

OPTIMIZATION OF A CROSS-LAYER ROUTING PROTOCOL FOR MULTI-HOP WIRELESS SENSOR NETWORKS

Moseena Thasneem¹, Dr. Avinash Gour²

¹Research Scholar, Dept. of Electronics And Communication Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal-Indore Road, MadhyaPradesh, India

²Research Guide, Dept. of Electronics And Communication Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal Indore Road, Madhya Pradesh, India

ABSTRACT: Clustering is just one among the methods that may set up the machine performance in model that is associated achieve system life, reduce energy intake, and also to see that the system scalability. Latest scientists have brought on that the proposal of different clustering algorithms to overcome this particular issue. But the majority of the suggested algorithms over-burden the cluster head (CH) throughout cluster development. To overcome this issue, most investigators have produced the notion of fuzzy logic (FL) that will be employed in WSN for decision-making. These calculations revolve around CH's efficacy, that might possibly be elastic adoptive, and smart enough to disperse the load. In this paper we indicate which Hexagonal Clustering using Cross-Layered optimization algorithm (HCCO) may lengthen the life of energy and network efficacy. HCCO relies on clustering the nodes. A hexagonal cluster contains audience members (CMs) along with also a cluster head (CH). Even the CHs are chosen in your CMs predicated on nodes close to the CH length that was best as well as also the electricity of those nodes. In addition will be based. The CHs are rotated one of most of CMs to balance also the traffic loading along with the power consumption from the system. Back in WSNs, power is absorbed throughout reception and transmission. The electricity efficacy cans reduce. These crashes could be prevented with a routine.

I. INTRODUCTION

Normal detector nodes can transport outside detection, information processing and communication parts, which makes them even viable to get a broad variety of promising software, such like: ecological tracking (e.g., humidity, fever), tragedy, health, armed forces, etc., [inch]. Nodes such as all these applications managed and usually are set up. Sensor nodes are battery abandoned and motivated in unfavourable surroundings, which makes it challenging to re charge or substitute batteries. Certainly one of those struggles in WSNs would be always to prolong system life thanks to power sources that are limited. Even the detectors are all people located close to the sink, and that take the load of re-laying considerable quantities of information visitors when numerous paths go these nodes. Avoiding the breakdown of pathways due to energy imbalance that is premature is essential for bettering your system life. When each single node and each wishes to transmit and receive information one other question does occur. This can cause lots of congestion and information collisions. A great sum of power has been lost, & the majority of the nodes will probably go from energy. Lots of suggestions have focused on strengthening the power efficacy. The investigation at WSNs is focused on clustering by lessening the variety of transmissions by utilizing also an energy efficient info aggregation mechanism along with a MAC coating to ease the struggles of WSNs. Clustering signifies group the nodes centred in to clusters. Even the strategy reduces the amount of nodes needed to forwards data bettering the scalability along with also thus cutting down the station load. The benefits of calculations is sold throughout also the audience creation procedure and CH range with overheads.

When using a communicating system will be Impossible or expensive end people may communicate via a wireless community with each other. Because of radio assortment of nodes there is more than a package restricted to traverse jumps. The freedom of nodes together with character of links create system. As a consequence of the problems lots of navigation protocol generated; hierarchical along with also horizontal routing techniques routing protocols. In a ad hoc system using protocol that is horizontal most of nodes have precisely exactly the exact very same part in packet routing. If the system size rises Proto Col performances hamper. In hierarchical routing protocol such as nodes possess part in nodes operate and also packet routing is inconspicuous. CBRP can be a protocol which features a style [7], [9]. The system area divides to smaller parts. CBRP's algorithm is LCC or minimum Cluster transform [10] signifies the elects as cluster mind. Different nodes are the nodes of this cluster. Because freedom of nodes in system it is likely the cluster head that is chosen to be portable. Since greater power is consumed by nodes together using cluster mind role compared to nodes node with I d release. During the following reasons audience mind election process isn't appropriate. We utilised style to work out this issue. Utilizing a set of cross-layer Even though the plan sophistication cans

improve and layered fundamentals at a fantastic strategy to community layout. In this a structure a few parameters characterize each coating. These parameters passed into layers that will simply help them accommodate the present station, software, and system. Indicate strength has been used to ascertain liberty of nodes to understanding that this procedure.

