A Delay Reduced Scheduling Approach for Fast Spectrum Access in Cognitive Radio

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***Abstract* - the mounting demand of wireless systems has put a bunch of restrictions on the usage of existing radio spectrum which is limited and expensive resource. Cognitive radio networks (CRN) have emerged as a capable, yet exigent, solution to improve spectrum utilization; credit to the technology of cognitive radios Cognitive radio has been documented as a promising mode to get better spectrum efficiency of wireless communication by exploiting underutilized approved spectrum in temporal, frequency and spatial domains. Cognitive radio intention is to use sparse and limited natural resource proficiently without interrupting the task of licensed users. The data or information is being transmitted in a timely approach in many wireless service applications. In cognitive radio networks, the users experience a delay during the switching to different frequency bands. The planned system addresses this delay as a scheduling trouble. In the Wireless sensor Networks when we distributed the packets while scheduling, there is always energy utilization & delays issues in the data transmission from one end to the other. It is vital that those packets should be scheduled first having highest priority, and the packets that should scheduled at last having lowest priority, means that the order of packets should be accurate . The algorithm used in this work aims at sinking the end-to end delay, and at the equivalent time dropping the ruin of throughput using a dynamic programming approach.**

***Index Terms* - cognitive radio, scheduling, waiting time, turnaround time, delay.**

I. INTRODUCTION

The extensive growth of wireless communications leads to the lack of frequency spectra and available radio spectrum which is a partial natural resource, being crammed day by day. Many of the preallocated frequency bands are sarcastically under-utilized, the resources are simply washed out. It has been found that the allocated spectrum is underutilized for fixed allocation of the spectrum [2].

The conservative approach to spectrum management is not elastic. To operate, every wireless operator is assigned a one and only license in a certain frequency band [1]. It is difficult to find vacant bands to organize new services and boost existing ones. We need an enhanced utilization of the spectrum to beat this situation, which will create opportunities for Dynamic Spectrum Access (DSA) [2]. “Cognitive Radio” is a probable way out which is a technology or radio[3], having the capability to sense and is fully sensitive of its functioning condition and can adjust its operating parameters . Cognitive radio adapts the surroundings conditions by analyzing, observing and learning, and makes use of this investigation for future decisions.

Cognitive radio (CR) is a capable solution for proficient consumption of radio resources. The main proposal of cognitive radio is to permit a class of radio devices, called secondary users (SUs), to opportunistically admittance certain portions of spectrum, and called white spaces that are not occupied by licensed users. The white space can be linked with a specific frequency carrier, time slot, or spatial direction [2]. In applications where the primary link occupies intact frequency band and is intensively active, an efficient approach to progress the spectrum efficiency is to discover the white spaces in spatial domain. In general, the selection of SUs is under one of the following two ideology: 1. the SUs who create least interference on primary receiver (PR) are selected; 2. The SUs who achieve the utmost throughput for the secondary network are selected, while maintenance the interference on PR under certain constraints.

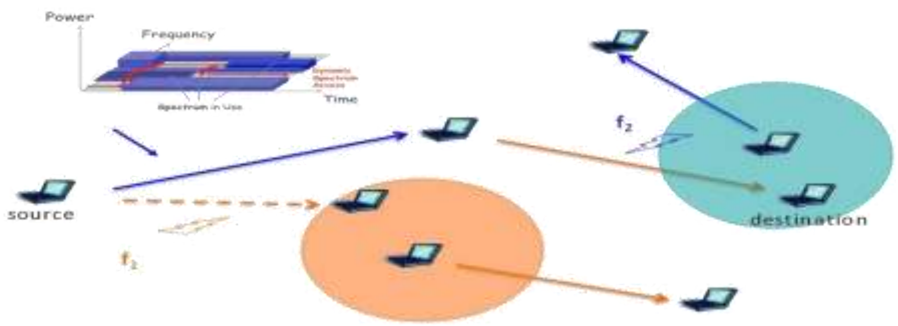


Figure 1 wireless network

The wireless network is the network where there is assortment of thousands of nodes that are related to each other. The main concern in the wireless sensor network is of expenditure of lot of energy and the hindrance of the data that is transmitted over the network. It's all about time that is taken to deliver the packet to the other node in wireless sensor networks. So here time is very important factor. Timing constraints are very vital in many wireless sensors networks applications and while designing packet scheduling schemes for such applications it should be taken into deliberation. To diminish the time we have to spotlight on the priority given to the packets [21]. The mechanisms for bandwidth allotment and multiplexing at the packet level are provided by the scheduling algorithms. Guaranteed QoS is also provided by certain scheduling algorithms.

