



GUJARAT TECHNOLOGICAL UNIVERSITY

(Established by Government of Gujarat under Gujarat Act No. : 20 of 2007)

ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી

(ગુજરાત સરકારના ગુજરાત અધિનિયમ ક્રમાંક : ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

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Abstract of the Thesis



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Faculty: **Engineering**

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Title of the Thesis: **“RAPID DATA TRANSMISSION TECHNIQUE THROUGH TREE GENERATION & EVENT AGGREGATION TO ACHIEVE LOW LATENCY & ENERGY SAVING IN WIRELESS SENSOR NETWORKS”**

Abstract

Wireless Sensor Networks (WSNs) have been indispensable elements of various technological systems in recent years, offering applications such as environmental monitoring, smart cities, industry automation, and healthcare. WSNs are made up of many sensor nodes that perform functions such as sensing, processing, and sending sensed data to the base station in the network. Nevertheless, due to the nature of WSNs and the presence of constraints like limited energy, computing ability, and limited bandwidth, efficient data transmission in wireless sensor networks has become difficult to achieve. One of the main challenges facing researchers nowadays is finding a balance between energy-efficiency and low latency since they conflict with each other.

The current study is aimed at proposing a method for fast data transmission that takes into consideration both energy-efficiency and latency aspects in WSNs.

The key difference between the current approach and the previous ones is the importance
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given to latency since in most cases studies have focused mainly on minimizing energy consumption. After building the aggregation tree, one of the most important steps of the current approach is the data aggregation technique, whereby the sensor readings collected from different sensors are packed in one packet.

Apart from data aggregation, this paper proposes an event aggregation technique, whereby the initial data is transformed into events that will facilitate fast and efficient data transmission process. In order to increase efficiency, the framework proposes the implementation of a combination of centralized and distributed scheduling methods together with intelligent scheduling algorithms that will avoid packet collision in the transmission channel. The use of these two techniques enhances efficiency by ensuring optimum allocation of time slots, thus enhancing the throughput of the network and minimization of transmission delays. Fault tolerance, such as retransmission, replication, and signal quality measures like RSSI and LQI have been included in this framework.

These proposed concepts have been tested using simulations in standard platforms such as Castalia and NS2 to show how effective they work. Through these simulations, the results show marked improvements in latency times, energy conservation and scalability of the network as compared to traditional techniques like LEACH and CTP.

As further proof of the practical nature of the solution, the development of a prototype is carried out through the implementation of a wireless network that involves gas detection as its main application area. This system is designed to acquire data, transmit it, and analyze it in the cloud environment, confirming the practical applicability of the proposed framework.

To summarize, the conducted research offers a powerful and effective approach towards



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implementing efficient communication in Wireless Sensor Networks via tree-based communication, aggregation of data, and intelligent scheduling strategies.

List of Publication(s):

1. Rapid Data Transmission through Tree Generation & Event Aggregation to Achieve Low Latency & Energy Saving in Wireless Sensor Networks.", International Journal of Advances in Signal and Image Sciences (IJASIS) 2025, (ISSN 2457-0370, Vol. 11 No. 2, Page 127-141).
2. "Scheduling with Multiple Channels for Rapid Convergecast in Wireless Sensor Networks", Journal of Emerging Technologies and Innovative Research, JETIR 2020, (ISSN 2349-5162, JETIR Volume 7, Issue 12, Page 708-716).
3. Energy Efficient and Fast Data Transmission Techniques for Wireless Sensor Networks, GIT JET Special Edition ICDSIA-2020 Twelfth Volume-I, 2020, (ISSN 2249 – 615 Page 17-20).