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ENHANCEMENT IN THE LIFETIME OF WSN USING ZIGBEE AND ADAPTION BASED NODE SCHEDULING

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ABSTRACT

In this research paper we proposed a wireless sensor network enabled with ZIGBEE based trans-receiver and individual node is configured a node time scheduling scheme known adaption node scheduling. In the projected approach, a call formula is projected so as to determine whether or not every node within the network sleeps or not sporadically. The choice relies on the native neighbor data. Every node gathers native neighbor data from every of its neighbors and also the data square measure updated sporadically. At last a unique duty cycle management formula for adaptive node scheduling has been projected and its performance has been evaluated.

KEYWORDS: ZIGBEE, Adaptive duty cycle, Network lifetime, Network coding, Motes etc.

I. INTRODUCTION

Wireless detector networks are enforced in varied observance applications like industrial, health, environmental, security, etc. Recently, conveyance applications have entered the list of applications, primarily through tire pressure observance systems. A lot of widespread use of wireless sensors in a very vehicle can result from one or a lot of many various factors as well as issue with wired sensing and value reduction chance. Oil-fired by the rising interest within the trade for deploying the next range of wireless sensors, there's a necessity to grasp and characterize the wireless channel at intervals a vehicle. To the present finish, we tend to report a case study victimization wireless detector nodes that area unit compliant with ZigBee. ZigBee is associate trade alliance that promotes a group of rules that builds on prime of the IEEE 802.15.4 standards [12].Channel behavior underneath varied eventualities is ascertained for ZigBee nodes placed throughout a midsize sedan. To the simplest of our data this paper presents the primary commit to characterize ZigBee performance inside a vehicle setting.

Intelligent area [1] may be an area (room, workplace or public space) integrated with type of devices for perception, decision-making, execution and management. These devices area unit networked to share info and supply considerate services. In recent years, service mechanism intelligent area [2] that is that the combination of intelligent area and repair mechanism, was projected to increase the potential of service mechanism for perception and decision-making. Moreover, service mechanism is additionally a sophisticated mobile device for initiative info perception and repair tasks execution in intelligent area. In commission mechanism intelligent area, the devices, i.e., varied sensors and actuators (including service robot), area unit connected with one another by network. Recently, the analysis of wireless detector and mechanism network and connected superior has attracted substantial concern [3]. For instance, Nilotic and his colleagues delineated a prototypal configuration for networked mechanism systems [4]. Distributed Intelligent Network Device (DIND) [5] projected by Hashimoto et al. is one in all the earliest works to implement Associate in Nursing intelligent area victimization networked devices. Baeg et al. initiated a wise home setting project for light-weight service robots to supply reliable services through the wireless detector network [6]. Liang et al. projected a system of wireless Smart-home detector network supported ZigBee and PSTN (Public Switched phone Network) [7]. Suh et al. instructed a replacement intelligent home system supported a wireless sensor/actuator network that divided and assigned varied home network tasks to acceptable elements [8]. Yu et al. enforced an omnipresent robotic area with a detector network supported ZigBee protocol [9]. Lee et al. designed an automatic construction of node software package for omnipresent detector network in intelligent setting [10]. Zhou et al. mentioned wireless detector network primarily based multi-pattern info acquisition and fusion in intelligent area [11]. However,

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service mechanism sometimes has not been concerned in most of on top of researches and connected literatures. During this paper, we have a tendency to introduce the look and implementation of a ZigBee primarily based wireless detector and mechanism network (here in after observed as ZWSAN), that has been applied in our service mechanism intelligent area in turn.

ZIGBEE OVERVIEW

ZigBee is that the preferred business wireless mesh networking normal for connecting sensors, instrumentation and management systems. ZigBee, a specification for communication in a very wireless personal area network (WPAN), has been referred to as the "Internet of things." on paper, your ZigBee-enabled kitchen appliance will communicate along with your ZigBee-enabled toaster. ZigBee is AN open, global, packet-based protocol designed to produce an easy-to-use design for secure, reliable, low power wireless networks. ZigBee and IEEE 802.15.4 area unit low rate wireless networking standards that may eliminate the pricey and injury prone wiring in industrial management applications. In this we use zigbee module rather then RF module because a ZigBee end device can operate for months or even years without needing its battery replaced.But the life of a Bluetooth module is about 1 to 7 days and wi-fi life time is only about 0.1 to 2 days.Zigbee can cover upto 100m but Bluetooth can covers only 10m.

