Optimizing Network Lifetimeand Energy Efficiency of Wireless Sensor Networkby Improved Hybrid Unequal Clustering Layering Protocol

Janish, Kapil Gupta

ABSTRACT---Theperformanceofsensornodescanbeoptimizedusingtheclustertechniques.Clusteringcanreducetraveltimebydecreasingthenumberoftransmissionsandreceptionsateachsensornode.Clusteringofsensorsinunlikegroupsmakethesensorsofoneclustertransmittheinformationtoanotherclusterandthatclusterwillsendouttheoriginalinformationtotheprocessingcenter,thisflowofinformationcansavealotofenergyinthesystem.Sensornodes'clusteringrepresentsaneffectualandproficientwayofmeetingallthenetworkneeds,forexamplenetworklifetime,energysavingetc.Ithasbeenobservedthatourtechniquecanbeincorporatebothwithstaticaswellasdynamicclusteringtechnique.Indeploying staticclusteringcomplexitycanbereducedbutthereisissueofenergyconsumptionwhereaswithdynamicclustering,theproblemcanbeeliminatedbutcomplexity(Clusteringoverheads)mayincreaseinthe network.Thus,specialattentionneedstoreaddressthesefacts.Inthispaper,someflawshasbeenobservedsuchasproperhandlingofclusteringtechniquebothinstaticanddynamicclustering.Inboththetechniquesanimprovedhybridclusteringtechniquehasbeenproposedwhichisacombinationofstaticanddynamicclusteringtoformhybridprocessthatwillsavetheenergyaswellasnetworklifetime.

Keywords—HybridClustering,WirelessSensorNetworks,HybridUnequalClusteringLayeringProtocol(HUCL),ImprovedHybridUnequalClusteringLayeringProtocol(IHUCL),EnergyEfficiency,NetworkLifetime.

1. INTRODUCTION

Anetworkofsensornodesrandomlyarrangedwithphysicality,isaWirelessSensorNetwork(WSN).Inreal-timemonitoringandmonitoringapplicationssuchasmilitarysurveillance,farming,disastermanagementetc.,WSNiscommonly applied.Eachsensornodehas4elements:sensor,microcontroller,electricitypowersupplyandtransceiver,wheresensorsareused tofeelreal-worldphysicalparameterslike temperature,pressureandmoistureetc.Theprocessingunitprocessthevalueofsensedafterthatcommunicationunitwillsendittothebaselocationviaintermediate nodesthroughoutsingleormultiplehops.Sincesensorsinruthlessenvironmentsaredeployed,whichisnoteasyandinsamesenseimpossibletoreplaceorrechargethebatteryofthenodes.Transmissioncostsarealwayshigherthanthesensingandprocessingcostsinwirelesssensornetworks.Therefore,thesendingofdatafromsensornodestoabasestationisessentialinordertoextendthenetworklifebyusingsomeenergyefficientdatatransmissionstrategy. AwarenessofenergyisamajordesignproblemwithintheWSN.Clusteringofferseveralotheradvantagesincludingbetterenergy efficiency,improvedlifespan,scalabilityandasmalldelay,andis themoredominantenergyproficienttechnology.Duetothelimitedenergyinnodesitispreferabletoreducetheenergyconsumption usingclusteringtechniquewhichdirectlyimprovesthenetworklifetime.

Theremainingdocumentisorganizedasfollows:section2containsthecorrespondingwork,section3discussesaboutcategorizationofenergyefficienttechniques,section4describestheclusteringinwirelesssensornetworks,section5givesanoverviewofunequalclustering,section6givesdetailaboutHybridunequallayeringprotocol,section7presentstheproposedwork,section8shows theresultanalysisandconclusion.

