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Design an Optimized Technique for Optimal Energy Utilization Based Upon Fading Channels

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Abstract— ***Wireless sensor network (WSN) refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. In case of the proposed approach with the low energy in the subset of network the neighbor nodes of the subset can cover the area of the died node. The proposed approach is defined on the basis of Ant Colony Optimization using which the algorithm become more energy efficient. In this way the data dropped due to the replacement of the subset may be reduced so there is a reduction in the energy dissipation. Using this approach the data dropped and other Quality parameters are also improved like, delay, load and throughput etc as defined in results and discussion.***

Keywords— ***WSN, RFD, Routing in WSN***

I. INTRODUCTION

Wireless sensor network (WSN) refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure the environmental conditions like temperature, pollution levels, sound, humidity, pressure, wind speed and direction, etc. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (sometimes several) sensors. Each such sensor network node has several parts: a radio transceiver with an external antenna or connection to an internal antenna, an electronic circuit for interfacing with the sensors and an energy source, a microcontroller, usually a battery or an embedded form of energy harvesting. A sensor node may vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions were created. The cost of sensor node is similarly variable. It may range from a few to hundreds of dollars, depending on the complexity of the individual sensor node. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as memory, energy, communications bandwidth and computational speed. The topology of the Wireless Sensor Networks can vary from a simple star network to an advanced multi-hop wireless mesh network.

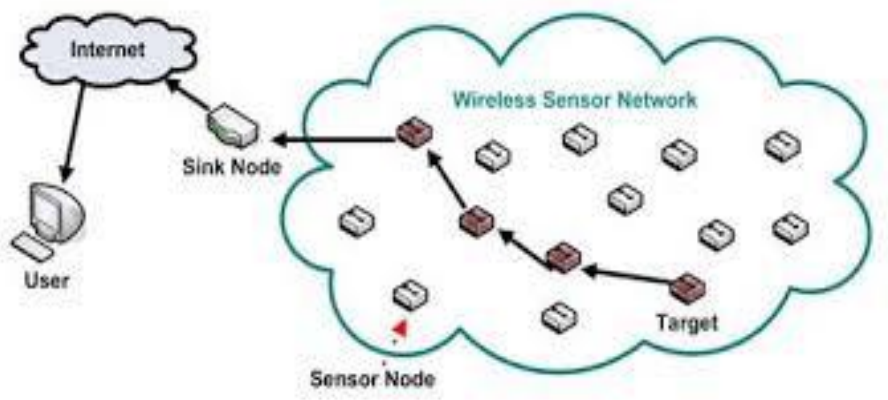

Fig 1: Wireless Sensor Network

II. COMPONENTS OF WSN

Sensor Node:

Sensor nodes are generally consist of few sensors and processing unit/mote as shown in figure: 2. a sensor is device which senses the information and pass it on to mote. Sensor are typically used to measure the change in physical environmental parameters like temperature, pressure, humidity, sound and change in the health parameter of person e.g. heartbeat and blood pressure.

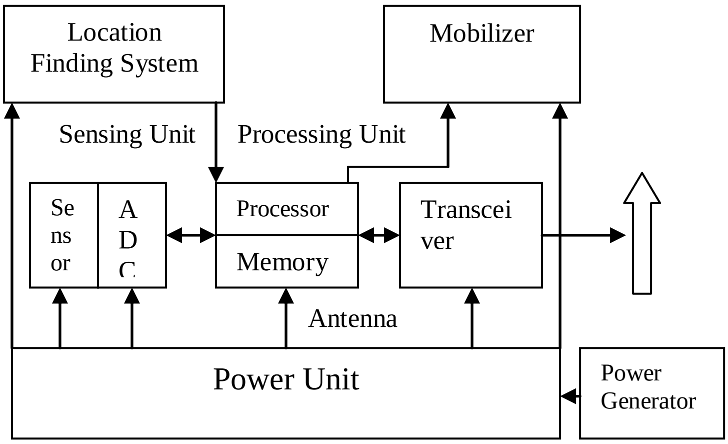

Fig 2: Block diagram sensor networks

Base Station:

