IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

Improving Quality of Service in Wireless Sensor Network Using Hybrid Approach

Miss. Maya Madhav Giri, Prof. Bankhele Neeta Baban, Prof. Bansode Rahul S.
Sharadchandra Pawar College of Engineering, Otur, Maharashtra

Abstract: *Wireless Sensor Network is an smart technology which deals with assembled devices having number of sensor nodes. In Wireless Sensor Network (WSN), the set of sensor nodes are used to measure the environmental condition parameters such as humidity, temperature, and light intensity etc. The sensor nodes perform the operations such as maintain wireless communication between source and sink nodes, sensing data, and establish . The set of sensor nodes in combined and form are termed as Wireless Sensor Network communication channel. Basic need of communication channel is form path between both nodes. During transmission and reception of data, the Quality of Service (QoS) of WSN plays an important role.*

Wireless Sensor Network based applications are being used more day by day in our life. Due to increase in the use of WSN, some problems occur, such as energy constraint and failure of nodes. It is very difficult to maintain the quality performance demands of Wireless Sensor Network according to the given conditions. The sensor nodes are able to communicate with each other and also able to communicate with the Base Station (BS). Quality of Service (QoS) is delivered by the sensor nodes during working with Wireless Sensor Network. It is very important to maintain the whole scenario of process with good QoS under given interval of time and duration. The QoS of WSN is very important challenges and issues, for the recent research work area..

Keywords: *Wireless Sensor Network*

I. INTRODUCTION

The Quality of Service (QoS) refers to the performance of the Wireless Sensor Network during the process of wireless communication. The performance of the WSN is measured in terms of number of QoS parameters such as delay, energy consumption, network lifetime, reliability, availability and serviceability of network. To achieve the better Quality of Service of the WSN we need to overcome the challenges occurring during the its real time application. WSN real time application having the combination hardware and software interface for the communication between sensor nodes. The hardware interface mainly consists of sensor nodes, processor unit, battery, power supply and Wi-Fi module to represents the Wireless Sensor Network. The software interface consists of TCP/IP protocol, Zigbee protocol, MATLAB/Simulink, NS-2 simulator and operating system for transmitting and receiving the data via Wi-Fi module from sensor nodes.

The QoS is the ability of Wireless Sensor Network, where the sensor nodes help to provide the services to fulfill the required data delivery. It is a group of required service which is necessary to meet with the network while transmitting and receiving the data between source and destination node. The dynamic nature of WSN having limited resource availability and insecure transmission medium for the data transmission and reception. There is a need to maintain the quality of service for the wireless sensor network. Resource may compose of hardware which is constituted of base station, group of nodes and routing path. Usually, Wireless Sensor Networks have redundancies with multiple sensors can have overlapping contributions towards real time applications. Hence, the simplest sensor selection scheme used to choose the sensor set randomly. The sensor sets meets the requirements of application and maintain the QoS during the process.

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

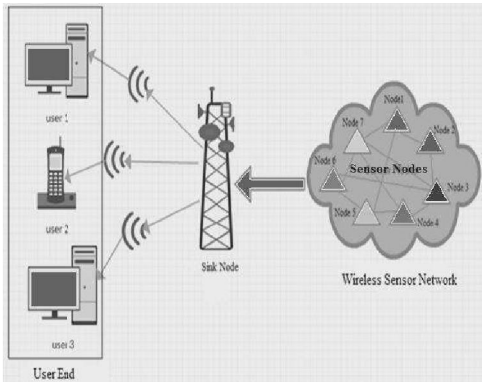

Fig 1: Wireless sensor network

1.1 QoS Interaction with WSN :

WSN interacts with the Quality of Service during the process of data transmission and reception. The design of WSN is an important part to improve the WSN service quality in a given real time applications . Wireless Sensor Network design deals with the hardware, software and hybrid approach. Literature related to hardware design of Wireless Sensor Network emphasizes to avoid complex architecture of Wireless Network. The use of multiple layers and multiple numbers of sensor nodes for maximum data transmission in minimum time duration is the key point. An efficient design of WSN uses multiple microcontrollers for processing under less power consumption. The use of protocols for inter-nodes data transmission is very important. Hardware design of WSN is

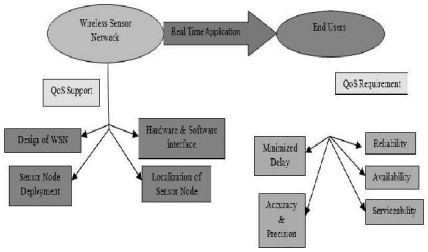

Fig. 2 Qos interaction with WSN

very important part during improve the QoS. To improve the WSN quality of service, needs to reduced complex grouping of sensor nodes and more power consumption. The major concern to improve the hardware efficiency during the increase demand of end users. All the above discussed factors shows the Quality of Service (QoS) parameters of WSN such as Reliability, Availability, and Serviceability of wireless sensor network. The QoS interaction with WSN are illustrated in Figure 2.

