Resourceful Data Collection and Transmission Strategies for Wireless Body Sensor and IOMT Network under Delay Sensitive and Energy Conservations as Quality Factors

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1. Abstract

Rapid development in the area of communications through wireless sensor networks attracted more attention of scientists and researchers over the last few years. Wireless sensor networks have proved to be an equally valuable and novel platform for wireless communication and other areas of applications. The potential of wireless sensor networks proportionately deployed in the broader field of applications such as defense equipment, ecological and habitat monitoring, industrial process control, home automation, weather forecasting, health care system, traffic control, civilian applications, etc. Wireless sensors are small size devices equipped with radio transceivers and low power batteries. Typical features of sensor node include power, storage, and low-cost computational capability hardware. A wireless sensor network is intended to sense, collect, processes, and transmit event-specific information to accomplish a distributed domain task.

Moreover, wireless sensor networks are the type of systems where the resultant have based on sensor nodes cooperation. A wireless sensor network consists of a group of sensors or nodes

connected through a linked mechanism to accomplish a distributed sensing task. Wireless sensor networks deployed in the conditions are severe from the physical deployment point of view. The significance of scalability on the behavior of the application, MAC, transport, and physical layer performance are vital criteria of the contemporary research in recent past.

Because numerous sensing nodes can produce the same data while sensing, a high redundancy of data traffic typically characterizes wireless sensor networks.

Wireless sensor networks, such as "wireless body area sensor networks," are an efficient s olution that is specialised to the healthcare industry and provides a number of advantages.
The difficulty, though, lies in getting these solutions to work as efficiently as possible.
Due to several inherent variables, such as the abundance of standards accessible, as well as the n ecessity to choose the optimal solutions, which are based on application needs.
However, limitations like the effects of the wireless medium and battery lifetime have an impact on wireless sensor networks.

Another important circumstance is the coexistence of systems with other nearby wireless networks, a delay in data gathering, and repeated efforts to transmit data with a particular priority. As a result, it is clear to take advantage of the wireless body area sensor networks' domain-specific limitations by making data collection and transmission fault-tolerant, delay-tolerant, and as energy- and bandwidth-efficient as feasible.

2. Introduction

The 'wireless sensor network' has inherent properties as opposed to conventional 'wireless communication networks' as a cellular network or MANET. It has restricted storage, the ability to process and produce energy, and is a very active network that is specific to the application.

According to the works [1], [2], and [3], it is extremely difficult to improve the routing protocol because of these features. In many cases, several sources must meet prerequisites before sending their data to a designated "base-station." Additionally, nodes that are about to sink use more energy, which leads to their eventual demise. This will segment the network in this case, which will shorten the network's lifespan. The term "energy hole problem [4]" or "hotspots [5]" refers to this occurrence.

In network, for overcoming this issue, they utilized a mobile-sink (MS) [6], [7]. The work [5] presents that system through MS indirectly manages the load amid sensor-nodes and lessens the opportunity of the hotspots. It might assist in attaining the regular consumption of energy and extending lifespan. However, some issues are related to MS. The MS needed for sending its current location information along with its network. This procedure causes an essential consumption of energy overhead.

Additionally, the MS creates "sensor network" vigorous in the environment. Therefore, it will not be adaptable to identify the path routing former to its pre-requisite. Usually, in reactive-routing, the "end-end latency is maximum" that can contain the prerequisite of new data. And in "event-based application," the sensor data validity relies on its novelty. For optimizing end-to-end latency in delay-sensitive transmission, it is recommended to perform priority-based data transmission. The lag might impact several aspects such as routing-path accessibility, identified location of MS, "the presence of non-interference paths."

It noticed that "rendezvous-based methods" are appropriate for the applications of time-sensitive. They were able to lessen latency. Some of the instances of the applications of time-sensitive might be "intruder detection systems" for tracking the target, the security of the building, monitoring the health status of human and detection system of CO/ Smoke. In an environment of MS, the source node should wait till it receives the path routing for data transmitting. In "rendezvous-based routing," some of the predefined regions are given, where the source-node might interact. And in some methods like "line-based data dissemination (LBDD) [8]" and "grid-based energy-efficient routing [9]" the source-node will transmit the data aimed at rendezvous area, and nodes of the rendezvous might further send data towards sink, while in methods such as ring routing [10] and railroad [11], the source node will regain the current location of sink from area of rendezvous and transfer the information straightly to sink through an intermediate nodes utilizing "geographical based methods" [12], [13]. Initially, the "end-end latency" is minimum. However, it contains sufficient energy. The second kind of techniques are productive energies, yet cooperates with latency, which therefore motivates suggested "rendezvous-based routing protocol."

In this article, "Delay Sensitive Data Routing Optimization using Rendezvous Agents (DSDRO)" is suggested that addresses pre-requisite of fault tolerance, productive energy, low end-end latency, and priority scheduling. In DSDRO, the network area is virtually segmented into numerous regions and provides node as "rendezvous agent" of MS for the respective field. Every node of the region will interact with "rendezvous agent" of that area. The path is determined to MS, which allows for visiting these areas under different QoS factors. The model involved in "Delay Sensitive Data Routing Optimization using Rendezvous Agents" chooses specific regions and determines the sequence of areas which selected for visiting through MS. The chosen fields "rendezvous agents" from entire areas have to get a chance for reaching MS, whereas the MS is traversing via selected areas.