II. REVIEW OF COGNITIVE RADIO

The main requirements for cognitive radio system performance are: primary user detection and power control method which is also required that assures trustworthy communication between cognitive radio terminals and non-interference to primary users CR can sense its environment and, without the intervention of the user.
The cognitive radio is an "intellectual radio" in the sense that it can sense channels that enclose signals from a huge class of various devices, networks, and services. On the foundation of this sensing, the radio will implement sophisticated algorithms to share the restricted bandwidth channel with other users in order to achieve proficient wireless communication [8].
The basic functions of cognitive radio as follows:

A. Spectrum Sensing*:* The first step of spectrum sensing is determines the existence of primary user on a band. After sensing the spectrum, cognitive radio shares the result of its detection with other cognitive radios. The ambition of spectrum sensing is to find out the spectrum status and activity by occasionally sensing the target frequency band [12]. Mainly, its transceivers observe the spectrum and determine which is unused or vacant band in that spectrum and also determines method of entrance without snooping the transmission of licensed.

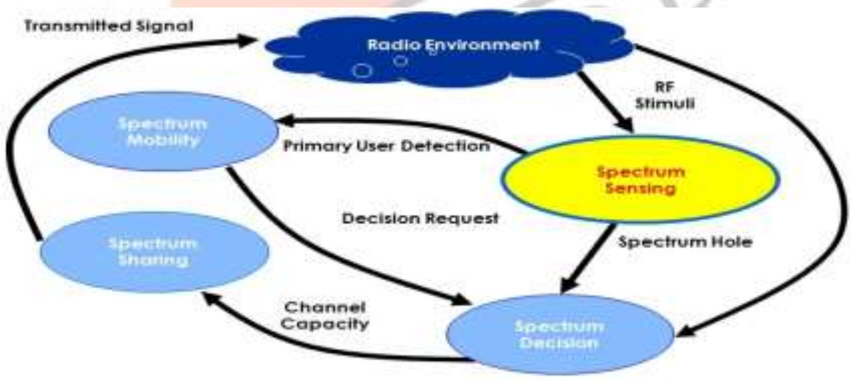


Figure2. Basic cognitive radio cycle

B. Spectrum management**:** It provides the reasonable spectrum scheduling method among coexisting users. If any available white space is found, it is immediately selected by cognitive radio. This property of cognitive radio is described as spectrum management [10]. It is also responsible for Spectrum Analysis which makes possible the categorization of different spectrum bands, which is demoralized to get the spectrum band suitable requirements of the user. Spectrum decision is also fall in spectrum management which refers to a cognitive radio decisions like the data rate, transmission mode, and bandwidth for the transmission. Then, according to the spectrum individuality and user necessities suitable frequency band in spectrum is preferred.

C. Spectrum Sharing**:** One more function of cognitive radio is spectrum sharing [5] which assigns the idle spectrum to the secondary user (SU) only when the primary user (PU) does not use it. There are mainly two functions under which they performed which are Underlay Spectrum Sharing and Overlay Spectrum.

***D. Spectrum Mobility*:** Cognitive Radio (CR) has to leave the channel immediately when a licensed user is found. This function of cognitive radio is called handoff. Spectrum mobility is the process that allows the Cognitive Radio user to vary its operating frequency [12]. This function has to be performed in real time in order to evade interference to primary licensed user, therefore cognitive radio has to persistently examine possible unusual spectrum holes.

III. SCHEDULING IN COGNITIVE RADIO

Scheduling is the scheme by which work specified by several means is assigned to resources that complete the work [3]. The work may be effective computation elements such as threads, processes or data flows, which are in turn scheduled onto hardware resources such as processors, network links.

A scheduler may intend at one of many goals, for instance, maximizing *throughput* i.e. the whole amount of work completed per time unit, minimizing *response time* which means time from work becoming enabled awaiting the initial point it begins implementation on resources, or minimizing *latency* i.e. the time among work becoming enabled and its subsequent completion, maximizing *fairness* which is usually suitable times according to the precedence and workload of every one process [5]**.** Many of wireless services exhibit different requirements to delay, probability of packet-loss, different QoS requirements; and throughput. Scheduling plays a vital role in reducing end-to-end data transmission delays in wireless applications. The different algorithms examined are the usual First-In-First- Out (FIFO) algorithm, the Strict Priority (SP) which is a queuing algorithm, the Deficit Round-Robin (DRR) algorithm and finally the Deficit Weighted Round-Robin (DWRR) algorithm Scheduling algorithms are essential gears in the terms of guaranteed quality of service parameters[15][21].

