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A Study of the Current Methods on the Energy Conservation in WSN

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Abstract—*WSN is defined as the group of sensor nodes which has the ability to sense various environmental parameters. It has limitation in ranges. The sensor nodes present in the network could be stationary or movable or even homogeneous or location aware. The sensed data from sensor nodes are transmitted to base station using multiple hops. It could also be done using Internet via router or gateway. Information gathered by base station increases according to the increase in sensor nodes occupying maximum capacity of present network. Wireless sensor network is an assembly of nodes from one to many or even hundreds or thousands, one of the nodes is connected to one sensor. These sensor nodes have different parts like a radio trans-receiver along with an internal or external antenna, microcontroller, power supply which will be battery oriented or connected with solar harvesting system and PCB based electronic circuit for interfacing. The trans-receiver receive and send information to and from the base station (control computer). Size of sensor node varies like size of a shoebox to the dust grain. Cost of these sensors varies according to their size, depending on the interfacing complexity of each node. Limitation of cost and size of sensor nodes results in correspondence limitation of resources used such as computational speed, power supply, and memory storage and network bandwidth. The main motto of this paper is to overcome the major problem of energy conservation in WSNs with a simpleapproach.*
Index Terms—*Wireless Sensor Network, Mobile Node, Energy, Optimization, Clustering, Leach, Throughput.*

I. Introduction

WSN is defined as the group of sensor nodes which has the ability to sense various environmental parameters. It has limitation in ranges. The sensor nodes present in the network could be stationary or movable or even homogeneous or location aware. The sensed data from sensor nodes are transmitted to base station using multiple hops. It could also be done using Internet via router or gateway. Information gathered by base station increases according to the increase in sensor nodes occupying maximum capacity of present network. Wireless sensor network is an assembly of nodes from one to many or even hundreds or thousands, one of the nodes is connected to one sensor. These sensor nodes have different parts like a radio trans-receiver[1] along with an internal or external antenna, microcontroller, power supply which will be battery oriented or connected with solar harvesting system and PCB based electronic circuit for interfacing[2,3]. The trans- receiver receive and send information to and from the base station (control computer). Size of sensor node varies like size of a shoebox to the dust grain. Cost of thesesensors varies according to their size, depending on the interfacing complexity of each node. Limitation of cost and size of sensor nodes results in correspondence limitation of resources used such as computational speed, power supply, and memory storage and network bandwidth. The main motto of this paper is to overcome the major problem of energy conservation in WSNs with a simple approach [4,5]. The scenario of sensor network is based on two nodes are–

- Root (Source) Node: - The node which provides the information or generates theinformation.
- Sink Node: - The destination nodes to which the data has to besent.

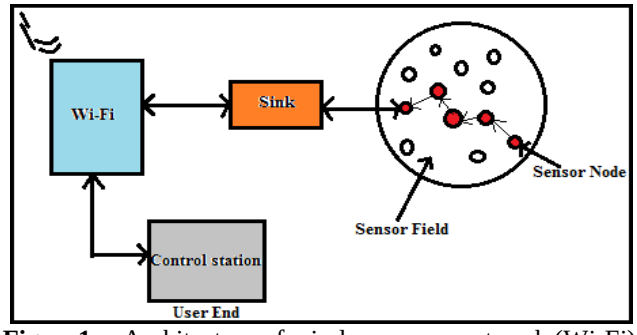

Figure1: - Architecture of wireless sensor network (Wi-Fi)

Following are the major components of WSN: -

- **Sensors**: - It is used for measuring and processing physicalphenomena.
- **Control station**: - It collects the data and stores it for futureuse.
- **Actuators**: - Data received form sensor nodes are responded bythem.
- **Refining (Process) elements**: -Transmitted data are examined. Inside processing in WSN is done using smart, short, cheap computing and sensing devices. In a whole distributed sensing behavior of WSN sensors is done for computation and communication of data wirelessly[6].