2. RELATEDWORK

LEACHisextremelynecessaryclusteringroutingprotocol,theauthorsof[1]comparedLEACHandLEACH-Cinnumeroussituationsandconcludethat LEACHisbestinuniformlydistributedclusteringapproachwhereasLEACH-Cisbestincentralizedapproachofclusteringhoweveradditionallyitwillincreasethesinkoverhead.Authorsin[2],proposesageneticclusteringroutingalgorithmandshowsthatitbalancesefficientlytheenergynodeconsumptionwhichdeclinenetworkenergyconsumptionascomparedtoLEACH.AuniqueclusterformationprotocolsupportedFuzzylogicinterferencesystem(FIC)knownas FuzzylogicClusterFormationProtocol(FLCFP)isproposedin[3]andcomparedtoLEACHprotocol.Thisnoveltechniqueoffers theadvanceof12%to19%becauseitusesthreeparameters(i.eenergystateoftheCH,CH'sdistancetothebasestationanddistancebetweenCHandalsothenode)withinthemethodofclusterformationwhereasLEACHusesjustoneparameterofnodedistancetothe CH.Theauthorsin[4],concludetheoptimumclustersizeandalsothepriceneededtorearrangethesensingnodesinaclusterbyusing variousdistributedclusteringtechniquesandconcludethatefficiencyoftheclustersdecreasesbecauseasthemeansquarebetween theclustersdecreases.Efficiencyofthenetworkcanincreaseifthe variationbetweentheclusterswillbeless.

Bayrakli[5],proposesaGeneticalgorithm(GABEEC)inclusterbasedtechniquetoseekoutanapplicablenumberofclusterhead

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sandtheirlocationstoreinforcethenetworklife.AhybridtechniqueTabuSwarmoptimization(TSO)isdevelopedin[6]toformastaticclusteringdesignandenergyawareroutingusingmixtureofTabuSearch(TS)andParticleSwarmOptimization(PSO).Thishybridoptimizationisemployedforinterclustercommunicationsandparamountshortestpathwithminimalenergyconsumptionischosenfornexthoptransferofdata.AnEnhancedDevelopedDistributedEnergyEfficientClustering(EDDEEC)schemeisprojectedbytheauthorsof[7].EDDEECprotocoldistributestheenergyequallyamongthesensornodestodynamicallychangetheprobabilityofnodestobecomeCHandgivingthehigherresultsincomparisonwithDEEC,DDEECandEDEEC.

Authorsof[8],conferredataxonomyofthevarious(block,gridandchain)sortsofclusterbasedroutingprotocolsontheideaoftheirmeritsanddemeritsandshowsthatclusterbasedroutingprotocolsbetterinoverallperformanceimprovementofthesensornetwork.Mirsadegi[9],proposesadistributedclusteringprotocolusingFuzzylogic.ForthechoiceoflatestCH,basicinfofromthenodeshasbeencollectedi.eresidualenergyofnodes,localdensityandnodespositionforthecalculationoftheprobabilitiesofanodegetselectedasnewCH.ProjectedtechniqueisfoundhigherincoverageandnetworklifetimecomparedwithUCFIA,GCAandSCP.In[10],optimizationLeach(O-LEACH)isprojectedinwhichtheCHselectionisaccordingtotheresidualenergyofthenodeswhichmakesitbetterthanLEACHandLEACH-C.howeverit'sdownsideisthatit'ssolelyenforcedinstaticnetworkandshowedthatpositionofthesinkaffectsthereliabilityofthenetworkandenergyconsumptionthenodes.Mahajan[11],proposesaclusterchainweightmetricsapproach(CCWM)whichprovidesaCHweightchoicemethodologywithinwhichinitialclusterheadischoseninnetworkonthepremiseofweightmetricsbeforethemethodofclusterformation.ThiswillresultinbetterloadbalancingandimprovedenergyefficiencyamongnodesthanLEACH,WCAandIWCA.In[12],variousdifferentclusteringprotocols(i.eLEACH,LEACH-C,TEEN,EEHC,DDAR,WCA,ACT,HCTE,CCM,SLGC,LEACH-VF,MWBCA,PEGASISandHEED)arereviewedthoroughlywithallthebenefitsanddrawbacks.Authorof[13],developsanalgorithmthatusesbothclusteringandchainapproachesapplyingwithtwooptimizationmeta-heuristici.efireflyandstimulatedannealing.Proposedalgorithmfirstfindtheoptimalclusteringusingfireflythenwithinaclusteritfindsbestchainofnodesusingstimulatedannealing.