II. PROPOSED MODEL

In this paper we suggest a radio version suggested in [4]. This radio electricity version is employed to quantify energy consumption to your HCCO algorithm that was proposed. In [4], the wireless version is a combo of three principal models: both the receiver the transmitter and the power amplifier. The power absorbed by the transmitter contains transmitter circuitry and also the ability amplifier, and also the power absorbed in the receiver is composed of this recipient [4]. After a package is sent to a receiver, in which the space between them is, the signal power at the recipient is [5]:

$$p_r(d) = \frac{p_t G_t G_r \lambda^2}{(4\pi)^2 d^\beta Loss} \tag{1}$$

At which G_t along with G_r are receiver and transmitter gains. Furthermore, $Loss$ signifies any added losses in the packet transmission, and λ represents carrier wavelength. Even the propagation reduction variable β normally varies between two and four. Thus, thinking about $G_t = G_r = \text{inch}$, and $Loss = \text{inch}$, the signal power in the recipient is all:

$$p_r(d) = \frac{p_t \lambda^2}{(4\pi)^2 d^\beta} \tag{2}$$

To obtain the data packets effectively, the received signal strength at the recipient must be over the absolute minimum threshold power (p_{thr}). Therefore the transmitter signal power in the transmitter must be above this threshold $p_{thr} (4\pi)^2 d^\beta / \lambda^2$. The power consumed from the transmitter is

Where $e_a = p_{thr} (4\pi)^2 / \lambda^2 d_r$, which will be regarded since the energy/bit absorbed in the transmitter amplifier, d_R is the transmit or receive information rate (bit/second) of every system node, P packet is that the quantity of pieces in the package and e_e is the energy/bit absorbed in ion electronic equipment. Hence, Dependent on [6], the power could be computed as follows:

$$E_t = (e_e + \frac{p_{thr} (4\pi)^2 R^\beta}{\lambda^2 d_r}) \times Packet = (e_e + e_a R^\beta) \times Packet \tag{3}$$

Enough timing for transmitting and receiving the information traffic between the cluster is denoted by T_r and T_t at which N_t and N_r would be. Equation (5) represents the worth of T_r and T_t .

$$T_t = N_t / d_R$$

$$T_r = N_r / d_R \tag{5}$$

The quantity of time invested in one second for listening into the radio station is represented as T_l : $T_l = 1 - T_t - T_r$, ($0 \leq T_l \leq 1$); thus, $0 \leq (1 - N_t / d_R - N_r / d_R \leq 1)$. Considering that the inactive data traffic surroundings, at which $N_t = N_r = N$, the value of N is reflected in Equation (6) for example:

$$0 \leq N \leq \frac{1}{2} \times d_R \times 1second \tag{6}$$

As a result, $1/2 \times d_R$ bits represents the maximum quantity of data which may be transmitted into every cluster every minute, when nodes in the cluster do not listen to this radio environment and spend half an instant for getting the most packets and a second half to hauling the packs. In simulations, we believe $d_R = 2.5 \times 10^5$ bps; the maximum data that could be relayed in WSNs based on Equation (6) is 1.25×10^5 pieces per minute, where in fact the energy consumed for listening into radio stations environment every instant will be represented since e_l , e_a and e_e are obtained from the design qualities of the transceivers.

Within This Area, We describe the task. The HCCO uses the procedure that is Self-Organization for clustering of all WSNs. From the planned strategy, every node has also to communicate with all the CH, and also to do the endeavour of setting sort information packets, the discipline parameters. Clustering at WSNs indicates partitioning nodes into a system in to clusters that are distinct. The system version is actually really a structure displayed together with the Base Station as well as detector nodes in Figure inch. The faucet node is fixed for every simulation and constant. Sensor nodes possess precisely the ability, are delegated using a special identifier and are optional in character. They can switch among conditions. CH nodes could forwards the messages that are accumulated CHs at direction of their container nodes. Using its hop neighbours, every node shares advice regarding place, the energy nation, cluster-ID along with also the CH-ID Back in HCCO. HCCO's nodes is going to maintain four unique models. The 4 models are all clarified the following.

