

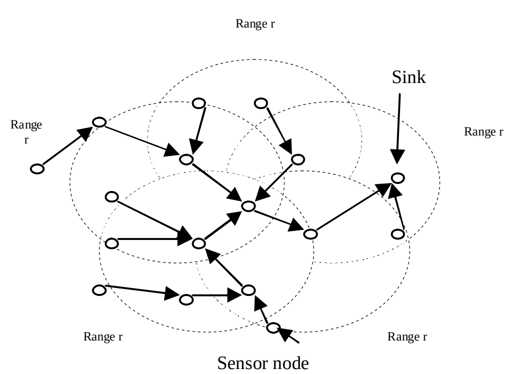

Figure.1. Wireless Multisensor Network

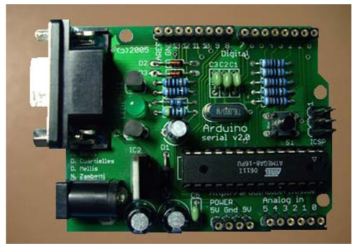

Figure.2 Arduino serial board

There is all sensor node is embedded with two sensor device and multiple communication port [2]. A Sensor node which is based on multisensor concept is in figure. 2 [2].

2. Priority MAC

After making a tree, the main concern to remove duplicate data in a network. The basic concept of MAC layer which is overcome the delay and remove the data duplication in a network. In a tree based protocol transmission unit is tasked to receive command or query from, and transmit the data to the outside world [13]. The MAC layer is concurrently transmitting queued packet with in second. It differentiated the real packet and non real packet deliver with the help of queue. The prioritized MAC layer also eliminates a lesser critical data packet. The aggregation is as in each sensor is collect the reading in its queue as Rx_bufferS1 is for sensor S1 and Rx_bufferS2 is for sensor S2. This new data or reading is send by Tx_bufferS1 of sensor1 and Tx_bufferS2 of sensor2.

3. Algorithm detail

The algorithm contain following steps:
Step 1. All the sensor node are broadcast the beacon message and stabilize the network. It initializes as new reading of sensor s1 data and sensor s2 data.
Step 2. if event is detected then sensor s1 is store a new data in Rx_bufferS1[ ] buffer and sensor s2 is store a new reading in Rx_bufferS2[ ] buffer.
Step 3. if (New_PacketS1 == Tx_bufferS1[ ]) then transmit the sensor S2 data to parent node i.e New_dataS2 else transmit the sensor S1 data i.e. New_PacketS1 to parent node.
End if
End if
Step 4. Aggregating node is receiving
Step 5. if data receiving form child node
Step 6. for i= 1 to no_of_child
Step 7. Check selected Frame_bit as reading is sensor S1 and sensor S2
Step 8. If (New_Packet[i] == New_Packet S1) then Rx_bufferS1[i]= New_Packet[i] means New_Packet[i] is the data from child node else if (New_Packet[i]== New_Packet S2) then Rx_bufferS2[i]= New_Packet [i]
End if
Step 9. Applying aggregation on new data stored in Rx_bufferS1[] and Rx_bufferS2[].
Step 10. if (New_Agg_PacketS1 == Tx_bufferS1[ ]) then transmit the sensor S2 data to parent node i.e New_Agg_PacketS2 else transmit the sensor S1 data i.e. New_Agg_PacketS1 to parent node.
End if
End if

Algorithm

```
Initialize:
int Rx_bufferS1[ ], Rx_bufferS2[ ], Tx_bufferS1[ ], Tx_bufferS1[],counter=4
 if(event detected by child node)
   get reading from sensor 1 and sensor 2 ;
   label S1:
       while (Sensor1 detect event is true)
        store New_Packet in Rx_bufferS1[ ]
            if(Tx_bufferS1[ ] != New_Packet)
                 for int i=1 to counter
```