AnewthresholdvalueinaLEACHbasedclusteringalgorithmisintroducedin[14].Thisthresholdisparameter-based(i.e.distancebetweennodesandthebasestation,nodeenergy,CH-BaseStationdistance)differentfromLEACHandresultsarebetterwithproposedthresholdvalueintermsofenergyconsumption.In[15],animprovedPSOisintroducedinEBUCalgorithmtoavoidstandardPSOissuesandhotspotproblem.ThebasicideainIPSOistokeepdiversityinlocalandglobaloptima.AlltheinformationissendtobasestationthenbasestationrunsIPSOtofindthebestClusterhead.CostfunctioninIPSOissameasinPSOtoavoidhotspotproblem.Resultsshowsdecreaseinthenumberofdeadnodesby30%andnetworklifetimeisimprovedin15%.

3. PROPOSEDWORK

3.1.Networkmodel

Consideringtheabovefacts,thefollowingmodelhasbeenpresented.Toimplementproposedmodel,Onsensornodesandnetworkmodel,thereislittlehypothesis:

a) Randomlydistributednodesofthe'N'sensorareinthefieldofM*N.
b) Everynodeisuniform.
c) Allnodesandthesinkarestationaryinthefield(M*N).
d) Allnodescandistance-basedadjusttheirtransmittingpower.
e) Thedischargeisoutsidethefieldofthesensor.Itcanbereachedbyallsensorsandhassufficientenergy.
f) Dataaggregationandcompressioncanbeperformedbyheadcluster.

3.2IHUCL:TheBasicConcept

ProposedtechniqueintroducesanoveloptimizedSelectionofSensorNode(OSSN)algorithm.ThisalgorithmishelpfulinenhancingtheefficiencyofdynamicclusteringapproachusedinWSN.Andisbasedontwophaseprocess:

1) IndexedbasedStatemanagement(IBSM)
2) FuzzyLogic

"IndexedBasedStatemanagement"istheprocesswhichhelpstogivetheinformationaboutLastnodedie(LND)orwhenanewheadofclusterisneedtointroduceinthecluster.Itssequencesandappliedoperationisbasedonthefuzzylogic.Thefuzzyrulesarecomposedofaseriesoffuzzyconditionalstatementsin“IF-THEN”type.Inthisprocess,fuzzyrulesareused.DependsupontheIndexedbasedStatemanagement,theclusterheadselectsthenodeswhichhavehighreliability.Nodeswithlowerdelayalsohaveabetterchanceofbeingchosenastheclusterhead.Inaddition,energyindexofnodesisalsoconsidered.Thesensornodewithmoreenergyhasmoreopportunitiestobechosenastheheadofcluster.Thefuzzyprocesswillalsooptimizetheenergyofclusterhead,distanceetc.

a) A"IBSM"isimplementedthatisbasedonstatemanagementmechanismwhichwillhelptogiveinformationaboutthelastnodedie(LND)orclusterheadneedtobechanged.
b) AnIdealnodeservicewillactivatethenodeifdatatransmissionisinitiatedforparticularnodeotherwisethenodewillstayinidealmode.Alotofnodeenergywillbesavedifthenodewillnotstayactivatedallthetimefortransmission.
c) Normally,theclusteringwillremainstaticanditwillchangefromstatictodynamiconlywhenthereisaneedtochangetheclusterheadduetolackofsufficientenergytohandlealltheasksofdataaggregation,compressionetc.
d) Tofindthedistancebetweenthenodesandclusterhead,thereshouldbeathresholdvalueforit.Theclusterwillbeformedbythenodeswhosedistancewilllieunderthethresholdvalue.
e) Alsothenodesinaclustershouldbeinlimitedrangeandforthatavalueformaximumnumberofnodesshouldbesettodecreasethecomplexityinclusteringprocess.

Threestatesofclusterheadarethereforconsiderationina"IBSM"toshowtheenergyleveloftheclusterhead.Theseareasfollows:

state0-Whentheclusterhead'senergyisabouttovanish
state1-Whentheenergyispartiallyusedandremainshalfofitsfullvalue
state2-Whentheclusterheadishavingitsfullenergy

AIndexBasedStateManagement(IBSM)isintroducedtomaintainthestateofclusterhead.Mathematically,IBSMisdefinedas

IBSM[α][i] where0≤α≤2,αisthestateofClusterHead 1≤i≤N,iisnumberofsensornodei.epresentlyaCluster Here,Nistotalnumberofnodesinacluster.Considertheparameter'd'whichindicatesthedistancebetweentwonodesinageographicalposition.