- Cluster head (CH): In CH model, it broadcasts messages promising its deadline to CMs. slots are then allocated by Even the CH into CMs. The CH collects and data in the CMs. They are accountable to distributing the CMs' advice. CHs are liable for collecting, aggregating and sending the information for space CH or the sink at their faucet node's management. CH receives or pushes messages from your CHs that are adjoining or into the Base Station at routine periods employing the slot.
- Cluster member (CM): A CM is a penis that Belongs into a cluster; the advice that is accumulated is often transmitted by it.
- Lifeless node: This can be just a condition in the detector node can't operate due to the fact its ability was emptied also it's separated. Even the node can transmit nor get the information. Additionally, that the node is regarded to be inside this nation if its own residual vitality is under 0.05 J.
- Isolated node: This implies node doesn't Have Almost any one-hop neighbours to transmit or acquire information, either also it generally cannot Receive some CH messages. The CH Re-election occurs if the present CH Value falls beneath the threshold price. Clustering options may be mixed Using strategies to lessen the price of listening. HCCO is split slot allocation, in to the installation and constant transmitting.

III. CROSS LAYER BASED CLUSTER MODEL HELPS OPTIMIZING ENERGY

The task recorded in [7] introduces an analytical version also to examine the association between energy-conservation and your hexagonal audience in WSNs and also to look for the best audience size. The experimentation consequences demonstrated the cluster version that was projected to become optimal compared to the square established audience version over the transmission speed to approximately 30 percent to 50 percent. The task is mimicked having simulator for characteristics because the model was demonstrated to become the audience size to its data-transmission in WSN. This segment introduces this suggested cluster and also the cluster model's version. The photo reflects simulated cluster version with all the detector nodes. The structures while inside the area are independently and uniformly distributed and where every detector node knows of its own location. The detector nodes using speed and transmission energy are all split to clusters as exhibited from this figure 1. The-fieldcomprises approximately a hundred nodes, even with all the cluster heads CH2, CH1 and CH 3 in the 31, by which all these structures have been divided to a few clusters of hexagon design. Using growth in detector nodes that the discipline will comprise CHi of clusters. The cluster heads come joined to the sink that may be the place node. Whenever the area divides it broadcasts at which in fact the node is going to be chosen whilst the CH, the fundamental purpose of each one and everycluster area to of the sensor nodes to select its audience thoughts. As clarified early in the day in an identical way, a cluster head election will occur in the collapse of this CH. Further the minds the ad messages comprising also the place data along with the identifier to encourage them to combine with their clusters. The relationship between your cluster heads along with the spout has been created employing the minimal spanning tree (MST) technique.