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            Rx_bufferS1[ i ] ← New_Packet;
            Tx_bufferS1[ i ] = Rx_bufferS1[ i ] ;
            i++;
            Transmitted New_Packet to parent node i.e.
            from Tx_bufferS1[ i ] ;
        else
          Discard the New_Packet from Rx_bufferS1[ ]
            goto S2
        end if
      end while
   lable S2:
      while (Sensor2 detect event is true)
       store New_Packet in Rx_bufferS2[ ]
         for int i=1 to counter
         Rx_bufferS2[ i ] ← New_Packet;
         Tx_bufferS2[ i ] = Rx_bufferS2[ i ] ;
        Transmitted New_Packet to parent node i.e.
        from Tx_bufferS2[ i ]
            goto S1;
     end while
  else if (Received by child node)
       for int j= 1 to no_of_child
       check the Frame_bit;
    if (New_Packet is sensor 1 )
       Rx_bufferS1[ j ] ← New_Packet;
    else
       Rx_bufferS2[ j ] ← New_Packet;
    end if
  Aggregating Rx_bufferS1[ j ]  and Rx_bufferS2[ j ]
  packet with the help of timestamp ;
   if (Tx_bufferS1[ ] != New_Agg_Packet)
       for int k=1 to counter
      Tx_bufferS1 [ k ] ← New_Agg_Packet;
       Transmitted a New_Agg_Packet to parent node
        or sink;
       k++;
    else
      for int m=1 to counter
      Tx_bufferS2 [ m ] ← New_Agg_Packet;
       transmitted a New_Agg_Packet to parent node or
       sink;
  end if
 end else if
 end if
```

V. Performance Evaluation

Average Delay: At initially a particular time the event is generated at this time is initial time T_1 then decides the coming event is sensor1 packet or sensor2 packet. After that remove the redundancy of data packet at MAC layer to send the data to communication unit. The work of communication unit is send this packet to neighboring node or sink at this time initial time is increases as T_2. The delay is calculated as

$$\text{Delay} = T_1 - T_2$$

The Average delay is defined as difference between source data packet and received data packet at sink.
The communication overhead of proposed algorithm is shown as figure.3.

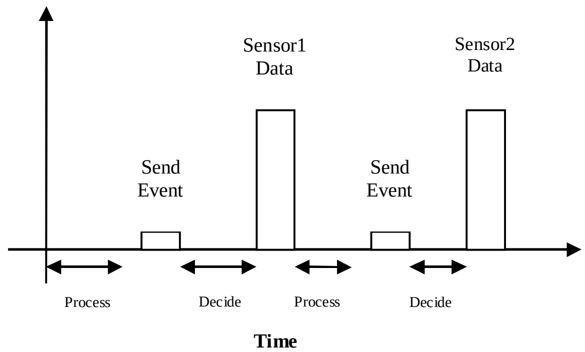

Figure.3 Communication Overhead

Data process ratio: The data process ratio is represents as the ratio between the process data and generated data. Let data process ratio is denoted as D.

$$D=\frac{\text{Total data packets are send by the sender}}{\text{Total data packets are received by the receiver}}$$

Average Energy Consumption: the energy consumption is propositional to network life span. The lower energy consumption is defining higher network life. The average energy consumption calculated as the difference between the initial energy E_1 in a sensor node and final energy E_2 in a sensor node divide by number of node n. The average energy consumption is denoted as A,

$$A=\frac{E_1-E_2}{n}$$

VI. Conclusion

The proposed algorithm has successfully reduced the blocking of aggressive deadline packet. The environment is highly dynamic in nature, so we reduce the unpredictable traffic in network, after that it achieves higher packet delivery ratio in particular time. The proposed routing protocol improves the network lifetime. The tree based routing schemes is stateless, deadline-driven and energy aware. The differentiated service model at the MAC layer reduces the packet delay. The differentiated service model on sensor1 acts as rate guaranteed service and on sensor2 acts as best effort service. The MAC layer is prioritized MAC scheme which is used to assign a critical data and non critical data.

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