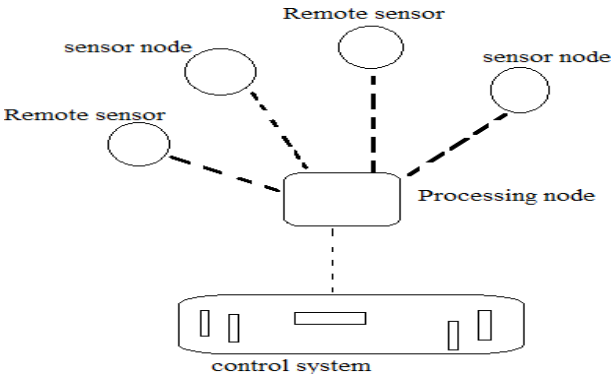

Figure 2: - Basic implementation of WSN

A. Energy conservation inWSN

When we were worked with network based embedded system like Wireless sensor networks (WSNs) main challenge is how to save energy or how to manage large energy consumption. Before find the methods of saving energy we have to be finding out the reasons of waste of energy. Most of the energy wasted during repetition of process of parameters measurement due to regular change in environment. In WSN, requirement of conservation of energy due to battery source which isn't rechargeable. The most required concept is energy saving in sensor network have being discussed. In wireless sensor network following are the main factors which are consume more energy[7]: - At a sensor two different packets dispatched at exact time thus it required retransmission of twopackets.

- ✓ When sensor isn't prepare to operate at the same time of datareception.
- ✓ Inert listing: - when any node of sensor pause for the influx.
- ✓ Listen to without permission: - When two sensor nodes place at the small distance to each other and receive similar data.

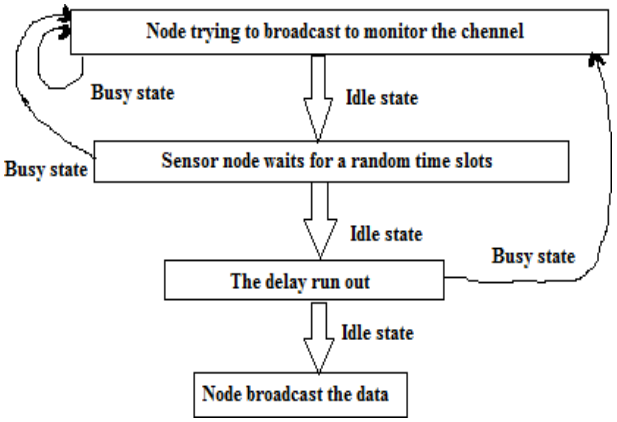

Figure 3: - Idle listening of nodes

- ✓ Demolishment: - While sensor node have more than two data packets at the sametime.
- ✓ Traffic inconstancy: - When sensor networks are reached on their maximum capability then interruption goes to its top most level.
- ✓ CPU and radio transducers are two main energy hungry devises.
- ✓ In wireless sensor network wastage of energy is one of the main reasons. There are some main causes of wastage of energy as follows:-
- ✓ Intervention
- ✓ Overhearing of controlpackets.

- ✓ Complexity ofcalculation.
- ✓ Allow to belled minimum amount of controlpackets.
- ✓ Idle channel is connected with sensor node.
- ✓ Data or information is smash up between two sensor nodes
- ✓ Energy is also being wasted when more energy spend during transmission of information than that is require for data sensing. So that's why communication of information uses the largest part of theenergy.

When sensor node has been receives data from other destination node rather than its original destination. For the sensor network we can say that each sensor node has its own way of processing and give the proper information about the respective parameter. The communication from a sensor to the other sensor or to the base station have been depends on the communication protocol used for that particular network. A TCP/IP[8] protocol suit is used in the most of the networks. In WSN, large number of data is monitor by amount of packet series. Thus, to keep long life of wireless sensor network battery supply has to be changed. But to change battery is not possible every time so it should be require using maximumrange.

B. **Energy conservationmethods:**

An energy resource used for the network implementation is directly affects the life time of sensor node of that particular network. As we know wireless sensor network consist sensor nodes, connections, control station where sensor node contains of processing system, storage space and power supply through battery or may be through anotherway. Here we are studied about various methods that can be used to truncate the consumption of energy. Some of those methods are:-