A. *Scheduling Types*

1) Static scheduling schedule tasks in acknowledged environment i.e. it previously has the information about entire structure of tasks and mapping of resources prior to implementation, estimates of task completing/running time [5].
2) Dynamic scheduling must depend on not only the submitted tasks to cloud surroundings but also the up to date states of system and computer machines to formulate scheduling judgment.

B. Scheduling schemes and Factors

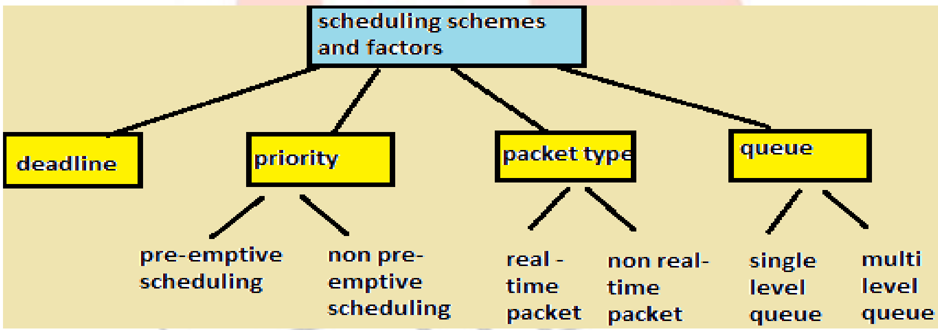
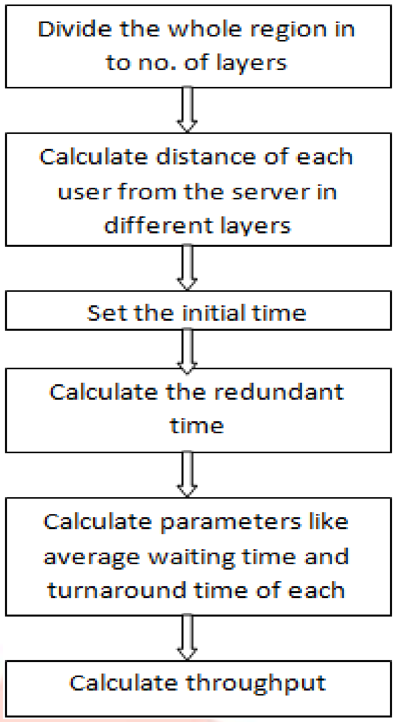


Figure 3. Scheduling schemes and factors

IV. PROPOSED ALGORITHM

As scheduling algorithms in cognitive radio network mostly focus on scheduling of system on random basis or depends on whether the spectrum is available or not. So to update this system a dynamically operated scheduling methodology will be implemented to operate as per demand of the users for using the spectrum available without affecting the primary user in the network. This approach will mainly focus on working for random as well as dynamically approach to make it self-operated as well as user requirement oriented.
The existing work assumes that no delay occurs when an SU switches from individual frequency to a new frequency but in actuality, some fraction of the subsequent time slot is inevitably wasted to tune to the new frequency. The main aim of proposed algorithm which is based on layered structure with distance calculation is to reduce Delay, average waiting time, average turnaround time and maximize the throughput.
Throughput can be defined as the number of processes that completes the execution per time unit.
Turnaround time is the time of a process can be given as the period from the time of submission of a process to the time of finishing point.
The waiting time is the time in which a process waits in the standing by queue to attain the processor.

Proposed section 1



Proposed section 2nd of dynamic approach

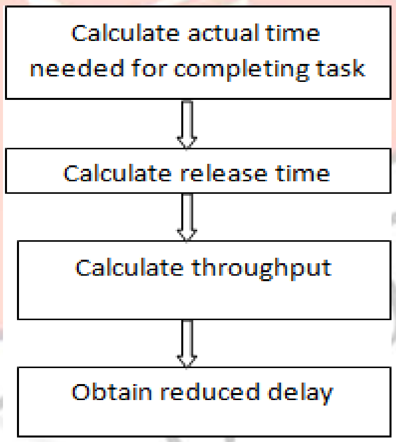


Figure 4. Flow chart of proposed work

V. METHODLOGY

The methodology of the proposed work is defined below. The proposed methodology is divided into two sections. In first section the scheduling is done on the basis of the time calculation of each user from server with layered structure and in second section the dynamic approach based on distance calculation is proposes that will help in reduction of energy and thus increasing the life time of the network .