Different wireless sensor network are connected with base station. It consists of a microprocessor, antenna, radio board and USB interface board. For communication with wireless sensor nodes, Base station is pre-programmed with low-power mesh networking software. As all the sensor nodes handover their data to base station so it is very important to deploy base station in wireless sensor network. Further this data is analysed at base station for processing and decision making. During deployment of base station in sensor network coverage of sensor nodes, Energy conservation and reliability issues are taken care of. Generally base stations are assumed static in nature but in some scenarios, they are assumed to be mobile to collect data from sensor nodes.[2]

Fig 2 is a block diagram, depicting different components in a Distributed sensor network from operating point of view. The primary goal of sensor networks is to make decisions or acquire knowledge based on the information fused from distributed sensor nodes. In the bottom, sensor node collects data from different sensing events or conditions. An initial data processing such as data aggregation can be carried out at the local node to generate local event detection result. These intermediate results will then be integrated/ fused at an upper processing unit to derive knowledge and help making decisions.[3] With the size of sensors getting shorter and the price of nodes getting cheaper, more sensors can be deployed to achieve quality through quantity. On the other hand, sensors typically communicate through wireless communication media where the network bandwidth is much lower than for wired communication media. These issues bring new challenges to the design of DSNs: the communication bandwidth for wireless network is much lower; data volumes being integrated are much larger; the power resource on each sensor is quite limited; fourth, the environment is more unreliable and unsecure, causing unreliable network connection and increasing the similarity of input data to be in faulty.[3]

III. RELATED STUDY

Wireless Sensor Networks (WSNs) are extensively used in numerous real time applications such as military, medical, disaster detection, structural monitoring, etc. These WSNs contains huge set of small sensor nodes, deployed in the environment for monitoring environmental parameters such as humidity, temperature, pressure, etc. The wireless sensor nodes sense the data from environment based on the application and forwards to the central base station or sink for further processing. This process is called data collection, which is the primary task of the WSNs. In data collection process, the sensor nodes forward the data to the central base station either by direct communication or by multi-hop communication. The direct communication from sensor nodes to base station is energy expensive due the distance between sensor nodes and base station is more, this reduces the lifetime of the network. Alternatively, Multi-hop communication schemes are used for better network lifetime and performance due to its effective utilization of resources. In multi-hop communication, every sensor node is busy in forwarding the sensed/received data to nearest intermediate (neighbor) nodes or to the base station using multi-hop routing paths. In this process, selection of next (neighbor) node in routing path is very important for forwarding data. The next node or forwarding node in the routing path is not only meant for relaying the data, but also useful for aggregating the data. Data aggregation or Data fusion techniques are used to shrink the size of the data packet to be transmitted to next node by aggregating the data or by eliminating similar data, received from previous nodes. Multi-hop techniques improve the energy conservation of node and the lifetime of the network. Swarm intelligence is one of the mechanism used for finding the suitable nodes in the routing path between sensor nodes and the base station. In WSNs, swarm intelligence mechanisms such as ant colony, bee colony, etc., are already used to elect the next node in the routing path.[1] A nature inspired mechanism known as River Formation Dynamics (RFD) can be introduced in WSNs for suitable node selection in multi-hop routing. RFD mechanism is free from local cycles and this is one of the facts making it suitable for path finding in WSNs. Applicability of RFD mechanism in path finding for WSNs is explored. The two parameters hop count distance and residual energy are used by RFD for selecting the suitable nodes. The proposed mechanism is called as RFDMRP (River formation Dynamics based Multi-Hop Routing Protocol). RFDMRP is implemented using MATLAB and performance is analyzed and compared with the existing algorithm such as LEACH and MODLEACH. The metrics network lifetime and energy consumption are used for comparison.[1]

IV. ROUTING SCHEMES IN WSN

Routing can be defined as a process [9] of finding a path between the source node and the sink or destination node to perform data transmission. In WSNs the network layer is oftenly used to implement the routing of the incoming data. As we know that generally in multi-hop networks the source node cannot reach the sink node directly. So, intermediate sensor nodes have to forward their packets to the destination nodes. The formation of routing tables gives the solution. These contain the lists of node option for any given packet destination. Routing table is the task of the routing algorithm along with the help of the routing protocol for their construction and maintenance [2].