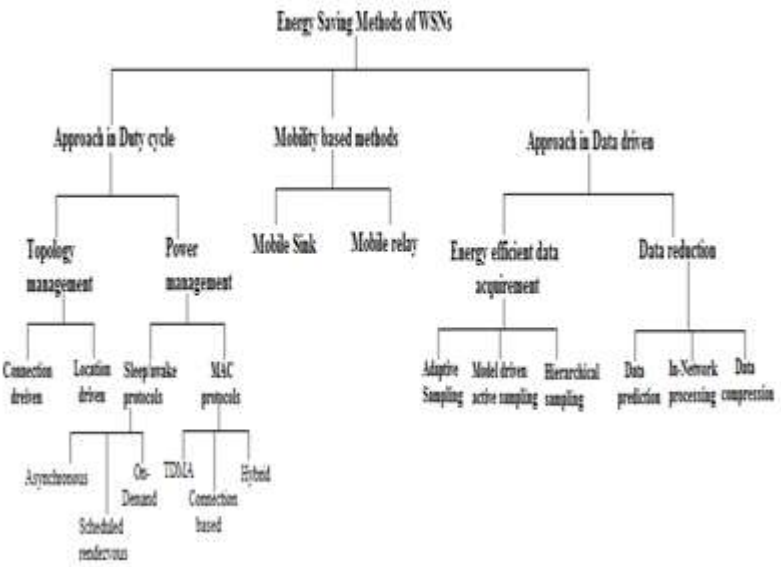

Figure 4: - Different approaches to energy conservation in WSNs

Clustering Method: - This is the most significant method that is used to boost the life time and to conserve the energy of WSN during the transmission. Clustering is a process in which sensor nodes are form group for the general gathering of data. Clustering method also boost the performance of the system. There is various form of clustering[9] such as: -

- ✓ Hierarchicalclustering
- ✓ Centroid-based clustering
- ✓ Distributed-based clustering
- ✓ Density-based clustering
- ✓ Spectralclustering

- Dual-pathbased
- Based on quality ofservice
- Based on
- Based on

As data communication is a hop-by-hop communication so energy can possibly be saved by reducing large amount (number) of hop of the sensor node which indirectly improves the life of the system. As the exact level of mobility ratio is not define for a node so it is expect that routing protocol mostly assumed sensor node to be unchanged [11].

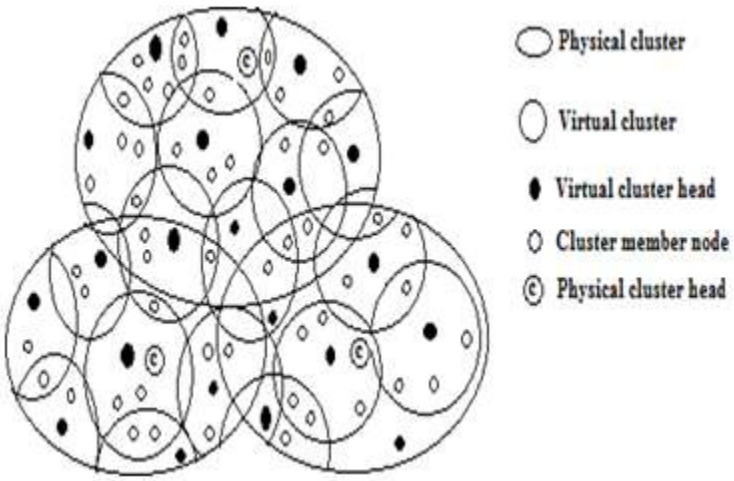

Figure 5: - General idea of cluster head

More than two cluster forms group of clusters that is known as sink node. This sink node decides the cluster head for each cluster. Cluster deducted the maximum amount of information transmission and then data gathering is perform by cluster head that is further improve the energy efficiency of the system. In entire method of clustering clusters are sensor node and cluster head is as another lead node. Several numbers of clusters send data to the cluster head then it gathers all information and passes that to the control station. At particular time slot cluster head to be chosen by the system themselves then cluster head gathered information and radiocast their distinction to the cluster which are placed as sensor node in the network. Every node in the network identifies that which cluster requires minimum energy for data communication that agrees by selecting the cluster head. Every cluster head organized as an agenda for the nodule in its cluster as a result those radio apparatus of every cluster head and non-cluster head nodule is turned off during every single time apart from its transmitting time, therefore energy is being conserved at each sensor node [10]. The basic strategy beyond the conservation of energy can be easily understood by the flow diagram. So we can create a flow diagram that show how energy will conserve during formation of clusterhead.

II. Method Of Routingprotocol

Routing of the network is the major part of the data communication. It minimizes the area for transmission and re-transmission. We have studied several routing and clustering protocol to conserve the energy such as LEACH, TEEN, APTEEN, PEGASIS etc. These protocols are also being in used to save energy. As we know that large amount of energy can only be spent through communication therefore most of energy can only being conserve by assign set of rules (protocol) for communication like routing protocol, Media access control protocol and transport layer protocol. We can be applying a routing algorithm which is energy efficient multiple sink mobility is also support to this algorithm. Normally followings are the basic parameters for routing protocol: -