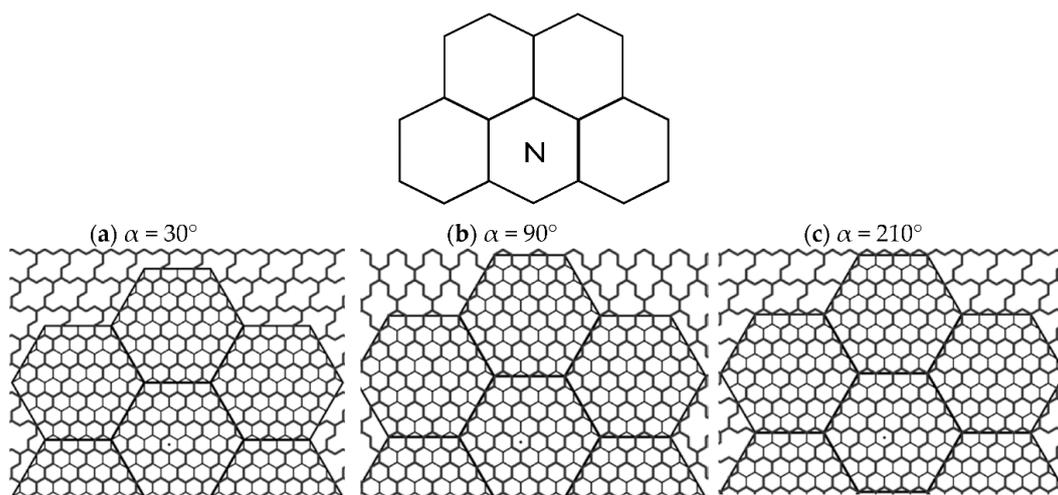


Figure 1 Hexagonal cluster

Two sorts of transmission: intercluster along with also intracluster transmissions are conducted one of the nodes within the area. Exactly the shortest route routing to transmit the info is followed by Even the intracluster transmission. Sometime that the intercluster transmission constructs a back pack shrub to attach the sink and with the CHs. The cluster heads require the info to be transmitted by M projections. The faucet disrupts the sent info of most sensor nodes on obtaining the information. Whilst the function at describes averts power in WSN, the cluster version that is projected conserves vitality from the system by lessening the range of the transmission speed that is entire and also intercluster data-transmission. The design investigation reports which the cluster version necessitates approximately 6 clusters to put on precisely the 100 detectors within the area, where as the cluster version that is projected puts precisely exactly the amount of detector nodes. This demonstrates the cluster covers bigger space compared to square cluster [two]. Ergo It's analysed in the simulator effects mentioned that the information transmission speed is reduced by the cluster and save energy in Contrast to cluster versions

Subsequent to the Aggregation of information from the CH, information will be transmitted by the CH. The CH functions in the reach of EP, that's the space between 2 cells at a hierarchical arrangement. As a way to send out burglar advice into each of CH applicants at their sink's management, another CH's signs will be broadcast by the CH. What's more, the CHs make a path to the sink and pick a more CH that is last for additional information. The "Closing CH" may be your CH node with got the next-hop while the Base Station. Energy use can be reduced by forwarding packets in comparison to this transmission of messages from all possible CHs into the sink. Throughout the introduction of this course for routing, then the CHs have their responsibilities while emphasizing on functions, although altering.

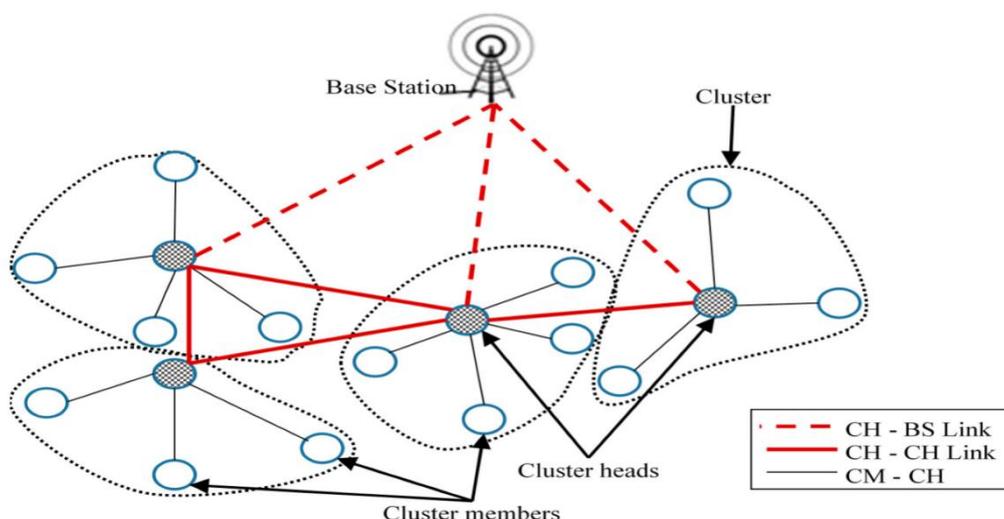


Figure 2 Proposed Hexagonal Cross layered Cluster

Preliminary model that is

- After the routing period begins, all CHs are delegated throughout the initialization procedure together with values.
- Route Mode broadcasting: This really is the model at which the signs are broadcasting to set up that an course.
- Route launching mode: " In such a model, Paths are created in individuals of the neighbours and their routes. In This newspaper we examine in the HCCO algorithm with all an LEACH and also HEED algorithm Details of throughput and their system life.