The software design of the Wireless Sensor Network is a very efficient and better way to implement and observe the working scenario of network. The Wireless Sensor Network design in software platform helps to analyze the performance of the WSN with its graphical and statistical data. The WSN design involved protocol-based algorithms for simulation. In these algorithms, the number of set of nodes, number of cluster head formation, number of rounds for data transmission and probability of data transmission etc are to be considered. The simulation platform for WSN is very efficient to observed real time application. The designing of network in software needs clustering and distributed algorithms for sensor node arrangement. There is a proper design of routing protocol to avoid the several limitations of network resources such as energy capacity, bandwidth, and location of sensor nodes and to tolerate the fault during operation. The software-based Wireless Sensor Network design and implementation very easy way to understand the real scenario in a virtual study form. But its practical formation is very difficult to understand the design and implementation with real time application.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 2, May 2026 Impact Factor: 8.2

To overcome the problems related to the hardware and software interface during implementation with real time application, by introducing the middleware design formation of Wireless Sensor Network. In this 9design, the Hybrid Approach (HA) of hardware and software is used to design the Wireless Sensor Networks (WSN). This approach overcomes the hardware resource limitations and avoids the software virtual visualization property restriction. Hardware resources have restriction in power supply, memory size, network lifetime and bandwidth. Software virtual visualization property have restrictions during arrangement of sensor nodes, clustering nodes and localization of sensor nodes with real time applications. Hybrid Approach deals with static and dynamic performance of the network. The static performance hybrid approach of Wireless Sensor Network represents the hardware components arrangement, where the structure of WSN is designed. The assembly of components is assembled in the Printed Circuit Board (PCB) according to the considered design. Hardware is represented as an input for the WSN, as a static model. The dynamic performance hybrid approach of WSN represents the software platform where the statistical and graphical views of Wireless Sensor Network outcomes are measured. Hybrid approach is best suitable way to maintain the QoS of Wireless Sensor Network during the process. Quality of Service parameters are evaluated in the form of Reliability, Availability and Serviceability using Hybrid Approach. With this approach we can easily overcome the issues of real time application and increase the real time application demands.

1.2 QoS Challenges and Issues :

In WSN, the role of Quality of Service is very important during the process of data transmission and reception. The good Quality of Service during the data transmission and reception helps to overcome the challenges and issues , which occur in real time applications. The implementation of Wireless Sensor Network with real time applications, have some challenges which affect the quality of service. These challenges and issues are listed below: -

1.Restriction in bandwidth, power supply and memory size.
2.Limited Area of Wireless Sensor Network for Transmission of Data.
3.Node Deployment Problem.
4.Network Traffic Problem.
5.Localization of Nodes under given Area of Network.
6.Wireless Sensor Network Design Issues with Hardware and Software.
7.Modularity of Hardware System.
8.Robust Design of WSN.
9.Feasibility of WSN with Real Time Applications.
10.Reliability, Availability and Serviceability (RAS) during the Data transmission and Reception.

The set of sensor nodes of given WSN are used to transfer and received data from one sensor nde to another sensor node. In the given WSN, the sensor nodes are distributed under limited area for the distribution of data for specific system with restricted bandwidth, limited power supply and for a limited memory size of data packets.

II. MEASUREMENT OF SENSOR NODE DATA DELAY IN WIRELESS SENSOR NETWORK

2.1 Introduction

WSN is a smart technology for the todays real working world. Wireless Sensor Networks are organized to provide service using sensor nodes for the end users. The sensor nodes are used to sense data which is to be transfer and receive from one sensor node to another sensor node. These sensor nodes provide end-to-end communication under specific time lines. An end-to-end communication between sensor nodes needs to maintain the QoS during the transmission process. The QoS is very important part during the data transmission and reception from one sensor node to another sensor node. It is necessary for sending and receiving data under given time-line for maintaining the quality of service towards the end users. The end users demand is to use the WSN service without causing delay during sensor nodes, end to end communication. The end-to-end communication between intermediate sensor nodes view point service quality can be measured in terms of parameters such as source to destination delay, source to destination data reliability,