- Concessionbased

III. Methodlogy

LEACH protocol: - LEACH protocol is used in a way that clusters are being designed at an exact interval and energetically. This is a self-control routing protocol. LEACH is an abbreviation for 'Low Energy Adaptive Clustering Hierarchy' protocol. To circulate the energy load similarly between the sensor nodes this protocol is always preferred to use. In this protocol sensor node worked as clusters and one of the sensor node working as cluster head. This LEACH protocol required the support of media access layer and also work as hierarchical protocol. Synchronization between two nodes require for the transmission of information in the form of bit stream from one to another node by the mean of communication link. The leading (cluster) head must have to know about that at which rate bit stream have been received. Generally, we have seen that the short life sensor nodes are chosen to being a cluster head which would have die in short time and indirectly disconnected from the network. Whole life of the network will be fixed with cluster. Thus the leach protocol explains randomized revolving of cluster head location such that it turn around together with the each sensor node and exhaust the battery of node [12]. LEACH executes local data mixture to minimize the quality of data which being transfer to the base station from the sensor node. It is further dropping the consumption of energy and increasing the lifetime of the system. A major energy saving approach of LEACH protocoliscombining data routingalong withdefeat density. There is a substitution between value of the output and the quantity of density reached. In this situation, some information from a particular signal is misplaced but this outcome in extensive diminution of the complete energy indulgence of the system. Since, within a network there is only a small number of leading head (cluster head) that have aneffectonfewnodes.Weobservethatthiswholeprocessis take high transmission of energy. To distribute energy on morethantwonodesforthisclusterheadnodesareset.Aset of sensor nodes becomes CH for a time interval but at other time interval cluster head goes with the other set of sensor nodes. Being a cluster head this choice is totally depends on amount of energy residue at sensor node. In such a mean, energy demanding functions of the sensor network will perform by the nodes which have moreenergy.

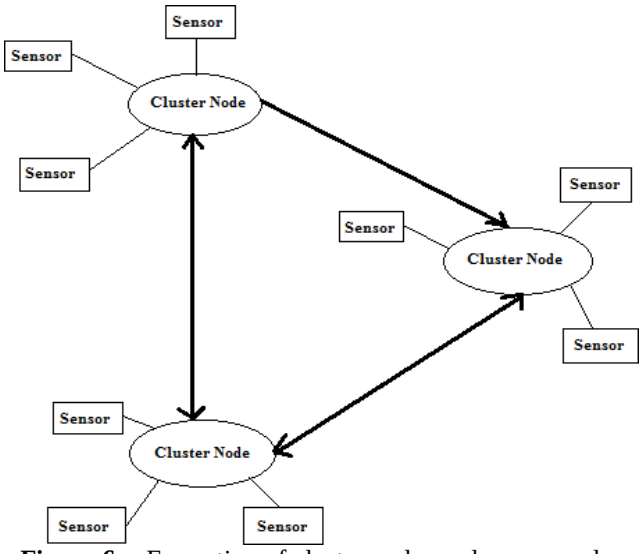

Figure 6: - Formation of cluster nodes and sensor nodes

In the WSN, if it have small number of cluster head these nodes able to transmit information far away to reach the cluster head (CH) to bring about the global energy in the network to be large. If there are large number of leading head then nodes require to reach adjoining cluster head that doesn't lose significantly, still there are large cluster head therefore we have to transfer data from long distance to the controlstation[23].

A. LeechAlgorithm:

The working of low energy adaptive clustering hierarchy proto colisseparated into rounds where eachandeveryround of working has two stages (phase). First stage is defined as a set-up stage and other one is defined as a steady state stage. When cluster are planned in the system and being with this phase until the information transfer to the control station. In array to minimize the transparency, duration of setup phase is smaller than to the steady state phase, while we designing cluster initially every node is free to takes their owndecision thus they can be or cannot be become a leading head for the existinground.

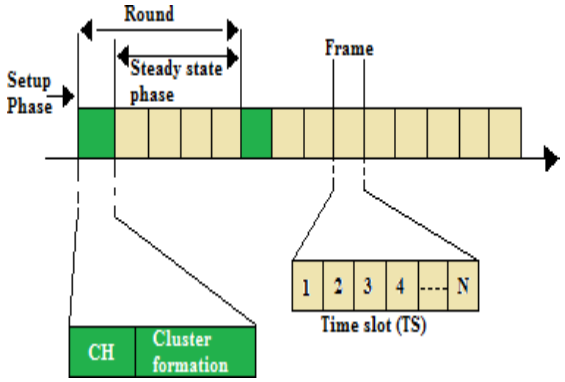

Figure 7: - Two stage of cluster

This choice of node totally depends on the requirement of energy in the network and as well as depends on at which time interval node act as leading head. This choice alone taken by the node by using binary number 0 and 1, if random number is lower than threshold level then node becomes aclusterheadfor that existing round.Thusduring all rounds each node has possibility to be become a cluster head. Which node who is cluster head (CH) for the existing round that must not be CH for the next possible round. By whole investigation of this algorithm we can be comprise threshold level based on energy for the conflicting node. In this case, each node which is intended as CH for the current round promotes a message to enduring nodes. For this reason, the CH uses a CSMA media access control protocol and each leading head taping similar quantity of energy to send message from every cluster head. When this set up phase is completed every non-cluster head node chose for which cluster it will go for the present round and depends on the strength of received signal [13].