IV. SIMULATION RESULTS

Simulation Environment

We employed NS2.34 for operation analysis of this proposed HCCO Proto Col. Inside our simulator setting, a system of 1-800 nodes has been set up in a place of 400m × 400m using the spout at the center (200, 200) along with also the spout never at the center (350, 200). We put the energy of each one and every node. The subject of a litercluster centred around the best left-hand aspect of 25.09 m is 1631 m-2. The amount of clusters generated within the field is ninety together with precisely exactly the selection of CHs. You can find 20 CMs in every single cluster. CMs having a cluster's institution stays unchanged within the simulation. CHs shift inside the simulation. We believe message processing. While in the Instance of LEACH and HEED, 802.15.4 MAC is Utilized to Assess together with all the HCCO Proto Col. We now believe the power consumption of every single node since the summation of power absorbed at reception and the transmission of information packets each variable. The simulation parameters have been presented in Table 1, where this air model's parameters are exactly like the ones in [3]. We obtain the perfect facet of this hexagon (e_p) from Equation (1-1) (d_{tc}) 25.09 m for $n = two$). We'll analyse the time-delay and also the power intake with different quantities of nodes such as LEACH, HCCO along with also HEED. Just about every CH has been allocated an transmission slot. As stated by the arrangement, you will find just six. Both of these CH nodes need a framework span of $\omega \times 6$, in which ω is your slot length of CH. In the start of every slot, both nodes which aren't devoting visit snooze. The CHs mixture the information predicated in their own power and ahead into perhaps even the base Station or this CH.

Table 1. Simulation parameters

Network length	2500 m
Propagation Factor (β)	3
Energy capacity of nodes (E_{cap})	3J
Simulation time (t)	0.03s
Number of nodes (N)	2000
Data Rate (d_R)	2.6×10^5 bps
Carrier frequency (f)	2.4×10^4 Hz
Min threshold power (p_{thr})	9×10^{-15} w
Optimal cluster size (r)	25.09 m

Performance Assessment We contrasted the HCCO algorithm to get distinct values of α using all the average protocols LEACH along with also HEED using different metrics: the energy intake within time, the percentage of living nodes within the years, how many programs obtained in the sink and also exactly the highest time delay together with raising variety of nodes at the sensor system along with the accuracy of these information obtained in the sink. The faucet has been put 8329 destinations of their detector system to test the impact of area on system life and electricity usage. Electricity consumption as time passes, the operation metric, provides an concept of this speed of ingestion of electricity from the system. The energy contributed to every detector node is just two Joules. Figure 3 demonstrates that the version of electricity consumption with respect. HCCO ($\alpha = 0$) absorbs 64 percent of their power of their whole network until 30 percent of these system nodes expire. Letting the detector nodes to maneuver at that period for both reception and transmission of programs reduces the power ingestion of HCCO. The vitality ingestion rises as per the amount of detector nodes from the system for many calculations. Much less energy use entails system life. It really is tested employing the system life Statistics 7 and 6.