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

availability and serviceability. All these parameters are depending upon the network traffics, congestion during data process, sensor nodes arrangement and CH formation. The cluster head refers to the group of sensor nodes which are arranged to transfer the data along with path. The cluster head formation in the WSN is an important term for managing the user to user point delay problem. An end-to-end delay during data transmission cause major problem towards the end users. The sensor nodes sense the data and transfer it to another sensor in multiple time with multiple different path formation. Sometimes, the end-to-end communication between sensor nodes suffer from bulk of data sending and receiving which causes congestion problem due to network traffics. The congestion problem along with network traffic causes delay during sending and receiving data. The real time application of WSN maintains the QoS parameters with reduced above-mentioned challenges and issues. The reduced challenges and issues during the process of wireless communication through sensor nodes increase the QoS of WSN.

2.2 Clustering Phenomenon

WSN consists of group sensor nodes for transmitting and receiving the data from one sensor node to another as shown in Figure 2.1. The process of data sending and receiving is through proper channels of WSN process. These sensor nodes are interconnected with each other through proper channel, they form a set of groups for performing the given tasks, and they are named as clusters. These clusters are responsible of collecting the data and arranging all the sensor nodes in the form group termed as clusters and are named as Cluster Head(CH).

These cluster heads are ready for the clustering process. Clustering [33][44] process is a process of grouping the sensor nodes into clusters form and electing the CHs for each cluster of nodes. These cluster heads are collecting the data from each set of clusters and transmit data to the Base Station (BS). Clustering phenomenon [97] is one of the very important ways to forward data from one end to another end of communications. To achieve the goal of transferring data from CH to the base station, there is a proper channel, which is used to proceed further.

The essential channel for transferring data, there is a need of proper routing protocol and code separation to prevent the cluster head interference.

In order to reduce and maintain the balance the energy consumption and reduce the delay during data transmission, the proper design and formation of cluster head is very necessary point. The formation of CH is essential concern in developing the cluster head protocol algorithm. Generally, the following given aspects are taken under consideration by the cluster protocol: -

1.Cluster head selection based on the nearby distance between the sensor nodes and Base Station(BS) communication point with balanced energy consumption level.

2.CH formation with greater balance in energy consumption level.

3.Proper rounds of cluster head for data transmission with balanced energy consumption.

4.Stability in CH formation during increase in the data transmission rounds of sensor nodes.

5.Reduction in random switching selection of Cluster Heads.

6.Avoid delay during data transmission by clustering the network traffic.

7.WSN quality of service maintain during the process.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

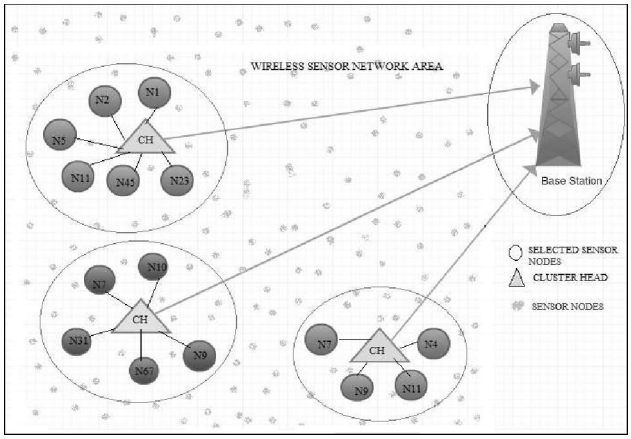

Figure 2. 1 Clustering Process

III. STUDY OF QoS PARAMETERS USING CRAWLING PATTERN

3.1 Introduction

In the current research area, WSN is very popular platform for enhanced their research work. It provides a huge platform over to transmit data and receive data using large WSN area. The wide WSN area needs proper deployment of sensor nodes with various locations during transmitting and extracting of data for the base station. WSN is having a collection of large number of sensor nodes, which is used for transmitting and receiving data. Due to this, there is a need to provide better design of sensor node deployment to attain the full coverage of WSN area for data transmission and reception.

The proper SND in wireless sensor network for transmitting and receiving data from one sensor node to another sensor node is very necessary. For the better communication between sensor nodes during data transmission and reception is important way to maintain the Quality of Service (QoS) of WSN. QoS is very important part of any process during real time applications of WSN. Good QoS of data transferring from end to end users during communication along with full coverage of area shows the WSN performance. The good quality of WSN provides good service towards the end users.