According to previously done research work WSN Routing Protocols can be classified [7] into five ways, according to the way of establishing the routing paths, according to the network structure, according to the protocol operation, according to the initiator of communications, and according to how a protocol chooses a next-hop on the route of the forwarded message, as shown in Figure 3.

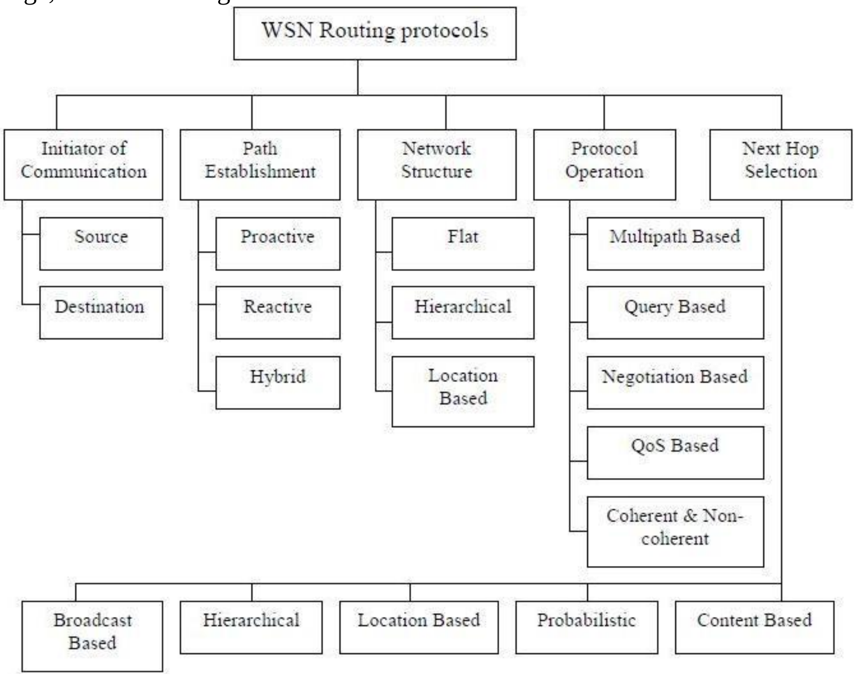

Fig 3: WSN Routing Protocols Classification

V. RIVER FORMATION DYNAMICS

RFD is one of the heuristic optimization method and a subset topic of swarm intelligence. RFD is based on replicating the concept of how water drops combine to form rivers and rivers in turn combine to join the Sea by selecting the shortest path based on altitudes of the land through which they flow. In the process of river formation, the water drops are always flowing from higher altitude position to lower altitude positions. Since, the slope of the two positions is more, then the water flowing from higher positions to lower positions erode and carry the eroded soil to be deposited in the lower positions. By this deposit the altitude of the lower position get increased. Also shortest path is formed from higher to lower position.[1]