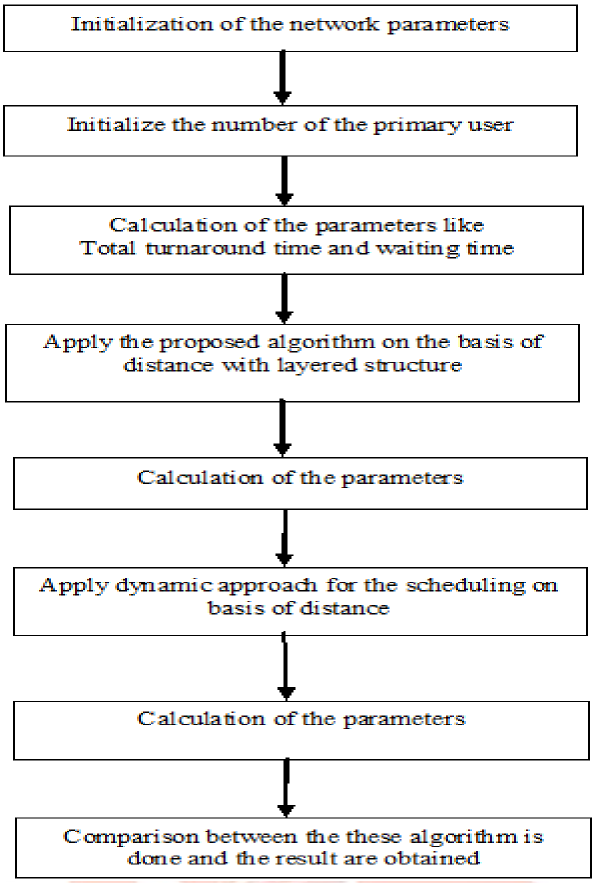


Figure5. Methodology of proposed work

VI. SIMULATION RESULTS

The simulation results presents the comparison between opportunistic scheduling and proposed scheduling which is based on distance based priority with layered structure, In this paper distance based dynamic scheduling is analyzed and compared with the old approach.
The comparison is made by using three parameters that are Average waiting time, average turnaround time and throughput. In this work, three methodologies which are old approach with opportunistic scheduling, Adv 1 which is based on layered structure approach and Adv2 which depends on dynamic approach based on distance are compared.
This work is concluded that proposed dynamic approach for scheduling is better than old approach having maximum throughput, minimum average waiting time, minimum average turnaround time and reduced delay.

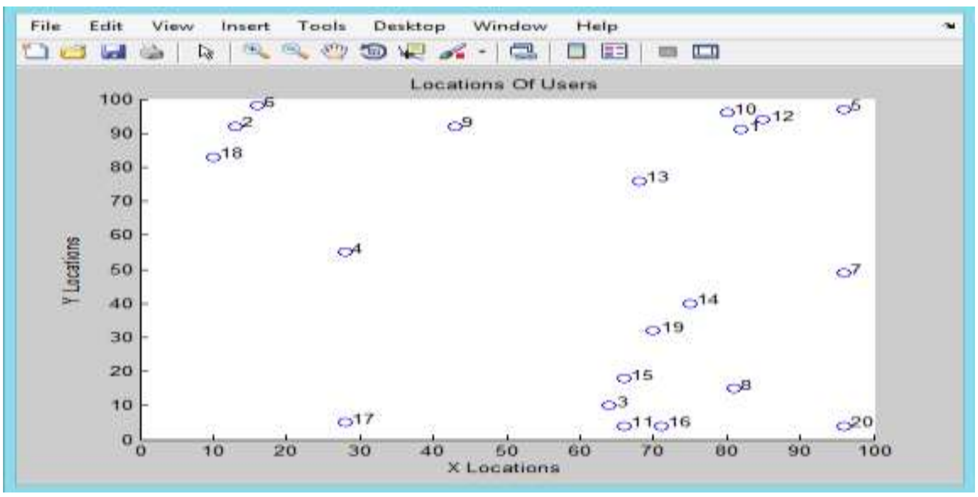


Figure6. Location of users in area of working

This above figure represents the region in which primary (licensed) user are placed at different locations. In this area 12 primary users are placed at different frequency band.