3.2 Sensor Node Deployment

Sensor Node Deployment (SND)[45][62] is a fundamental challenge to be solved in WSNs during data transmission. A appropriate SND strategy can reduce the complexity of problem in WSNs as, for example end-end communication and proper distribution of data over each and every sensor nodes of WSN. Due to the proper management of sensor nodes and their deployment under given area of WSN will increase the service lifetime of WSNs by minimizing energy consumption.

3.3 Sensor Node Deployment Approach

The novel sensor node deployment approach is designed to overcome above discussed challenges and issues. The main focus of the approach is analysis of QoS of WSN[78]. The sensor node deployment is based on the random network coverage model. The random network coverage model which deals with the uniformly designed WSN are covered by each sensor node of the designed WSN and maintain the connectivity by assigning the probability for each sensor node. It depends upon the designed surfer model where the number of sensor nodes are deployed. Such approach is known as Sensor Node Deployment Approach.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

3.3 Sensor Node Deployment Implementation

hen deploying the sensor nodes over the whole area of WSN, the proper clustering [85][86] of sensor nodes are necessary. The clustering [53] of sensor nodes originate the cluster head which is required to authorized the sensor nodes to transmit and receive the data from end to end users. The authorizations of sensor nodes help to transmit and receive data easily by avoiding network traffic [125] and delay. The designed WSN is said to be a Surfer Model having crawling patterns of sensor nodes.

For designing and implementing the surfer model following simulation parameters are required, is shown in Table 3.1.

Table 3. 1 Simulation Parameters for the design of Surfer Model

Simulation Parameters	Values
Number of Senor Nodes	6
Simulation Time	20 s
WSN Area	100 m^2
Sensor Node Mobility	Random Way Point
Sensor Node Traversing Color Coding	Red, Blue and Green Color

IV. AUTHORATIVE SENSOR NODE

4.1 Introduction

WSN are highly adaptable technology in the number of applications such as environment monitoring, video surveillance and military etc. for the security purpose. Now a day, there are many applications real time applications required WSN in a manner of single hop and multi-hop traffic patterns.Both traffic patterns are used under optimum network solutions according to the real time application user demand. The optimum analysis of the WSN deals with the optimization of WSN nodes path. The proper communication between the sensor nodes during transmitting and receiving data is very important task. The path formation of sensor nodes is very important task during data transmission and reception. The proper path adopts by the sensor nodes helps to avoid the network traffic congestion drawback and minimized the delay during data transmission and reception. An identification of proper combination of sensor nodes is required along with maximum WSN area covered and manages the time duration for avoiding the delay problem. Currently, WSN related research work, based on the identification of best possible optimal path planning using sensor nodes. The optimal path planning adoption helps in reducing the delay, network congestion problem and packet loss. An optimum path has the property to transmit and receive data along with minimum simulation time with maximum coverage of area of WSN. Such approach involves the equal participation of sensor nodes performance, less energy consumption and makes the WSN more efficient. Due to efficient performance of WSN and proper transmission of data as per the demand of the user increase the WSN quality of service.

4.2 Reliable Routing Protocol

The formation of reliable path for the WSN using combination of sensor nodes needs well designed routing process [43]. The routing process is a process of forming suitable path using sensor nodes. The sensor nodes are transmitting and receiving sensed data which travel from source to destination. The data sensed by the source sensor nodes in a WSN is send to the base station which connects the sensor network with the other sensor network.

4.3 AODV Routing Protocol

In this work, the AODV routing protocol is used. The AODV routing protocol [2][10] is stands for Ad-hoc On-Demand Distance Vector routing protocol. AODV routing protocol is a reliable routing protocol which reactive as per the request is established by the sensor nodes during the process and established the path. An establishment of path, AODV routing protocol an intelligent enough to form shortest path as per the considered the nearer distance between the sensor nodes.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