B. MAC protocol:-

MAC is a set of rules which is used to organize the transmission link among sensor nodes. This transmission link has faced two main problems. First problem with communication link is that sensor nodes are battery oriented and it is gone be tough to change or replace batteries for whole network. Second problem is nodes are frequently not arranged with framing method. To applying different method for many applications big quantity of nodes would be necessary and that's any big number of node may face congestion problem take place to defeat all above difficulties. The usual TDMA based media access control (MAC) protocol doesn't acceptable. So, for that reason CSMA based media access control (MAC) protocol is suitable for the transmission system.TCP/IP protocol suit various layers out of those protocol layers, MAC protocol layer is mostly suitable for radio functions. MAC layer protocols monitor the wireless sensor network when it require radio operation and also control the transreceiver according to the condition. As we know when the signals are overlapped it makes confliction between the signals thus MAC layer protocol is correct choice because it eliminate the existence of confliction. So we can state that MAC protocol is absolutely designed to conserve energy[14].

C. Energy saving microprocessor:-

Management of power has come about to specified in the between software and hardware. The preference of microprocessor come to be very important in energy sensible design CMOS and MEMS (Micro Electronic Mechanical system) are modern techniques which allow fabricating to develop an improved field of circuits through processing of signal. Digital options of output sense of integration and conditioning of signal andsupply of power units like an example the aligned pairing of a super- capacitor and a battery has come to use to expand the running time of small power sensor nodes. In later years, wireless sensor nodes have been created using small energy powered microcontroller like as taxes instrument to MSP430 or cool real semiconductor chip(RISC).

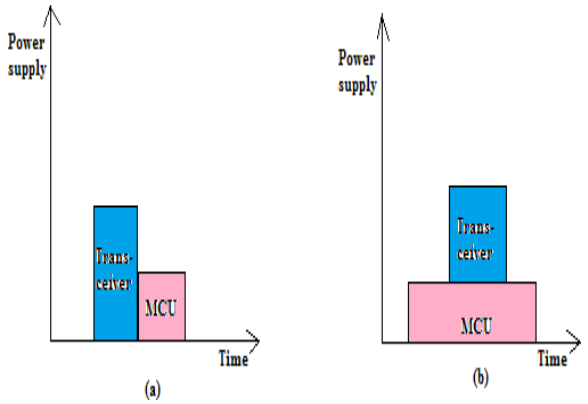

Figure 8: - Integrity between power and time - (a) Transceiver with Micro controller unit (MCU), (b) Communication controller

D. Solar energy harvestingsystem:

As we discussed that WSN facing their problems of energy and life time of its nodes or its whole installed system to save energy in WSN stellar (solar) energy harvesting system is one of the most suitable methods. Due to the solar system develop through sun light and further energy from the sunlight is transferred into the electricity that's why it's easy to manage. Challenges come to with common wireless sensor network (WSN) can easily be solved by environment friendly solar harvesting system[15]. A LEACH-C protocol has proposed through SHE sensor node to extend the life of node in the network for the improvement of cluster head (CH) LEACH-C protocol suggest a sin (vice) cluster head method along the operation of transmission. This VCHM (vice cluster head mechanism) and low lose low energy adaptive clustering hierarchy centralized protocol also introduce a new set of rules (protocol) that is call as SLLEACH-C protocol. This low lose low energy adaptive clustering hierarchy centralized protocol is introduce to extend the life time the system approximately 78.99% and further slowdown the loss of packet during transmission. In addition the protocol SLLEACH-C comes to be extremely suitable in favor of solar surrounding which in terms used SCHR (solar cluster head recovery) mechanism to improving the CH at the same time of communication. If the quantity of SEH nodes will go high through which the life of sensor node extend by using these particular protocols [16].