The process of RFD mainly consist of two stages viz., Initialization stage and River formation stage. In initialization stage, three different positions (called water drop generating positions or Source (S), intermediate positions (I), and destination (D) or sea) are initialized. All these positions are represented with different altitude value (S and I are represented with positive altitude values and D is represented with Zero). The water drop generating positions always generates water drops. The intermediate positions receives the water drops from source and forward towards the Sea. In river formation stage, the river is created between drop generating positions and Sea using the iterative process having the functions select−Forward−Position(), move−Drops(), erode−Path(), and add−Sediments(). The iterative process is repeated until either all drops follow the same path or satisfying the other ending conditions such as limited number of iterations, limited execution time. There is similarity a between RFD and data collection processes in WSN. In RFD, the source (drop generating) positions generate water drops and these water drops are interested to meet the destination or Sea. Similarly, in WSN data collection process, the sensor nodes generate the data and this data is interested to reach the base station. Hence, the sensor data act like water drops, the source positions like sensor nodes, and base station as Sea. The drops are combined and flows from source to sea to form the rivers based on altitude value of position in RFD. In the same way to forward the data in WSNs, the sensor nodes can form a path to the base station based on hop-count and residual energy.

VI. METHODOLOGY

Initially, in this stage, all the sensor nodes are randomly placed in the environment depends on the application. All nodes in the network compute its hop count distance from the BS. For calculation of hop count, BS broadcasts the Beacon message containing its identity. The node, which receives the Beacon signal responds with its id and its location coordinates. BS calculate the hop count from each node using the node coordinates and send the hop count value to nodes.

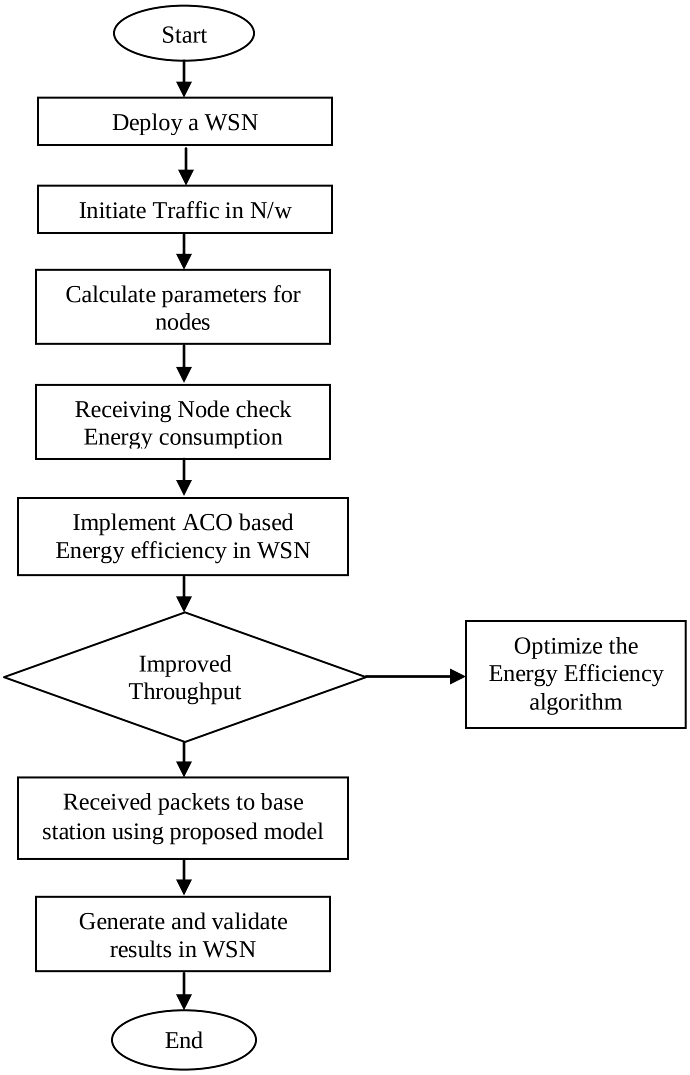

Fig 4: Flow Chart

Each sensor node stores hop count value in Neighbor Node information table (NN table). The NN table consist of Next−Node, Hop Count between Next node and BS (HC−BS), Neighbor Node Remaining Energy (NNRE), Distance (Distance between source node and next node), and Distance from next node to BS (D−to−BS). To calculate the neighbor node information, source nodes (Src−ID) sends a REQUEST packet to the neighboring nodes. The neighboring (Dest−ID) node upon receiving REQUEST packet, search in its NN table for HC−BS, NNRE, and Coordinates. Then, it replies with the REPLY packet to the source node (Src−ID) then source node updates its NNtable. The format of REQUEST and REPLY packets.