Here, $d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

$(x_1,y_1)=Node_j$ atsomepoint

$(x_2,y_2)=Node_k$ atsomepoint

Wherej&karegraphicalpointinalocationand'd'isusedtofindthedistancefromtheclusterheadandthenodesofsensor,toselectitsclustermembers.Clusterheadalsohasalimitforchoosingthenumberofmembers.Athresholdvalueisused,whichlimitsthedistancefromsinglenodesandtonumberofnodesinacluster.Basedontheaboveinformationthealgorithmhasbeenorganizedwithfollowingfacts:

a) StateofclusterheadshouldbemaintainedinIBSM.
b) Clusterwillchooseitsmembernodesonthebasisofthresholdvaluefordistance.
c) Nodeneedtobestayinactiveoridealmodeinaclusteraspperrequirement.

Allthesearetheconditionswhichwillexistwheneveraoldclusterheadreplaceswithnewclusterhead.Firstly,accordingtotheenergylevelofclusterheadstatesinthe'IBSM'shouldbechangedtonotifyallothernodesaboutthenewclusterheadandnowtheyhavetosendthedatatonewclusterhead.Thebackupnodeidentitynumbershouldalsobemaintainedinthelookuptableasthiswillgivetheaddressofthenewclusterheadtoallothermembers'nodes.Secondly,whennewclusterheadreplacetheoldclusterheadatthattimeclusterwillalsoreformandchoosethenewmembersnodesthatwillfallwithinitsthresholdvalueofdistance.Thisprocessmaketheclusteringprocessdynamicasthereismovementinclusternodes.Thirdly,allthenodesshouldbeinidealmodeorinactivemodeasperrequirementfortransmissionsitmeansifthenodeshouldbeidealifitisnotrequiredfortransmissionandonlygetactivewhenneededfortransmission.Thiswillsavealotofnodeenergyandalsohelpsinenhancementoflifetimeofthenetwork.

Letusconsiderthatthereare'N'numbersofnodesinafieldM*Nand'L'isthelimitforclusternodesinacluster.

Also,'T'isthetotalclusternodesand'Th'isthresholdvaluealso'd'isthedistance.

$$N_i = T \{\text{whereT<LandTh≤d}\}$$

AboveexpressionisforDynamicclusterformationwithrespecttodistancebetweennodesinaclusterandtotallimit.

3.3StateInformation

$N_i \underrightarrow{CH_i}$ state $\underrightarrow{\text{IBSM}}$[α][i]

a) α==2shows,that CH_1 shouldremaininclusterheadrolebecauseitisinitsfullenergymode.
b) α==1shows,thatit'stimetofindthenewclusterheadwhichisthenearernode N_k havingIdealstate.
c) α==0shows,thatit'stimetoinitiate N_k asclusterheadinthecluster,andreformtheclusteraccordingtothenewclusterhead.Also,maintainIBSMstateduringreforming.

4. RESULTANALYSIS:

TheessentialparameterswithvaluesprinciplesarelistedbelowinTable1.

Table1SimulationParameters[]

ParameterValue	
Sensorfield	1000m*1000m
BSlocation	(125,150)
Numberofnodes	50
Initialenergyofnodes	2J
Datapacketsize	500bytes
Packetheadersize	25bytes
Controlmessagesize	50bytes
RLmax	5–100m
Eelec	50nJ/bit
Efs	10pJ/(bitm2)
Eamp	0.0013pJ/(bitm4)
Eagg	5nJ/(bitsignal)
Ecom	2nJ/(bitsignal)
ES	0.5nJ/(bitsignal)

a) **NETWORKLIFETIMEWITHOUTDATACOMPRESSION:**

Inperiodicdatacollection,nodesofsensorsensetheenvironmentandsendtheinformationtothesink.Duringthisprocessmanynodesdiewhicheffectthelifetimeofthenetwork.Figure1showsthenetwoklifetimebeforecompressingthedata.Here,itisshowninHUCLtechnique50nodesarealiveonlyupto550roundsofdatatransmissionafterthatnodesstartsdying.Similarly,upto650roundsHUCLhas30nodesalivefrom50nodeswhileIHUCLhasall50nodesalive.ThisshowsnetworkwithIHUCLtechniquehasbetternetworklifetimeandisbetterinenergyefficiency.