ADAPTIVE DUTY CYCLED WSN

The adaptive duty cycle works on the queue management system to achieve high-performance under variable traffic rates. We design a feedback controller to have energy efficiency while minimizing the delay, which adapts the sleep time to the traffic change dynamically by constraining the queue length at a predetermined value. We design the distributed duty cycle controller. We control the duty cycle of each node by dynamically adjusting the dormant time interval under network condition changes. The controller determines a node’s sleep time using the local information available at the node, in each control period. One of the important components of end-to-end delay is the queuing delay, specially in WSN applications with uncertain packet generating time. Generally, a larger queuing occurs in a node when it receives more data than it can forward. In a sensor network where the packets converge towards a sink node, the excessive packets received by a node eventually result in an excessively large queue length. This phenomenon may be sustain by several reasons, such as congestion, contention, collision, and high traffic. Thus, we use the trajectories of the queue (the length of queue) as an indirect indicator of network status, such as traffic load, route depth. Based on the queue length and its variations, we propose a dynamic duty cycle control scheme to meet time-varying or spatially non-uniform traffic loads by constraining the queue length at a predetermined threshold.

A system is considered with N sensor nodes scattered uniformly in area A. The area A is shown in Fig 1. Adaptive Duty Cycled in typical WSN in Fig 2. All the N sensor nodes are Queue Detect Duty Cycle Enabled (i.e. switching between active and dormant state) in the bottleneck zone B, the nodes are classified into two groups such as relay sensor and Linear Network Coder Sensor nodes. The active relay sensor nodes (R) transmit the data which are generates outside as well as inside the bottleneck zone (B). In the bottleneck zone (B) the relay nodes (R) can communicate to the sink node using a single hop communication, the relay node communicate to the another relay node and Liner network coder node using a multi hop communication. The active Linear Network Coder sensor nodes encode the relay node data before transmission to the sink. The relay node will use the single hop to communicate with the sink. The leaf sensor nodes periodically sense the data and transmit them to the neighboring nodes towards the sink. The intermediate motes periodically sense the data and it will relay the sensed data and received data in the direction of sink mote S.

Adaptive duty cycle Algorithm: Packet process (Pi, Pj): Packet processing at a node inside the network coding layer
Requirement: Packet transmission and reception starts, sensed packets inserted into the senseQueue() and receiveQueue()
Ensure: The node will be active state or not
1 if (Threshold < (ReceiveQueue().Length+ sense Queue().Length))
2 The sensor node going to sleep state
3. else
4. The sensor node will move to active state
5. Pick a packet Pi from the receiveQueue()
6. if node N in Relay node set() continue
7. Node act as a relay node and transmit the packet Pi to the Sink or Network coding layer

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8. else
9. Performing XOR operations
10. if senseQueue() is not empty and receiveQueue() is not empty then
11. Pick a packet Pi from the head of receiveQueue()
12. Pick a packet Pj from the heat of the senseQueue()
13 Computing Px=Pi ⊕Pj
14 else
15 if senseQueue() is empty and receiveQueue() is not empty then
16. Pick a two packets Pi and Pi+1 from the receiveQueue()
17. Computing Px=Pi ⊕ Pi+1
18.else
19. Pick a two packets Pj and Pj+1 from the SenseQueue()
20. Computing Px=Pj⊕ Pj+1
21. end if
22. if(receiveQueue()!=empty&&senseQueue()!=empty)
23. goto step10
24. if(receiveQueue()!=empty&&senseQueue()==empty)
25. goto step17
26. if(receiveQueue()==empty&&senseQueue()!=empty)
27. goto step20
28 else exit
29. end if
30. end if