E. Neuralnetworks:

Neural networks are one of the methods of energy conservation these networks contributes in proportional reduction and forecasting of data from the output of algorithm of neural system of sensor. Neural system algorithms will be directed to low transmission cost and conservation of energy. As neural network have been deliberate all demeanor of wireless sensor network in which conservation of energy is main concern and it also gives high agreeableness with sensor networks characteristics. Neural system follow different types of cartographies like self-arranging map wireless basis functions, repeating neural system and procreation neural system etc [17]. There are some features of neural network which are applicable in wireless sensor network as follows:-

- Melding ofsensor
- Augury of sensordata
- Discovering ofpath
- Node grouping
- Classification of sensorinformation

Contrived neural systems usually explain as numeric algorithm. These algorithms are able to justified difficult mapping among the input and the respective output. Neural system algorithms can be classified to the unjustified manner of input data. Attic fabricated neural system buildup various algorithms which can acquire to sensor network platforms and fulfill all the requirements. Dispraised storage easy parallel dispraised estimation information robustness and categorization of readings of sensor are some of main requirement of sensor network. Since, as we studied that wireless sensor network have amalgamate attribution in that case every node of sensor frequently transmit their information to the control station. At the control station information from the sensor can be stored and that is further calculated by the neural system which can able to block undersigned transmitted data of nodes and secure or rescue eloquent energy[17].

F. Radio frequency- Biological process:

By the help of this system so that another WSN can be created there will interpretation of a combination of this system. The receiver of this system is most important appliances which work for consuming the energy in large amount in their process. In order to scrutinize also reply regard appeal related to main node process which falls upon regularly rising upon acceptor. Usually, nodes went in the rest mode which doesn't use

any energy also come surrounding upon exterior appeal to make a combination of radio frequency energy appliances the power capability of this technologist have to contend that take near toward the technologist have to contend that take near toward the ideal WSN. The appliance went in totally asleep situation but making use of high signal, can also wake up. By changing the concentration level of the ions in the cell we can change the low quality signals to a biological type of signal. The overall system took place with the BMSI. Observing node location also produce signals so that waking up is the important node in its important activity [18].

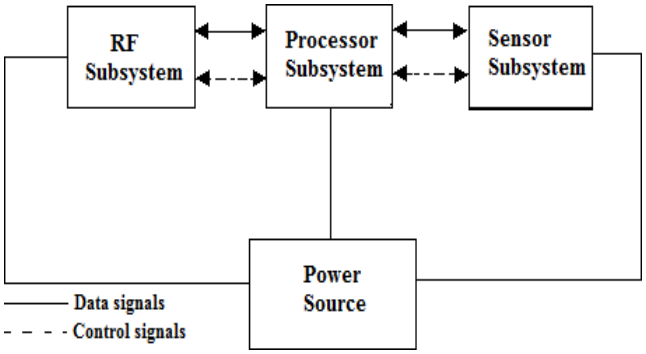

Figure 9: - Diagram of Radio frequency system

This process contains appreciably less energy other present wireless sensing nodule. Also bio-empower waked technique showed in the process would take 10 sec. that was potent upon the volume also postpone the waking up of the medium. Within described backbone regarding theidentical RF medium replacement among determent , volume, also energy for fascinating the volume of the network operation determent also the process energy limited, totally dead module also regularly waking up both together and various transmitter scheme which hold shipper sensing also destruction disclosing process is expansion regard the connection mode[19].

G. Wirelesstransducer:

The best adequate energy preserving method is placing the wireless transreceiver in dead mode at the time when no use of the connection. Divinely, the wireless system must be off when there is no transfer or receiving of the information must be prepared or available. There are three different modes of the entire sensing module that is effective, idle and dead. Within the first module the available the available nodes start consuming the energy during getting or broadcasting information also in another module, it takes the identical quantity of power in active state but when it became in sleep mode, thus nodule switched off of the transmission link that conserve theenergy.

H. Adaptive Samplingapproach:

For the collection of data an adaptive and traverse approach have been used in wireless sensor network. This cross layer method takes an energy attentive conversion module which fabricated with media access control layer. Cross layer and conversion approach executed through ADAPT (Adaptive Access Parameters Tuning) algorithm which is built on IEEE 802.15.4 standard. Adaptive access parameter tuning algorithm is easy and transfer information from local area to the sensor nodule system. It spread information very well thus it is likely suitable to limit the resources. This algorithm includes conversion modules which communicate to the various layer of communication protocol. This adaptive approach has its own architecture that chooses the vertical parameters for communication with the layers of protocol. It reduces the identical information and guide to develop more suitable system. ADAPT states to estimate the traffic condition from the transmission link at the present time and then according to the estimation it has to replace all the parameters of media access controllayer[20].