The works [1], [2], [3] contribute that the Wireless Sensor Networks with inbuilt features like extreme dynamic networkability, application specificity, restricted processing, energy, and storage capabilities tends to be a highly tall order task for developing a routing protocol which is in contrast to the traditional wireless communication networks such as MANET, cellular network. Mostly, for sending data to a particular database set, it uses various sources. And the nodes which are about to sink ultimately die because of extreme energy depletion and leads to network partition and subsequently diminish the lifespan of the network. i.e., hotspots [5] or energy hole problem [4]. For overcoming this issue [6], [7], the system uses a mobile sink, where such mobile sinking networks subtly stable the sensor nodes load a well as dwindles the hotspot chance [5] also supports for achieving even energy consumption as well as extends the lifespan of the network. Contrarily, the mobile sink has a few issues like the requirement of sending existing position information throughout the system, which leads to the significant overhead of energy consumption. Besides, adding a dynamic feature to the sensor network. Therefore, to identify the route path as per the demand is complex. There is an extreme end-to-end latency in reactive path routing that leads to compromise a need for new data. The sensor data validity in the application that base on the event depend on the data freshness; there is a utilization of delayed data. Hence, the end-to-end latency has reduced in the application that is on an event which will be the primary requirement. However, factors such as routing path accessibility, mobile sink location familiarity, non-interference paths existence affect the latency.

2.1 Problem Era in IOMT

The observations show that techniques based on rendezvous are the most popular choice for time-sensitive applications since they can reduce latency. After quantifying the predefined area, communication via the source node occurs in rendezvous-based routing.

Wearable technology and wireless devices and solutions that are customised for medical and healthcare diagnostics have both become demands for wireless area networks. Additionally, the linked routing protocols have become incredibly important in the process of communication. Along with beneficial improvements, there are also significant increases in problems and complications in handling such solutions.

Data collecting and transmission services are getting better thanks to a variety of sources. Despite the fact that several models have developed in order to improve operational effectiveness, it is crucial to note that..

2.2 Research Scope

Through multicast transmission, which is typically a sequence transmission in other contemporary models, and the avoidance of the transmission complexity with minimal control packets, the objectives covered by the contributions of this doctoral thesis handle a diverse range of traffic classes more effectively. Another important goal is to prevent controller delays brought on by transmission resource blockages, which frequently happen in condition. A node's active sensor unexpectedly lost range, failing to signal the controller in any way, and forcing the node into a hanging state.

Congestion Control: Several strategies have been developed to actively or passively address congestion using various features of the network [14]. One of the most widely utilised indicators of congestion is packet loss. When a source delivers a packet, it starts a timer at its end and waits for a certain period of time for a response from the destination. Due to network congestion, if an acknowledgement is not received within this time frame, the packet is deemed lost. The congestion control algorithm in place assumes control after a packet loss is discovered to lessen network congestion.. In IoT networks, mechanisms that rely on packet loss to detect congestion are useless because (i) they make the assumption that a packet loss only occurs due to congestion, which is untrue for low-power and lossy networks, where packet loss can also occur due to link errors or poor signal strength [15], and (ii) delaying the response to congestion until a packet is lost degrades performance because IoT packets typically carry small payloads and their retransmission takes time. Usually, TCP and the congestion control techniques are closely related. The main issue is that TCP is not the de facto transport protocol for Internet of Things applications [16], making it difficult to create congestion management algorithms for IoT applications

Handling Tradeoff between energy efficiency & Delay Sensitivity: Several studies have demonstrated a trade off between event report delays and energy efficiency [17]. All nodes in a node's transmission range that are closer to the sink than it are are included in the candidate forwarding set when a node wants to forward packets. Nodes in asynchronous sleep-wake cycle networks can be arbitrarily awake or asleep, so they can only relay packets while they are in the active state. It is obvious that the nodes that are available change over time. The one-hop transmission distance is the longest when a node needs to transfer data and an available node is the closest to the sink, but data can be sent to the sink with fewer hops.When a node wants to forward data, the nearest node to the sink is not always the first one that becomes accessible. In this case, as soon as any nodes are available, the node broadcasts right away. Although utilising this approach reduces transmission time, it is difficult to ensure that each hop will move swiftly in the direction of the sink. As a result, the number of hops needed to send the data to the sink may be rather high. Additionally, the overall delay is not always minimised, and energy efficiency is not always good. In contrast, if a node chooses to wait until the best node is operational, it may ensure faster forward motion and increase energy efficiency. However, owing to the higher per-hop delay because of the extra waiting time.

When a node wants to forward data, the nearest node to the sink is not always the first one that becomes accessible. This means that the overall delay may also be larger because the node transmits right away whenever any other nodes are present. In the future, research goals in the medical area will focus on the delay sensitivity and energy efficiency of IOT, which are highly correlated and given significant emphasis.

Edge Level Scheduling: The integration of edge/fog computing with the target IOT network is c
rucial in order to connect massively deployed IoT devices connected to a variety of smart-
world applications and process the vast volumes of data that IoT devices collect.
These Internet of Things (IoT) gadgets, which are wireless and a part of a network of IoT gatewa
ys, send copious amounts of data to edge computer nodes.
Following data processing, the edge nodes transmit their findings to cloud datacenters.Real-
time streaming and sensitive data transmissions in the medical domain, in particular, necessitate
a high rate of data transfer between IoT devices and edge/fog connection. This connectivity must
also be dependable and efficient to meet the performance requirements of the target applications
Optimising the scheduling procedure in this regard to prioritise delay sensitivity and the hierarch
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tions.
Along with the aforementioned important goals of the IOT networks in the medical sector, optim

ising the scheduling process that prioritises delay sensitivity and order of the data frames generat ed from the Internet of Medical Things is another research goal in this regard.

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