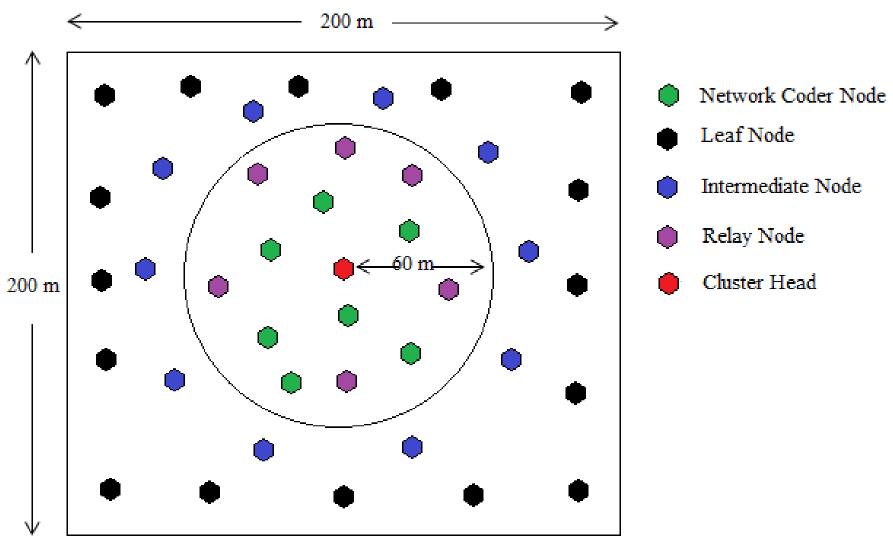

Fig. 1 A Wireless Sensor Network

Every sensor node has a number of Received queue and sensed Queue attached to it, to other nodes, more to the sink. On each sensor node the packets are arrived and depart except the Leaf (or) Terminal node and Sink node. This approach is dedicate the buffer at each node to a single FIFO queue. When the buffer occupancy exceeds a threshold the switch begins to the sensor node as an active state to do so until buffer occupancy falls below the threshold. If the buffer size below the threshold means the sensor node going to the dormant (sleep) state.

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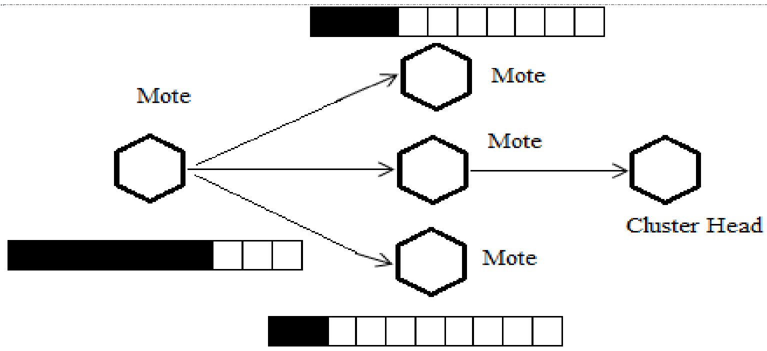

Fig. 2 Adaptive Duty Cycle Scheme

II. SYSTEM MODELLING

The lifetime of the nodes is evaluated by the overall energy consumption of the nodes such a sin [13]. If the energy consumption decreases, then the lifetime of the nodes is increased. The total energy consumed by the nodes consists of the energy consumed for receiving E_{rx} transmitting E_{tx} and sleeping E_{sleep} . The notations and values listed in Table 1 are used throughout the paper. Total energy consumed is given by

$$E = E_{rx} + E_{tx} + E_{sleep} \quad (1)$$

A device node consumes energy at completely different states, such as, sensing and generating knowledge, sending, receiving and sleeping state. During this work, the radio model [14] has been changed for a requirement cycle primarily based WSN. Energy savings area unit done at the node level through shift between active and sleep states.