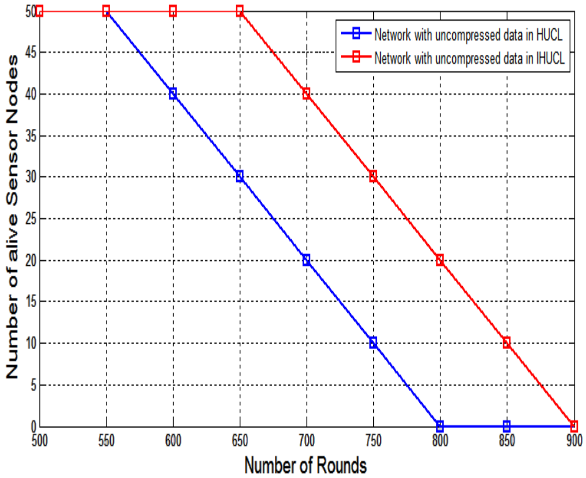

Figure1.NetworkwithoutdatacompressionforHUCLandIHUCL

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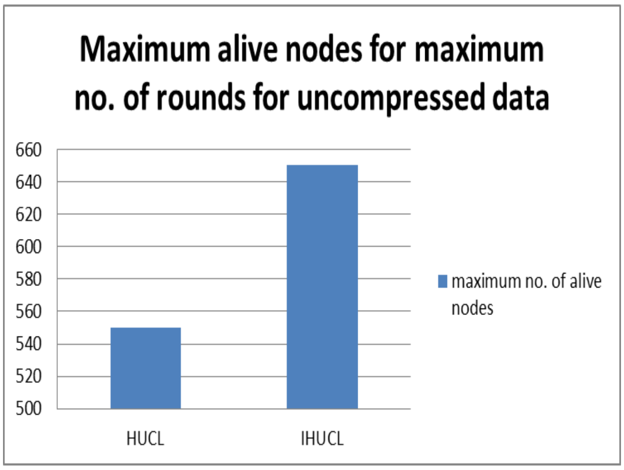

Figure2.Max.transmissionroundswithmax.alivenodesbef oredatacompressiongraphforHUCLandIHUCL

SummarizedbargraphinFigure2showscomparisonbetween averagevalueofnetworklifetimeinHUCLis550andforIHUCLtechniqueis650whichisimprovedinIHUCL.Itgivesaclearimprovementof100roundsmeans15.3%inpresentproposedtechniqueofIHUCL.

b) **NETWORKLIFETIMEAFTERDATACOMPRESSION:**Figure3isshowingtheMaxdatatransmissionroundswithmax.alivenodesafterthedatacompression.Compressiontechniqueisappliedtoenhancethenetworkefficiencysothatmoredatacanbesendinlessroundsofdatatransmission.ItisclearlyshownintheFigure3thatinHUCLall50nodesarealivetill600roundsofdatatransmissionwhileinIHUCL50nodesarealivetill700roundsoftransmissionsafterthatnodesstartsdying.ThisshowsthatIHUCLtechniqueisbetterthanHUCL.InHUCL,allnodesdieupto800roundswhileinIHUCLitismorethan900rounds.ThismakesnetworkwithIHUCLtechniquemoreenergyefficientandbetternetworklifetime.