I. Hierarchical Routing protocol:

Hierarchical routing protocol is basically used to manage the power resources and apply the low power management approach. This hierarchical protocol mainly used in wireless air pollution control system. This system consist number of motes and every sensor node consists two state of performance. One is ACTIVE state and second is SLEEP state. Active state follows the lively behavior of all the nodes while Sleep state follows the snooze mode for all nodes. At the sleep state wireless transmission link will also goes on the snooze mode. No nodule become active until when they gets a revive signal. Initialization of the transmission of data will do by base station of the system. For example let if pollution goes uncontrollable then we take the system into the sleep mode and fixed the time duration i.e. 10 minutes for that mode. Further we wait for 5 minutes for high pollution and then disrupt to wake up module to read the currentsituation.

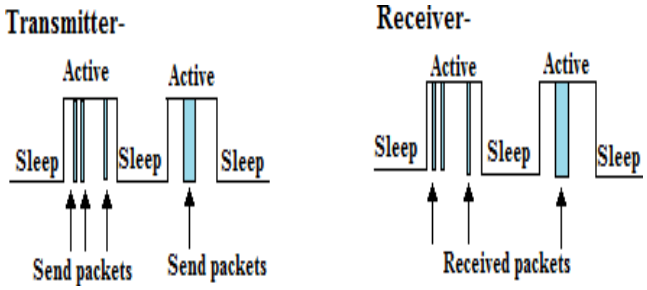

Figure 10: - Transmitter and receiver mode of system

Wireless air pollution system conserves energy by causing the nodes into sleep mode when idle condition occurs during transmission. The traditional air pollution system is consists only analytical equipments which are costly, power consuming, taking more time and cannot observe real time data of surroundings. When in dead position, every part is in off position, also gained up with the operative standards. Every nodule is in the dead position unless it got the signals. Monetizing the pollution of the air doesn't a designated application. So the process can be made for a decided time as in the dead mode remained fifteen minute if the level can be controlled and for the minute if at highest level also by using interrupt for the waking up process so to gain the latest information AQI is being so that they can easily different the various level of the pollution by using the different color to the stages, thus the location can be pointed out very comfortably. It makes the use of process to information gathering so for heal thing the prorogating of the minimum energy taken in theWSN.

IV. Result Andanalysis

A. Biological encouraged methodology:

It is the best method for conserving the power among the nodules. This method is galvanized by the biological technique. By making use of the various processes gave encouragement to make various accessories of grid. Like accumulating, time integrating, swapping also assurance etc. This algorithm is group of rules that established upon the attribute of biological mimic molecule example as ACO, PSO, and BOA. The important field as follows:-

B. Biological encouraged enumerating:

A class which had been forwarded upon the process of accession. A class of process constructed for the allocated sense also for the analysis.

C. Biological encouraged Grid:

A class of approach which make accomplished also scalable gridding regarding democratic configuration.

Biological encouraged algorithm:-It had distinctive algorithm. To reforming the composite of grid WSN previously had different methods. These methods assimilate expansion design also had appliances in various field of WSN. Infect these came out from the climate also used coordinate decorum of WSN. To advanced long time of grid also QOS constant, the enlargement method involves in WSN which desired absolute selection of the algorithm.

The above progressive techniques are usually based on bio imitate (mimic) approaches. We are deliberate number of optimization algorithm which are can be used in radio networks out of those algorithms some are as follows: -

D. Particle Swarm (Speck myriad) optimization(PSO):

This method pertained by taking swarm of different particle. SMP is a bio inspired algorithm that is initially inspired from the behavior of scouring of swarm of bird. In this procedure of frisk speck flies in frisking area and manage grain through out to the experience of past. Antecedent knowledge contains their extreme position and information of neighbor speck. Position or movement of myriad arrived through movement of speck that is conducted by their situation in the field of searching. The PSO is an algorithm which is suitable for multi-dimensional so that's why this is generally used for aggregation of data and clustering in the way of energy savingapproach.

E. Bug community (Ant colony) optimization(ACO):

This optimization method basically inspired from the hunting process of group of ant species. From the group of ant and bug one ant go through the path to find the area of hunting and marked a corridor from the shell

to the point of destination and put down the pheromone towards of path. Pheromone is the hormones of ant that will be used by other ants easily get a smallest route for the foodhunting.