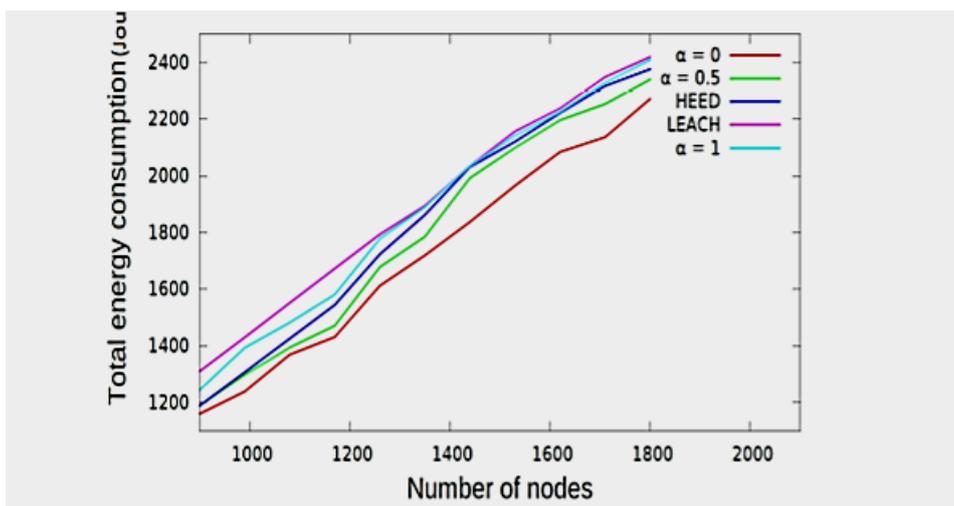


Figure 3. Energy consumption analysis

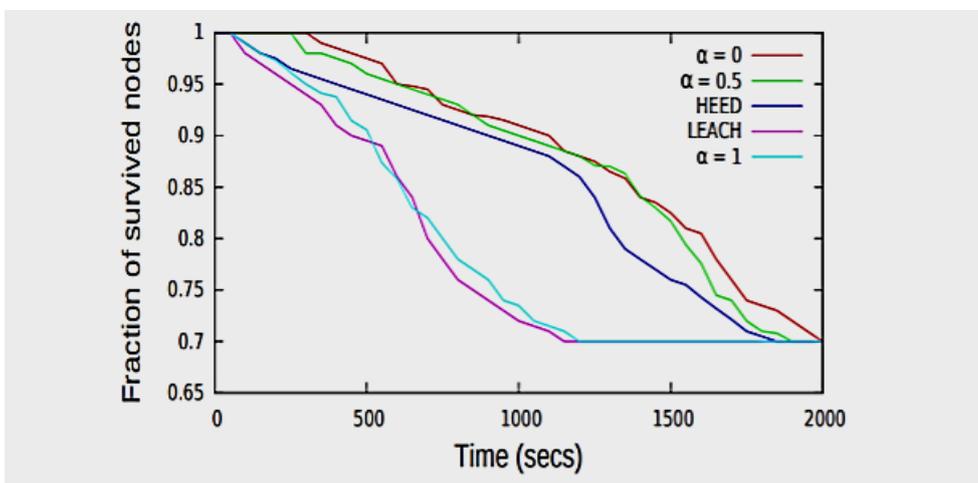


Figure 4. Network lifetime analysis

The system life is understood to be the portion of nodes. This also provides thought of this period on the system will ship the info prior to the nodes in the network all die. Once α is put into the best worth, it'll prolong the community life; for example, if the definition of their life of this system is 30 percent of nodes entirely obliterated their own power. In addition, 30 percent of nodes known to preceding equates to some 70 percent "percent of nodes that were survived" in Figures 4 and 5. This 30 percent of nodes will not need enough capability transmit or to receive a package. In Figure 4, the system life predicated on different facets of α from zero to a can be revealed, if the Base Station remains at the middle. In both genders 7 and 6, HCCO ($\alpha = 1$) and also LEACH, the system life reduces radically in relation to another calculations. That really can be due to that LEACH and also HCCO ($\alpha \neq 1$) don't take into account the residual energy of nodes throughout CH choice. In picking CHs with nodes with power, this might result. This will influence depletion of losing of programs along with power to get a node. HCCO ($\alpha = 0$) believes merely staying energy through CH choice, which contributes to getting the greatest network life in comparison with additional protocols. Back in HCCO ($\alpha = 0$), nodes using reduced electricity are not picked since CHs if the cluster features nodes having high residual energy. This lessens the packet reduction in communications. The HEED and also HCCO ($\alpha = 0.5$) pick CHs predicated on both the staying electricity and communicating prices. This contributes to using a network life that is medium in comparison to additional protocols. The system with all the base Station at the centre includes media life as a result of decrease in the amount. In front of a percentage of nodes stands from electricity, Inside this paper we specify that the duration of this system at enough period duration, and also the consequences in Figure 4 reveal the efficacy of every algorithm as soon as the sink remains at the middle. For example, the moment the definition of this duration of this system is 30 percent of nodes fully drained of vitality, the proportion of the lives of their system (determined in loops in among zero till finally 30 activities) underneath different calculations can be the following. Considering that LEACH and also HCCO ($\alpha = 1$) do take into account the remaining power of nodes, so the system life reduces radically in relation to another calculations. As a way to

evaluate the impact of packet loss with electricity on account of this range of CHs, within this particular newspaper, we've compared the range of programs.