Energy consumption by a supply node per second across a distance d with path loss exponent n is,

$$E_{tx} = R_d (\alpha_{11} + \alpha_2 d^n) \quad (2)$$

Where R_d is the data rate of transceiver relay, α_{11} is the energy consumption per bit by the transmitter and α_2 is the energy consumption per bit in the transmit op-amp [14]. Total energy consumption in time t by a leaf mote without acting as a relay (intermediate node) is,

$$E_l = t[p(R_sE_s + E_{tx}) + (1-p)E_{sleep}] \quad (3)$$

where E_{sleep} is the idle mode energy consumption of a sensor node per second, R_s is the sensor's average sensing rate and it is equal for all the nodes, E_s is the energy consumption of a mote to sense a bit, the probability p is the average proportion of time t that the sensor node use in active mode. Thus, p is the duty-cycle. A sensor node remains in the idle state with probability (1-p) till time t. The energy consumption per second by an intermediate node which act as a relay mote is given by

$$E_{rtx} = R_d (\alpha_1 + \alpha_2 d^n) \quad (4)$$

Where α_1 is the energy consumption by the sensor node to receive a bit. Total energy consumed till time t by an intermediate (relay) node is

$$E_i = t[p(R_sE_s + E_{rtx}) + (1-p)E_{sleep}] \quad (5)$$

The total energy consumption in the bottleneck zone in time *t* for a *p* duty-cycle network coding with duty cycle wireless sensor network is given by

$$E_d = E_{1d} + E_{2d} + E_{3d} + (1-p)tNE_{sleep} \le (NBE_b)/A \quad (6)$$

$$E_d = \left[\frac{m+1}{2}\right] tNpR_s \frac{A-B}{A}\alpha_1 \left(\frac{n}{n-1}\frac{x}{d_m}\right)\frac{1+k(h-1)}{kh} + Np\frac{B}{A}E_sR_st + p\frac{N}{A}tR_s \int\int_B^A \alpha_1\left(\frac{n}{n-1}\frac{x}{d_m} - \alpha_{12}\right) ds + (1-p)Nt\frac{B}{A}E_{sleep} \le (NBE_b)/A \quad (7)$$

Where d is node density, *B* is area of bottleneck zone and *A* is area of sensor network.

When *p*=1 and *m*=1 the energy consumption in the bottleneck zone to relay the data bits that are generated inside as well as outside the bottleneck zone becomes same as in a general or same as wireless sensor network without any duty cycle [13]. Thus, (6) also covers the general network scenario without considering duty cycle of nodes.

The lifetime of a wireless sensor network is significantly depended on the energy consumption at the node level. Let $E_{battery}$ is the initial battery energy available at each sensor node. In a network of *N* nodes, the energy reserve at the start is $NE_{battery}$.

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The performance of a wireless sensor network strictly depends on the failure statistics of the sensor nodes. The failure pattern of sensor nodes depends on the rate of depletion of energy. The network lifetime demands that the total energy consumption is no greater than the initial energy reserve in the network. The upper bound on network lifetime can be achieved when the total battery energy ($NE_{battery}$.) available in a wireless sensor network is depleted completely. The following inequality holds to estimate the upper-bound of the network lifetime for a duty cycle based wireless sensor network.

$$E_d \leq \frac{B}{A} NE_{battery} \text{Thust} \leq \frac{BdmE_{battery}}{P_x} \quad (8)$$

where the term P_x is given by

$$P_x = p\alpha_1 \frac{n}{n-1}\left[\left(\frac{m+1}{2}\right) D(A-B) + \int \int_B^A sds\right] + Bd_m\left[pR_s(E_s - \alpha_2) + (1-p)E_{sleep}\right] \quad (9)$$

The amount of energy consumption is maximum when *p=1* (i.e. all node active condition) and the lifetime minimizes in a wireless sensor network. The energy efficiency of the network increases with low duty cycle which enhances the lifetime of the network.