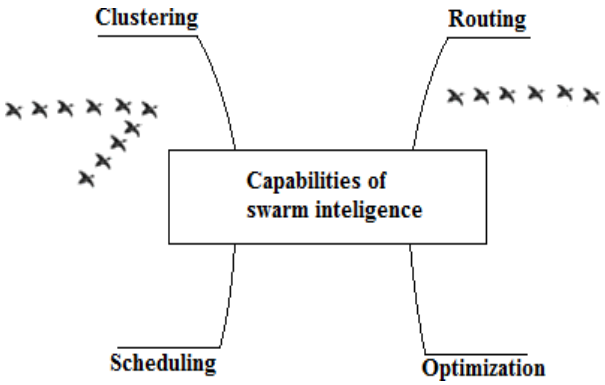

Figure 11: - Swarm system Capabilities

This scenario takes routing of network and food hunting of ants in a same basket. This method is very flexible and distributed in a manner. As routing is an important decision for any computer network likely ACO is also a stochastic style to overcome the optimization problem. Position Ant (POSANT) optimization algorithm is used for the routing that defines loopholes to identify a route and it would not sure about the shortest route. The basic phenomenon of ACO is to find the smallest path which has closest length from the destination. In POSANT algorithm number of organizing messages are required to be transmitting when route is going to be establish. In the similar way of ant algorithm a zone based ant colony routing algorithm is also defined which is much better than ACO and POSANT. The zone based ant colony algorithm is used for clustering which is varying from other algorithm on the basis of such parameter like mobility, size of cluster and number ofnode.

F. Bee optimizationmethod:

This method defines the food hunting of bee. For the searching of food swarm of honey bee select a pollster who search the location of food and when it find out the exact location then return back to the swarm and informed to the swarm about the location of food. This phenomenon can be applied in the WSN by selecting an investigator node from the cluster that identify the exact destination and same the idle state condition of node in the network [21].

G. Data Acquisition:

We examine a data acquirement approach which defines the two methods of sampling of signals. One is hierarchical sampling approach and second is model driven active sampling approach. In the processing of network the signals are sampled at a rate which reduce collision at an ideal level and further conserve energy. In this manner data compression and prediction approaches will also be reduce the energy consumption in the network.

H. Compressed sensing:

In WSNs sensing task consumed less energy compare to communication task, but still energy is being wasted during sensing. Thus, to provide energy efficient sensing compressed sensing has been considered. Compressed sensing is a novel process of sensing that goes opposed to traditional way of data acquisition and exceed the previous limits of sampling. Compressed sensing work at a Sub- Nyquist rate and the sampling is defined by Sub-Nyquist sampling. Compressed sensing (CS) is asymmetric in nature that makes it more appealing for compression in WSNs. Most of the computation occurs at the sink rather than at the sensor nodes thus, sensor nodes performed minimum computation process. CS has define two advantages one is that it refined degradation of irregular event in the sensor reading and second is, it reduce sensitivity. So we can say that CS is capable method to remove redundancy of sensing and suitable for energy efficient sensing.

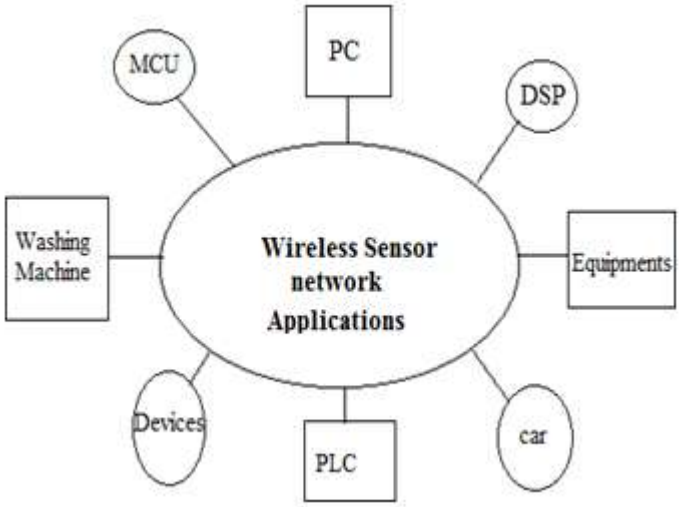

Figure 12: - WSN Applications

V. Conclusion

In today's world, to facilitate variety of challenging task wireless remote sensing technology, low cost modern solution and different sensing technologies have been used. To develop sensors for a specific solution of any application, researchers are being used motion detection technology which is mainly used in robot and cell phones. This motion detection technology provides early warning and information about landslips in risky zone of the world. Motion sensors are additionally used to measure soil quality and moisture in soil. These Motion sensors are implemented around dynamic landslips for the awareness from dangers of extreme landslips disasters to save people lives. Since, aswe almost know about the different shades and zones of sensors so we can say that it is like a challenge to control the ecosystem on farm field. The control of farm field through sensors goes very difficult in case of insects and disease pests. So, we have to protect the crops from the harmful effects of insects by a real time positioning system which traces the insects in the farm land.

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