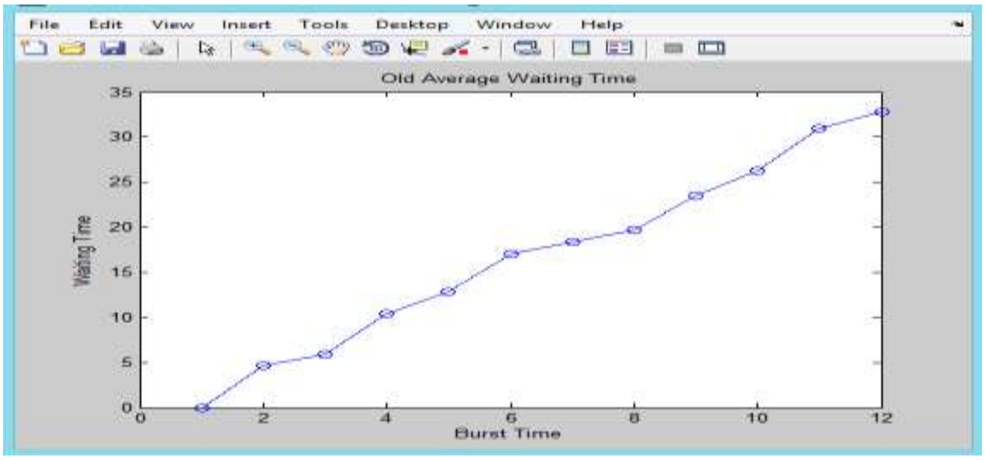


Figure7. Average waiting time

The above figure describe average waiting time of old approach of all 12 users which is 16.85 after calculated.. Burst time is the time of each user to transmit their data. Waiting time is calculated from total time and burst time.