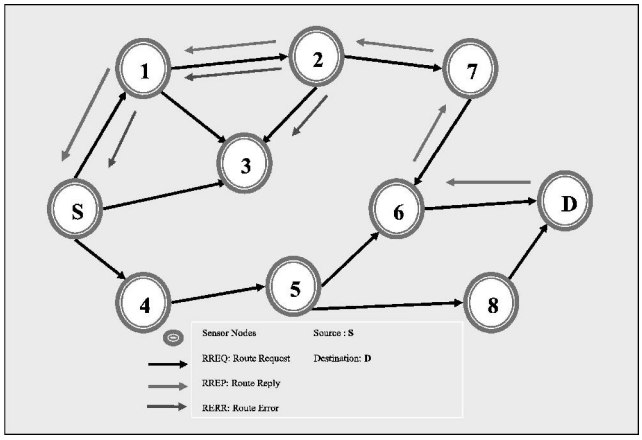

Figure 4. 3 Path Formation using AODV Routing Protocol

V. THE HYBRID APPROACH

5.1 Introduction

In the recent trends, the WSN service is important part of the development of many physical and environmental applications. These applications require the service of Wireless Sensor Network is more reliable during the process.The Reliable Wireless Sensor Network(RWSN) is designed as a reliable network, which refers to the real time application along with the better QoS. The real time application requirements with RWSN are to manage running condition of process. During the process, sometimes network become comes under failure condition due to network failure. When network failure is happened, the sensor sensing ability gets reduced. In the reduction in sensor sensing ability the network interact with the reduction in network Quality of Service (QoS). To maintain the QoS is the big challenge with the real time application towards end users.

In this chapter, the QoS parameters are used to evaluate the wireless sensor network using Hybrid Approach (HA). The QoS is deals with the three QoS parameters such as Reliability, Serviceability and Availability of WSN. These parameters are evaluated along with HA which is used to designed the WSN under real time environmental condition. The evaluation is deals with the testbed of the WSN. The property the testbed is to makes the WSN efficient and reliable during data transmission under environment condition.

5.1 Wireless Sensor Network Testbed.

Wireless Sensor Network-Testbed (WSN-Testbed) provide practical platform for the real world application project by applying an experiments. An experiment interacts with the real-world scenario. WSN-Testbed performs flexible and duplicate testing of theories along with the new innovations and computational tools. WSN-Testbed enables more reliable and authenticate experimentation with hardware and software with their dynamic behavior of the wireless sensor network.

Generally, WSN-Testbed consist of sensor nodes for the given wireless sensor nodes. These WSN sensor nodes are deployed in a given environment. This is an efficient way which helps the researcher for evaluating their algorithms, protocols and applications. The designing of the WSN-Testbed is based on the research objective basis. This is an important feature to design the Testbed according to the objective basis. Such design helps the researchers during experiment through repeating experiments again and again for producing the similar results for their analysis.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

VI. QoS PARAMETERS: RELAIBILITY, AVAILABILITY & SERVICEABILITY (RAS)

6.1 Introduction

Quality of Service in WSN represents the measurement of parameters which are used to improve the network performance as per the user demand. QoS parameters are application specific parameters which includes sensor node measurement, node deployment, sensor node accuracy while sensing data etc. Wireless Sensor Network is very much affected by the above-mentioned parameters during the inter-node WSN communication.

During the recent developments in the Wireless Sensor Networks testbed are considered as more accurate and reliable with their performance. The accurate and reliable wireless sensor networks avoid the network malfunctioning such as communication failure between the nodes, failure of sensing data from sensor and failure sensors during communication. All these factors affect the WSN QoS. QoS is a performance of WSN required during the network communication. The flow is related to the network service delivery to the end users of network. The WSN measures the network packet loss probability, network reliability, availability of the network with packet loss condition and serviceability between end to end communications with delay. In RAS, reliability emphasize on the wireless network failure, communication failure between source to destination node and hardware failure etc. Availability shows the data transmission ability during failure of link, efficiency of network and serviceability shows the WSN-Testbed capability after failure and repair of network.

6.2 Experiment Setup with WSN-Testbed

In this research work, Reliable Wireless Sensor Network (R-WSN) testbed is considered. By using the WSN-Testbed, the evaluation of reliability, availability and serviceability of the WSN-Testbed[26] using three different sensors established via Hybrid Approach as shown in Figure 6.1.

Figure 6.2 Experimental Setup

The performance of hardware sensors interaction with the environmental monitoring conditions is carried out. The hardware assembly interacts with the software through using IP address via ESP8266 WiFi module. In this section, the observed reading through each sensor is display and stored along with observed time. For the proper observation with accuracy and precision the hardware has the digital LCD display on the circuit board.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