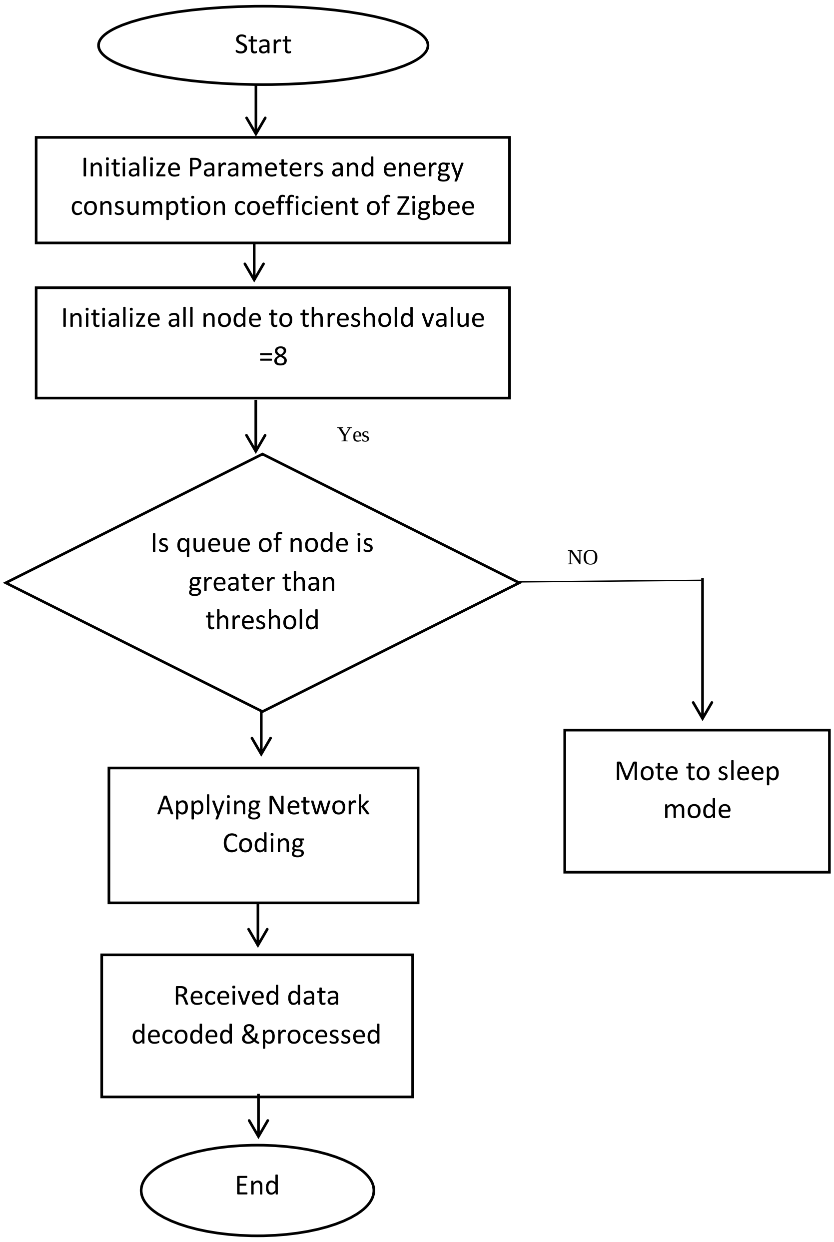

Fig.3 Flow chart of project

To improve the lifetime of wireless sensor network we used ZIGBEE module in place of RF module. Energy consumption of RF module (V=5v, I=100mA) is P=5x100=500mW and energy consumption of ZIGBEE (V=3.3v, I=20mA) is P=3.3x20=66mW. Hence ratio of energy consumption ratio is 66/500.
Transmission energy = alpha11=(66*0.937e-6)/500;
Sleep Energy will reduced approximately 40% of previous.
Esleep=(30e-6)*(40/100);

Table 1: Parameter Settings

Number of nodes (N)	1000
Area (A)	200 X 200 m2
Bottleneck Zone radius (D)	60 meter
Path loss exponent (n)	2
α_{11}	(66/500)X(0.937)µ joule per bit
α_{12}	0.787 µ joule per bit
α_{2}	0.0172 µ joule per bit
Esleep	40% of 30 µ joule per second
Eb	25K joule

III. RESULTS AND DISCUSSION

ENERGY CONSUMPTION FOR NETWORK CODED DUTY CYCLED WSN

In Fig. 4 Comparison of the Lifetime of Sensor Network for different techniques has been shown for a random duty cycle based WSN with network coding and without network coding. We observe that per node energy consumption in case of a WSN with random duty cycle is more than a WSN with random duty cycle and network coding.