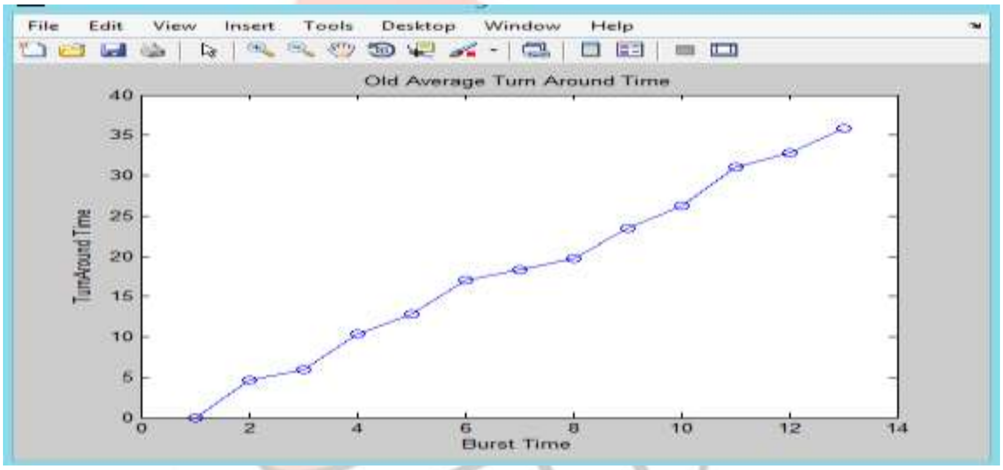


Figure8.   Average Turnaround time

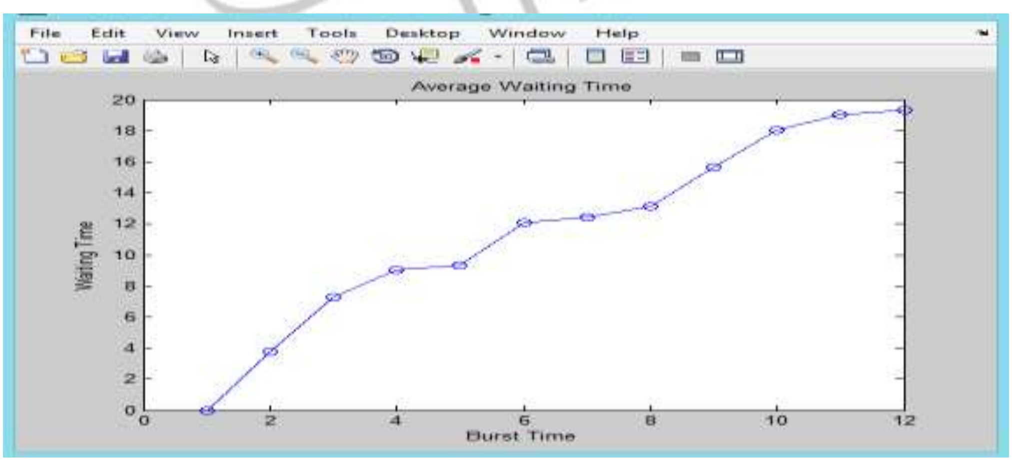


Figure9. Average Waiting Time with layered structure based approach

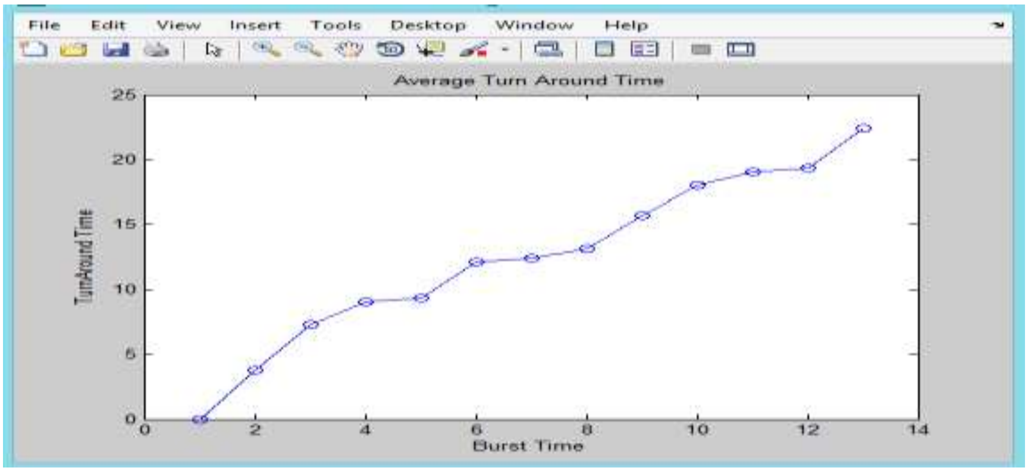


Figure10. Average Turnaround time with layered structure based approach

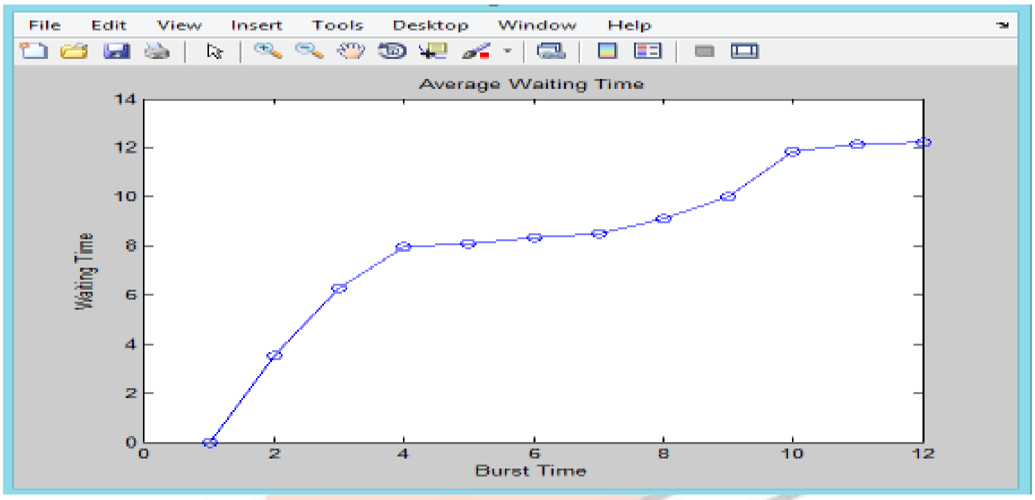


Figure11. Average Waiting Time with dynamic distance based approach

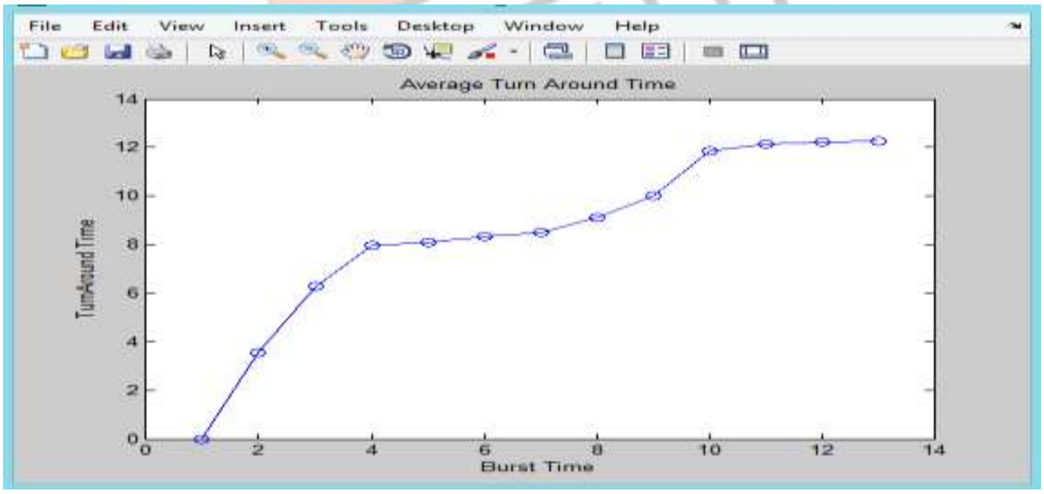