Time Interval	Temperature Sensor	Day I Observation	Day 2 Observation	Day 3 Observation	Day 4 Observation	Day 5 Observation	Total Failure
AM to PM		**Failure**	**Failure**	**Failure**	**Failure**	**Failure**	
11:00		0.3333	0.0476	0.6194	0.3333	0.4761	1.8097
2:00		0.2083	0	0.25	0.25	0.3333	1.0416
5:00		0.2608	0.0416	0.0869	0.434	0.0435	0.8668
8:00		0.0714	0.5525	0.1785	0.214	0.1785	1.1949
AM to PM							
11:00	**Humidity Sensor**	0	0	0	0.0625	0.0625	0.125
2:00		0.0625	0.0625	0.0625	0.0625	0	0.25
5:00		0	0.125	0	0.0666	0.0666	0.2582
8:00		0	0	0	0	0	0
AM to PM							
11:00	**Light Intensity Sensor**	0.1168	0.0649	0.0649	0.0519	0.0129	0.3114
2:00		0.2553	0.2127	0.0106	0.0106	0.1595	0.6487
5:00		0.2666	0.0133	0.08	0.04	0.0266	0.4265
8:00		0	0.0294	0	0.147	0.1768	0.3532

6.2 QoS Parameters Calculation

In the conducted experiment with sensors are placed in a given operating environment condition have the capability to observe the parameters like temperature, humidity, and light intensity. WSN-Testbed having the ability to access the network through Wi-Fi connectivity to calculate the sensors readings continuously with the connected the computer. The observed readings of sensors which is discussed in chapter 5 are used for the calculation

Table 6. lError during Sensor Sensing Reading

VII. CONCLUSION

This study proposes a simple, low-cost air pollution monitoring system using WSN and embedded technology. It monitors harmful gases such as CO_2, NO_2, and SO_2, sends data from mobile sensor nodes to a central server, and makes it accessible to government agencies. The system evaluates pollution levels using the AQI with color-coded indicators for easy understanding and health awareness. Its main goals are to detect and control vehicular emissions, alert drivers when limits are exceeded, and reduce environmental damage. As a non-intrusive add-on, it can be easily integrated into existing vehicles, improves engine maintenance, and can also be applied in industrial environments.

BIBLIOGRAPHY

[1] Mohamed Elshrkawey (et.al) (2018), "An Enhancement Approach for Reducing the Energy Consumption in Wireless Sensor Networks", , Science Direct, 30(2), 259-267

[2] Emanuele Lattanzi (et.al)(2018), "A Scalable Multitasking Wireless Sensor Network Testbed for Monitoring Indoor Human Comfort", IEEE Access, 6, 17952-17967.

[3] .Nathalie Mitton (2018), "QoS in Wireless Sensor Networks", Sensors Journal, 18, 3983

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, May 2026
Impact Factor: 8.2

[4] Chih-Min Yu(et.al)(2018), "Joint Hybrid Transmission and Adaptive Routing for Lifetime Extension of WSNs", IEEE Access,6, 21658-21667
[5] Mohammed Asif(et.aI)(2017)," Quality of Service of Routing Protocols in Wireless Sensor Networks: A Review", IEEE Access, 5, 1846-1871
[6] Dina Deif(et.al)(2017), "A comprehensive wireless sensor network reliability metric for critical Internet of Things applications", EURASIP Journal on Wireless Communications and Networking, 145, 1-18
[7] Muhammad Asif (et.al) (2017),"Quality of Service for Routing Protocols in Wireless Networks: A Review", IEEE Access, 5, 1846-
[8] Alvaro Diaz and Pablo Sanchez (2016), "Simulation of Attacks for Security in wireless Sensor Network", Sensors Journal, 16, 1-27,
[9] Tarek Azizi (et. al) (2016), "Increasing QoS Parameters in WSN Spiral Based Cluster Architecture", Elsevier Journal, 83, 401-408,
[10] Gurvinder Singh Brar(et.al)(2016) " Energy Efficient Direction Based PDORP Routing Protocol for WSN", IEEE Access, 4, 3182-3194,.
[11] Amit Sarkar and T.Senthil Murugan (2016), "Routing Protocols for Wireless Sensor Networks: What the literature says?", Alexandria Engineering Journal, 55(4), 3173-3183,
[11] Mohamed Abdelaal (et.al) (2016),"Improving Energy Efficiency in QoS-Constraint Wireless Sensor Networks", International Journal of Distributed Sensor Networks, 1-28
[12] Omar Said(2015) "Performance evaluation of WSN management system for QoS guarantee", Springer Journal, 220, 1-18
[13] Jun Long(et. al)(2015) "Reliability Guaranteed Efficient Data Gathering in Wireless Sensor Networks", IEEE Access, 3 430-444,
[14] Ahemed Jemal(et. al)(2014)," Energy Saving in WSN using Monitoring Value Prediction", Elsevier Journal, 32, 1154-1159