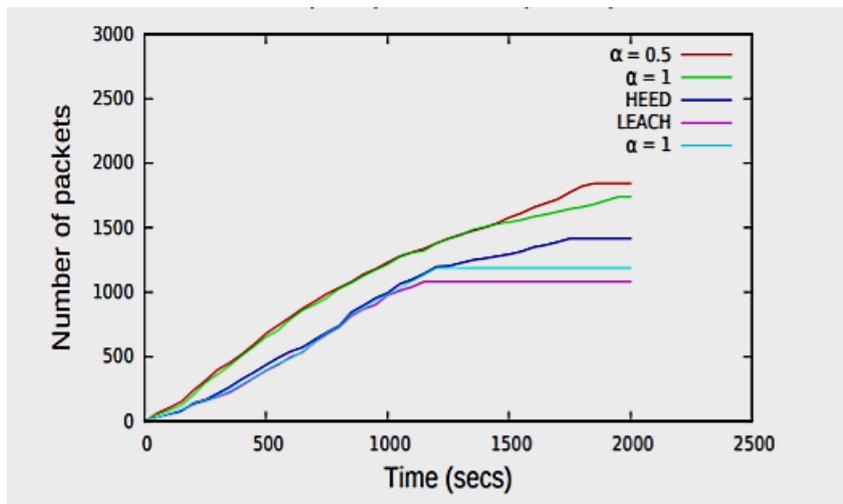


Figure5. Data received analysis

It is clear that once that the base Station is at the middle, it gets much high quantity of packs in comparison to. Figures 5 and 6 reveal that until the system disconnection, the Base Station of this HCCO ($\alpha = 0.5$) algorithm receives far more info packets compared to other calculations. In Figure 5, the obtained information together with HCCO ($\alpha = 0.5$) grow faster compared to other protocols. That really can be a consequence of utilizing power and also CH choice was missing for by the communicating. Even the Base Station at the centre for HCCO ($\alpha = 0.5$) reduces the amount of additional data transmissions out of the CH into the Base Station, thus leading to with a high quantity of information packets obtained in the Base Station.

Table 2 LEACH, low-energy adaptive clustering hierarchy, Base Station in the center

	$\alpha = 1$	LEACH	HEED	$\alpha = 0.5$	$\alpha = 0$
Packets	1197	1091	1516	1943	1639
Lifetime (s)	1307	1232	1823	1935	1856

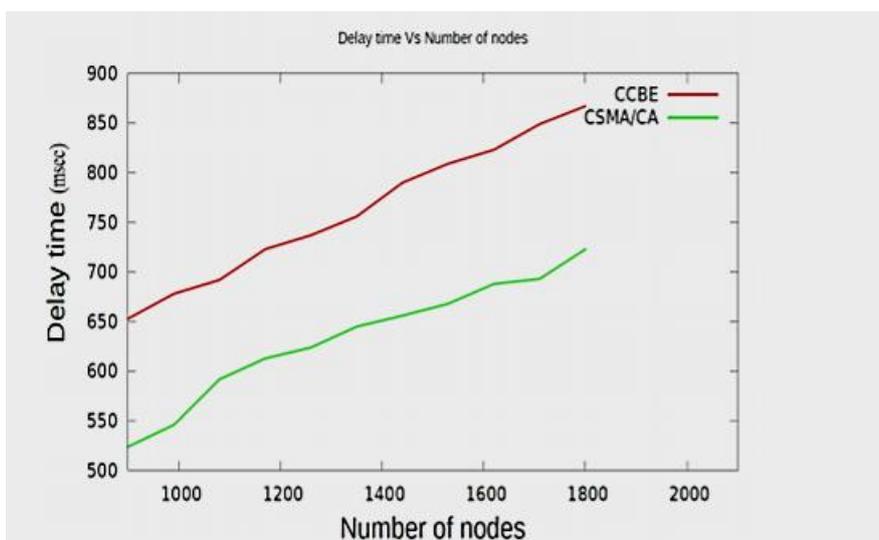


Figure 6 Time delay analysis

So as to know the operation of this scheme enough period delay with quantity of nodes at the detector system is displayed at Figure 7. It's obvious the delay rises with the quantity of detector nodes from the system. Back in HCCO for many respects of this α MAC strategy relies on TDMA. The range of slots expected rises. This results in delay for communicating. In Figure 6, the variety of CMs has raised in every single audience. Figure 6 compares the wait for CSMA/CA along with HCCO, and it is utilized in HEED and LEACH. CSMA/CA has wait due to this channel's access, also at HCCO, for carrying the information to additional 33, the nodes will want to wait.