Figure12. Average turnaround Time with dynamic distance based approach

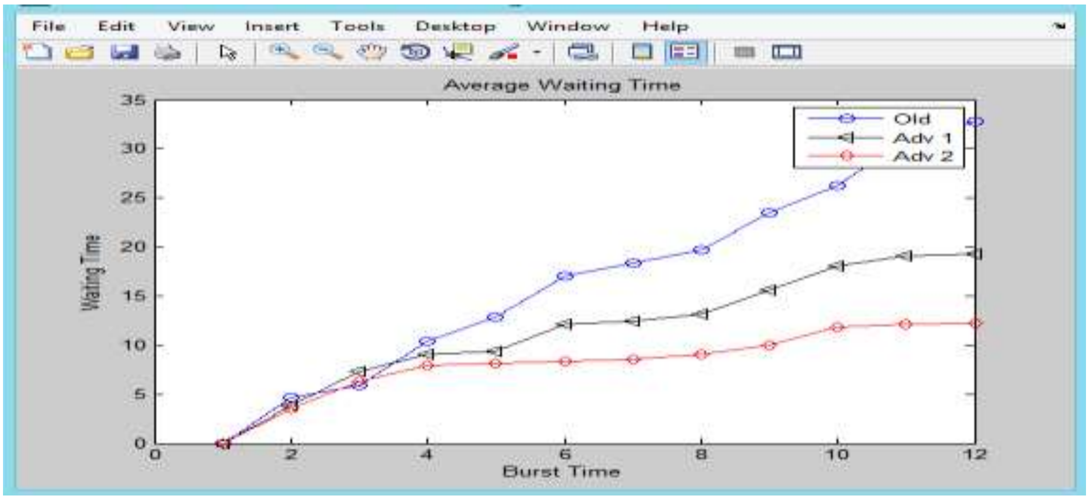


Figure13. Comparison of average waiting time between all approach used for scheduling

This above figure gives the comparison between all three approaches showing that dynamic approach is better than others with less waiting time.

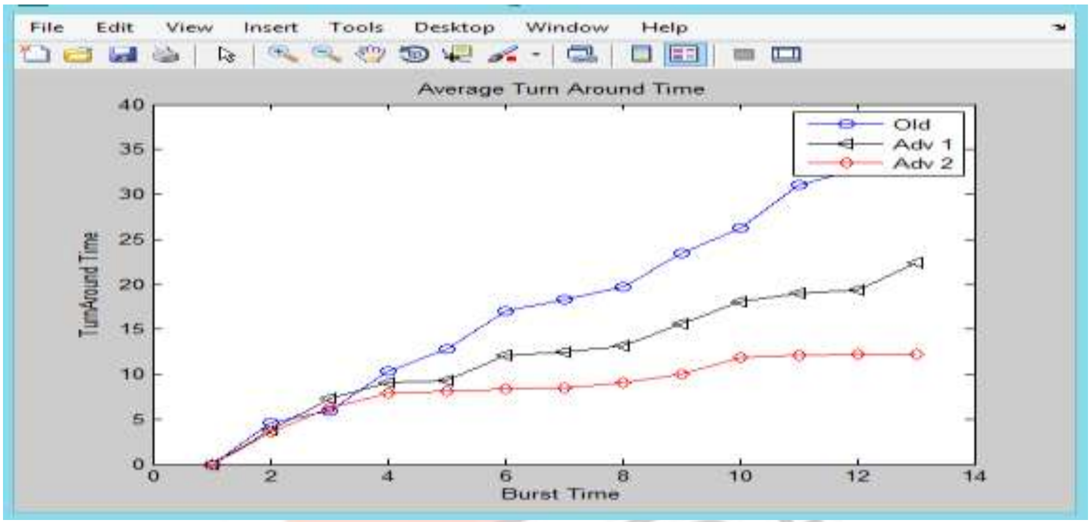


Figure14. Comparison of average turnaround time between all approach used for scheduling