VII. RESULTS

In current chapter with the help of comparative study, we can draw all the pros and cons of the above defined scheduling schemes. In this scenario a comparison is made between hybrid routing schemes by taking 25 subscriber stations which is shown below.

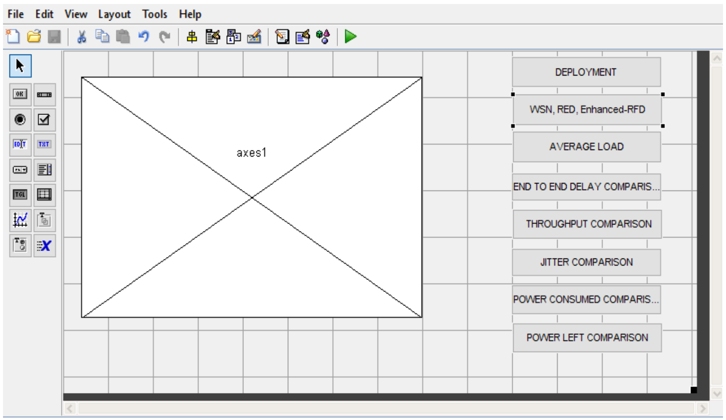

Fig 5: Simulation Setup

Fig 5 is the simulation setup for operation of RFD and Enhanced RFD protocol. In the deployment phase the WSN nodes will be deployed in the area defined that is 400*400 units. The results are compared using the paramteres i.e. load, delay, throughput, jitter, power consumed and power residual.

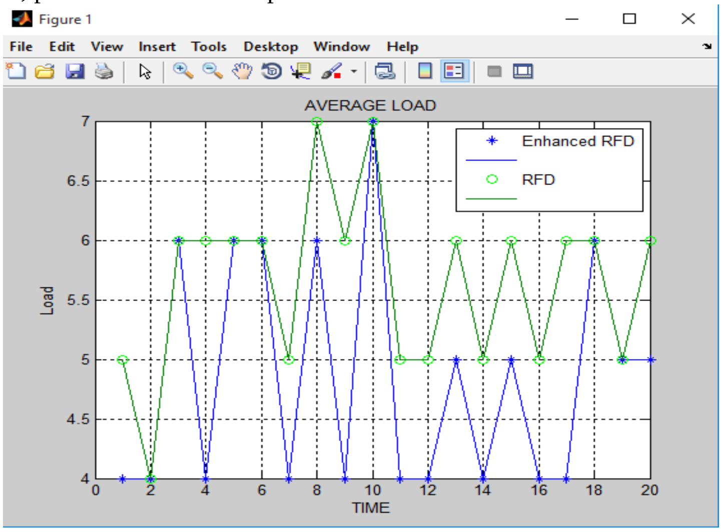

Fig 6: Average load

Load: The load in two WSN protocols called RFD and enhanced RFD in 25 nodes. From the above graph it is shown that the load in proposed approach is less than that of existing approach.