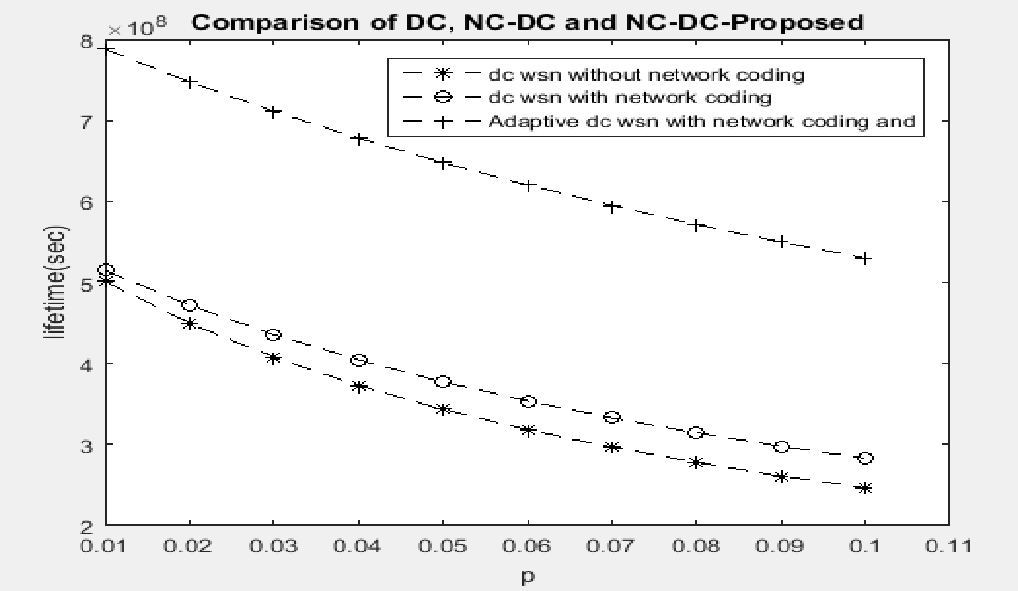

Fig. 4 **Comparison of the Lifetime of Sensor Network for different techniques**

Energy Consumption Comparison of Different Techniques

In Fig. 5 energy consumption (per node) has been shown for an adaptive duty cycle with network coding based WSN, random duty cycle with network coding based WSN and random duty cycle based WSN. The per node energy consumption in case of a WSN with random duty cycle is more than a WSN with random duty cycle and network coding. Also the per node energy consumption in case of a WSN with random duty cycle and network coding is more than a WSN with adaptive duty cycle and network coding.

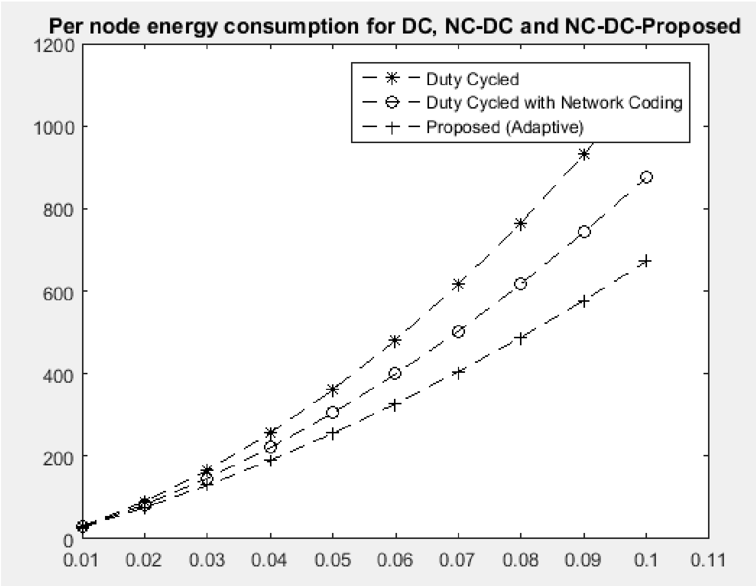

Fig. 5 Node Energy Consumption (A) Random Duty Cycle (B) Random Duty Cycle and Network Coding in aWSN (C) Adaption Scheduling and Network Coding in aWSN