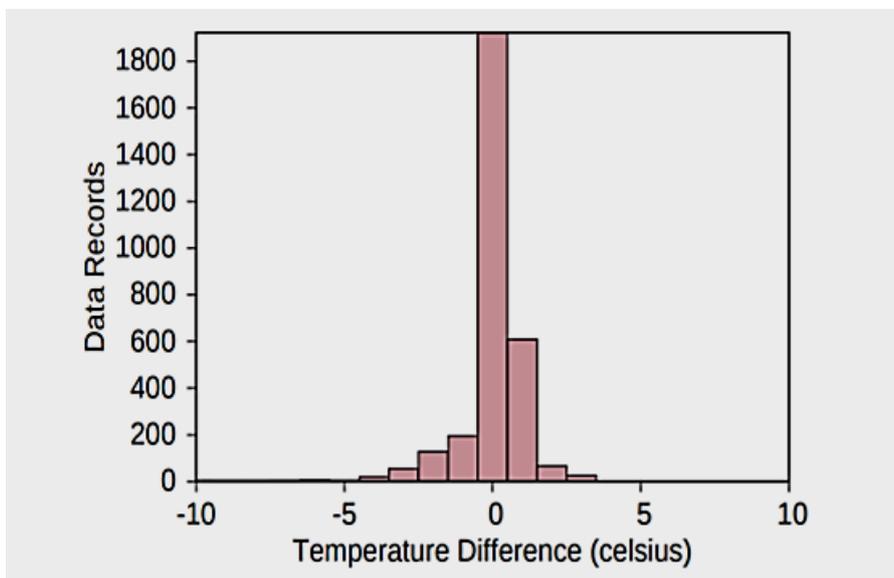


Figure7. Data received accuracy

By enabling these nodes sleep soundly till it's time for your own transmission or reception of packets, the power absorbed throughout the listening period for every detector node at HCCO is reduced. The Range of clusters stayed exactly precisely the Very Same, although the Range of CMs is raised in every cluster.

Time slots such as CMs at the CHs' quantity has been raised. This is going to cause a package dimensions that is greater, therefore far much more electricity is absorbed at the package transmission. Aggregating the information maintains the packets measurement. Aggregating data are going to result in mistake or accuracy that is not as in the Base Station. Figure 7 demonstrates the truth of information. Evaluating the values got with values at Base Station obtains even the chart. At the simulations, temperature worth are blatantly sent by each one and every CM into the CHs. It is clear our protocol works compared to protocols, for example as for example for instance HEED and also LEACH.

V. CONCLUSIONS AND FUTURE WORK

In this paper we suggested the HCCO algorithm also to lower the electricity consumption also to both expand the system life. The simulation results have been contrasted with all LEACH the clustering algorithms along with HEED. The HCCO algorithm that is projected divides the sensor nodes in the network all in to clusters that are hexagonal that are different. The negative span of this structure is based, and also clusters have been well formed. The CMs select a CH from the cluster. Even the CM (inside the cluster) that reduces the worthiness of $[\alpha r I 2r -(1-\alpha) EresEcap]$ is chosen since the CH. This CH may be your node that demands that the energy also has got the energy that is very finest. Additionally, fat parameter α determines the comparative significance placed on those two parameters. The MAC plot is predicated on TDMA. Enough slots are allocated by base Stations. Afterward, slots are allocated by the CH to each the CMs depending around the electricity. The CMs shift towards the sleeping condition immediately following the retention and also wake up up during the hearing condition (CH transmission to CMs). Data gathers out of three CHs supporting forward to another location CH or also the sink and the CH. Before sending the information into another CH, the CH aggregates the info depending on the staying vitality and then selects the acceptable aggregation degree. The outcomes in simulations demonstrate that the HCCO algorithm gets got the optimal/optimally efficacy concerning each information packets obtained from the Base Station as well as the system life. HCCO irregular use of nodes in close proximity to the sink and also results in the overhead of command packs. Next move is always to review

the single-hop transmission out of the CH into the faucet and also multi-hop transmission in your CHs into the Base Station; it also to examine the power absorbed throughout info aggregation also to assess it with no having information aggregation; also, to come across the perfect spot of their Base Station depending about the setup of this detector nodes; subsequently, to adaptively growth and reduce the magnitude of this hierarchical arrangement dependent around the range of living nodes; more over, to execute a lively targeted visitors scenario using a flexible aerodynamic structure dependent around the audience measurement.

VI. REFERENCE

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