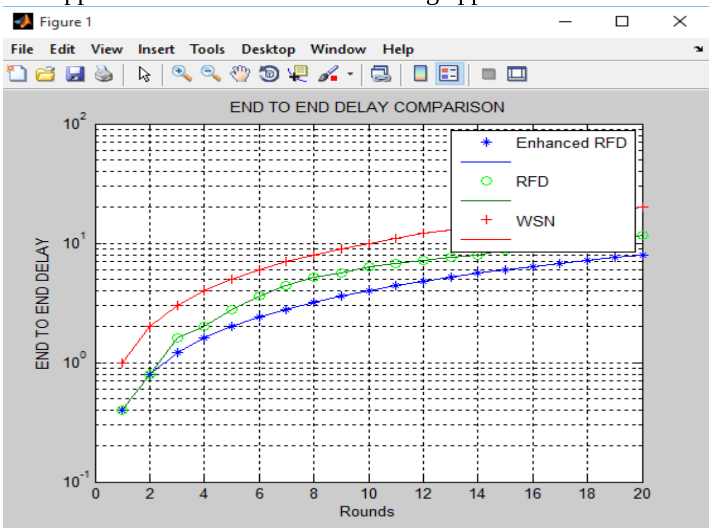

Fig 7: Delay

Delay: Delay in enhanced RFD and RFD in WSN in 25 nodes. From the graph it can easily depicted that the delay in enhanced RFD is less than that of existing RFD protocol.

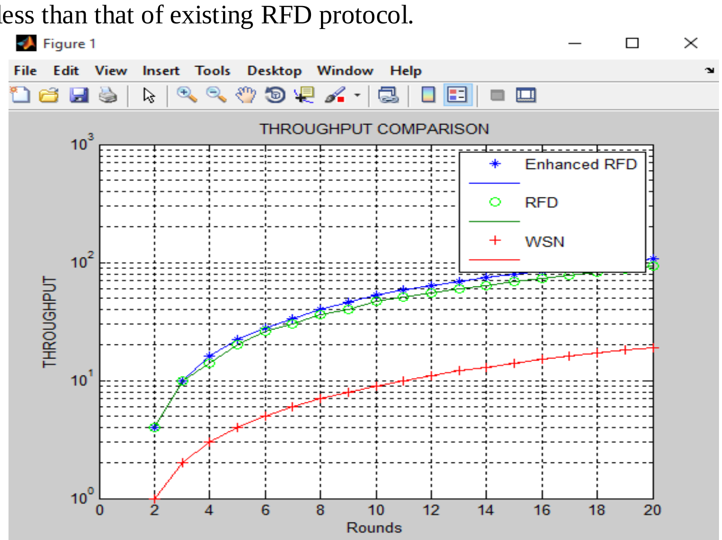

Fig 8: Throughput

Throughput: Throughput in enhanced RFD and RFD in WSN in 25 nodes. From the graph it can easily depicted that the throughput in enhanced RFD is less than that of existing RFD protocol. Throughput in case of proposed case is approx 110 packets and in existing case it is approx 100 packets.

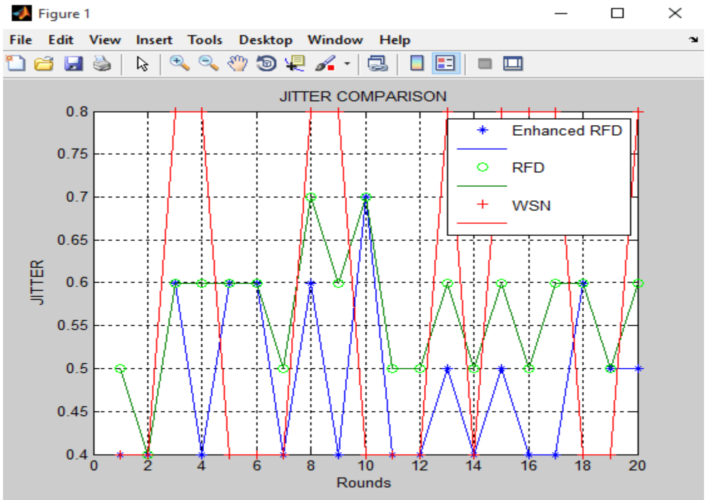

Fig 9: Jitter

Jitter: Jitter in enhanced RFD and RFD in WSN in 25 nodes. From the graph it can easily depicted that the jitter in enhanced RFD is less than that of existing RFD protocol. Jitter in case of proposed case is approx 3.5 sec and in existing case it is approx 7 sec.