Fig. 6. Represents the comparison of lifetime of zigbee based module using adaptive duty cycle and network coding with random duty cycle and network coding.We observe that lifetime of zigbee based sensor node is more than rf module nodes.

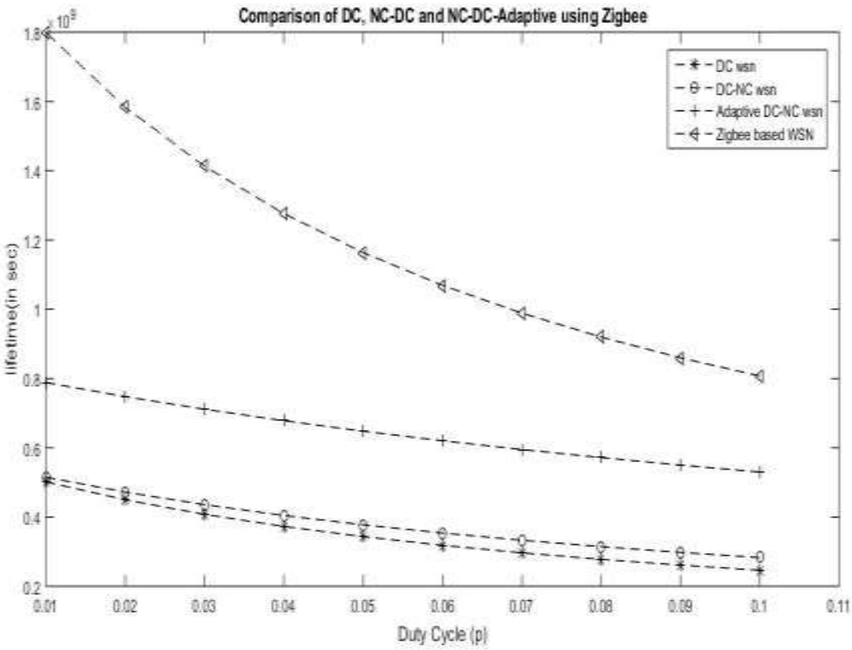

Fig. 6 Comparison of Lifetime of Basic Techniques and Proposed Technique

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Comparison table of performance analysis of different energy saving techniques are shown below:
Table – 2: Comparison of Lifetime of different techniques

S. No.	Duty Cycle	Lifetime ($\times 10^8$ sec) DC	Lifetime ($\times 10^8$ sec) NC-DC	Lifetime ($\times 10^8$ sec) Adaptive	Lifetime ($\times 10^8$ sec) Proposed
1	0.01	5.0148	5.1503	7.8820	18
2	0.02	4.4974	4.7202	7.4771	15.8
3	0.03	4.0768	4.3564	7.1117	14.1
4	0.04	3.7281	4.0446	6.7804	12.3
5	0.05	3.4344	3.7745	6.4786	11.2
6	0.06	3.1836	3.5382	6.2025	10.5
7	0.07	2.9669	3.3298	5.9489	9.5
8	0.08	2.7779	3.1445	5.7153	8.6
9	0.09	2.6114	2.9788	5.4994	8.3
10	0.1	2.4638	2.8297	5.2991	8.1

IV. CONCLUSION

Final results of lifetime is shown in Fig. 6 and table 2. According to results it can be conclude that after applying energy saving technique an increase in network lifetime is recorded. In case of adaptive node scheduling an improvement of 10.5% is analyzed. Finally when ZIGBEE module is used as trans-receiver in place of other radio trans-receiver increment of 120% is observed. Hence use of Zigbee module is better option as compared to any other radio technology.

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