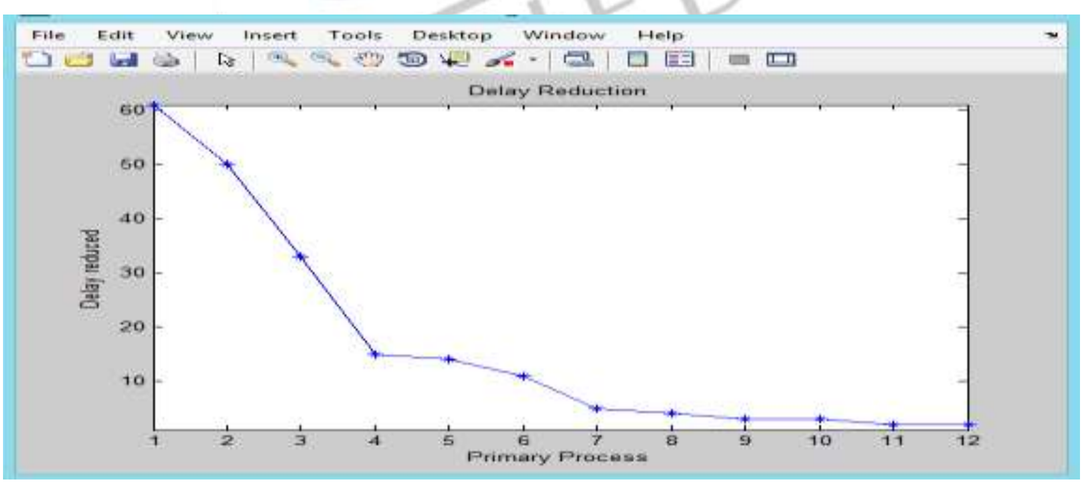


Figure15. Delay reduced using dynamic approach scheduling

This figure depicts that delay is reduced as one can go from process 1 to process 12.at the end of processes the delay is completely reduced with distance based dynamic approach.

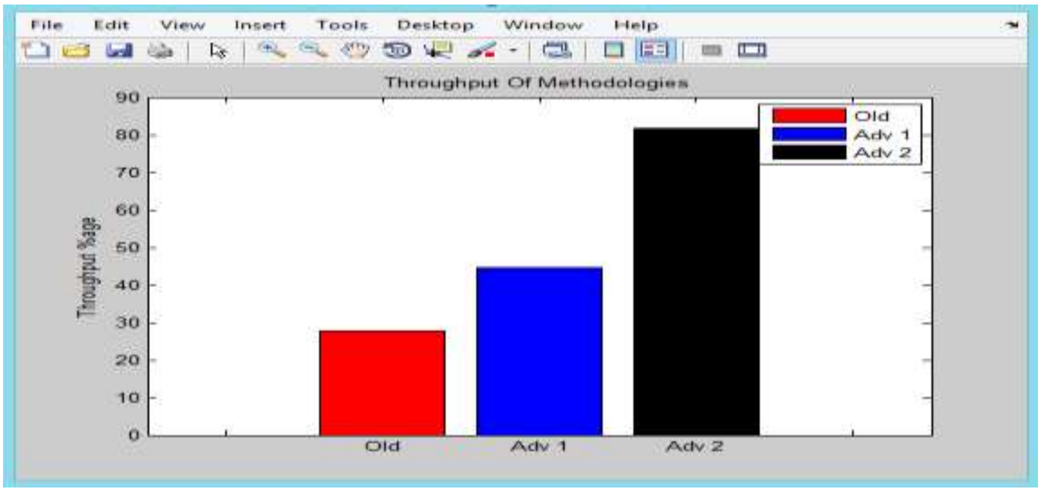


Figure16. Throughput of three methodologies

This figure illustrate that the throughput of dynamic distance based approach is better than old approach having value81.632%

parameters	Old approach	Adv 1(layered structure)	Adv 2(dynamic distance based approach)
Average waiting time	16.85	11.59	8.17
Average turnaround time	18.31	12.42	8.48
Throughput(%)	27.894	44.642	81.632

Figure17. Comparison table between all approaches

The above figure depicts the values of parameters in different approaches used for scheduling. It is clear from that table that dynamic approach of scheduling is much better than old approach which is random approach having maximum throughput, minimum waiting time and minimum turnaround time.

VII. CONCLUSION

Wireless networks are always better and more useful than wired networks as one can use wireless sensor applications for real time applications. For proper and reliable delivery of real time data, the efficient technique should be used for scheduling the various packets during transmission. The technique for scheduling with less delay and less energy consumption in sending and receiving packets should be preferred. Each scheduling algorithm is having its own merits and demerits. The proposed algorithm overcomes the disadvantages of existing scheduling algorithms like high average waiting time, high average turnaround time, low throughput and delay.

In this proposed work a new method is proposed for the scheduling for the node for the data transmission in the network. The time and the energy are two main factors that area taken in consideration while the data is transmitted from the source to the destination .So in this way the energy consumption is also reduced and the time consumed for the process completion is also reduced. . From the result obtained it is concluded that this proposed method is efficient and better than the traditional algorithm for the data transmission.

VIII. FUTURE SCOPE

The algorithm that is proposed in this work is considered to be better than the traditional used algorithm as it consider the energy consumption of the system is reduced so the life time of the network is increased. So in future this technique can be further enhanced by using considering more parameters for the scheduling. Along with this the algorithm that minimized the energy consumption and time utilization for transmitting the data needs to be proposed.

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