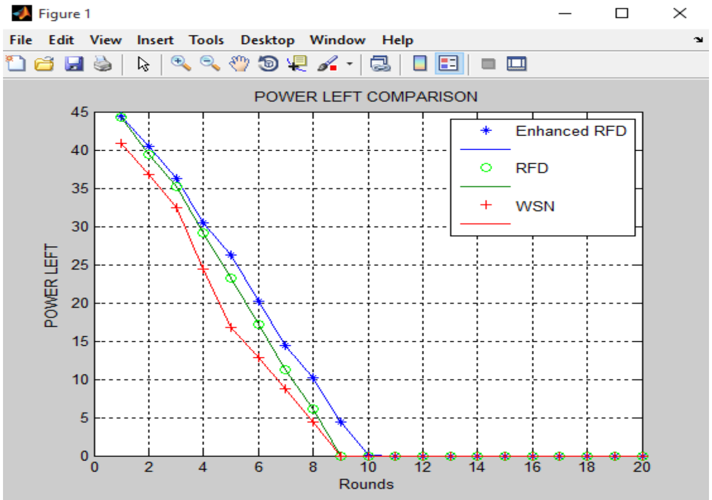

Fig 10: Power Left

Power Left: Power Residual in enhanced RFD and RFD in WSN in 25 nodes. From the graph it can easily depicted that the residual power in enhanced RFD is more than that of existing RFD protocol. Residual power in case of proposed case is retained upto approx 10 rounds and in existing case it is approx 8 rounds.

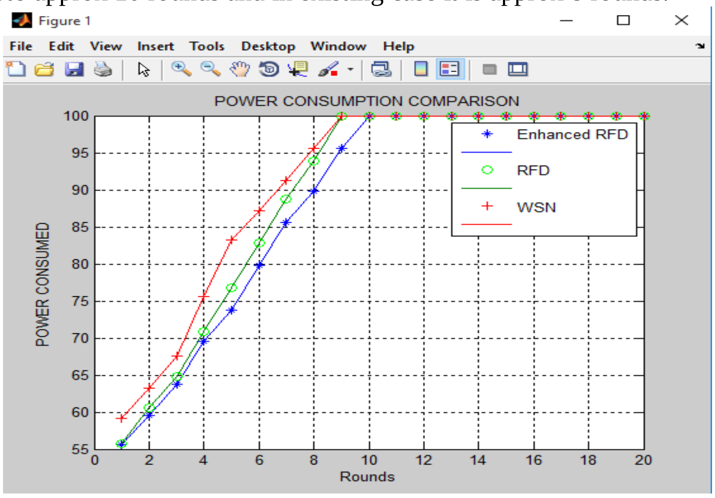

Fig 11: Power Consumption

Power Consumption: Power Consumption in enhanced RFD and RFD in WSN in 25 nodes. From the graph it can easily depicted that the residual power in enhanced RFD is more than that of existing RFD protocol. Residual power in case of proposed case is retained upto approx 10 rounds and in existing case it is approx 8 rounds.

Table 5.1 Comparative study of various parameters for both algorithms

Algorithm / Parameters	RFD	Enhanced RFD
Delay(sec)	80	60
Throughput(packets)	100	110
Residual power	8 rounds	10 rounds
Jitter(sec)	7	3.5
Average Load(bits/sec)	7000	6000
Power Consumption	8 Rounds	10 rounds

VIII. CONCLUSION

In the proposal an approach is defined for energy efficiency and reduction in data dropped in the WSN network. In RFD algorithm a subset is defined, in which if a single node in that subset is died out then the whole subset have to be replaced. A modification in the RFD algorithm is made to achieve the objectives of the research in which an energy threshold set for each node. In case of the proposed approach with the low energy in the subset of network the neighbor nodes of the subset can cover the area of the died node. In this way the data dropped due to the replacement of the subset may be reduced so there is a reduction in the energy dissipation. Using this approach the data dropped and other Quality parameters are also improved like, delay, load and throughput etc as defined in results and discussion.

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