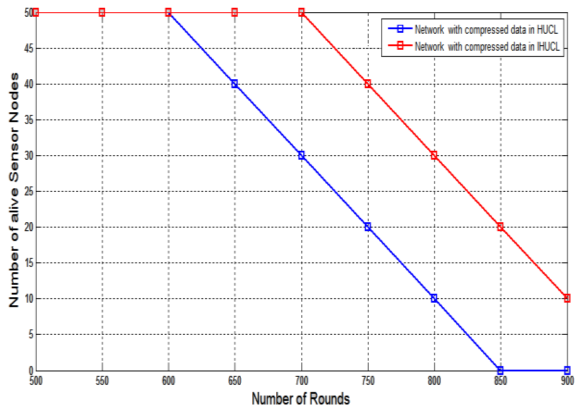

Figure3.NetworkafterdatacompressiongraphforHUCLandIHUCL

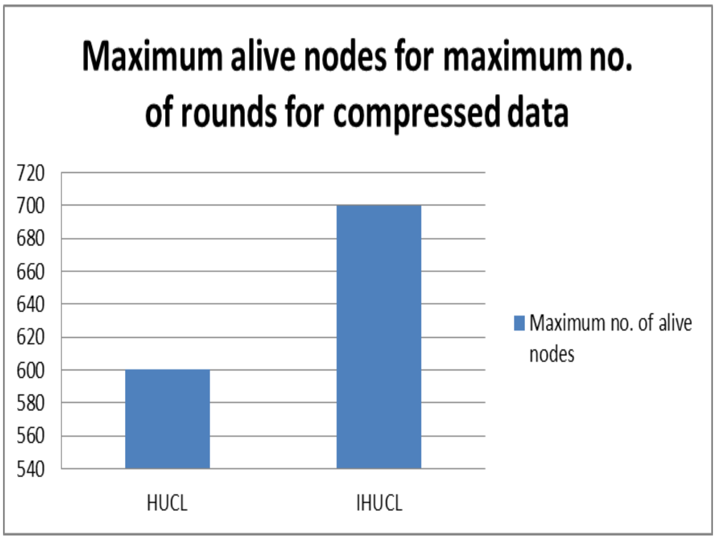

Figure4.Max.transmissionroundswithmax.alivenodesafterdatacompressiongraphforHUCLandIHUCL

Figure4showsthesummarizedbargraphofMax.transmissionroundswithmax.alivenodesforHUCLandIHUCLtechnique.Here,Max.datatransmissionroundsformaximumalivenodesarecomesoutforHUCLis600andforIHUCLis700.Thisgivesanimprovementof100roundsmeans14.2%inpresentproposedtechniqueincaseofdatacompression.

c) **SUCCESSFULPACKETDELIVERY:**Asuccessfuldeliveryofdatapacketsmakethenetworkmoreefficient.Figure5showsthat100%datapacketsaresuccessfullydelivereduntilthenumberofalivenodesisreducedto34inHUCL.PercentageofdelivereddatapacketsstartsreducingwhenthenumberofalivenodesarebelowX34,whileincaseofIHUCL100%datapacketsaredelivereduntilalivenodesarereducedto19.ThisshowsIHUCLismoreefficientindeliveringdatathanHUCLasmorenodesaredelivering100%datapacketsinIHUCLi.e31nodeswhileinHUCLonly16nodesaredelivering100%datapackets.ThisbetterpacketdeliveryinIHUCLtechniquemakesthenetworkmoreenergyefficientwithbetternetworklifetime.

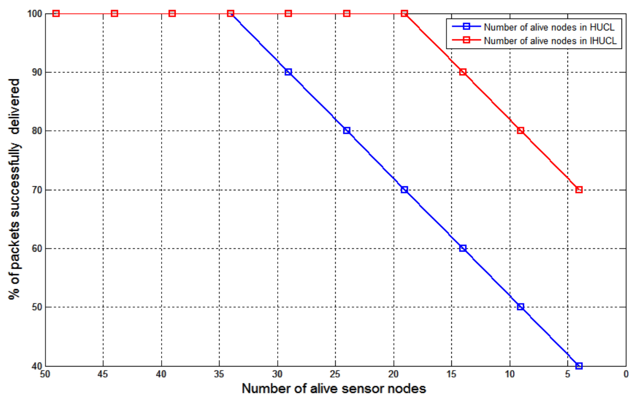

Figure5.Percentageofsuccessfulpacketdelivery

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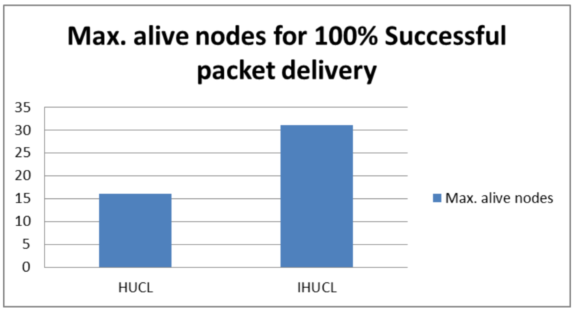

Figure6.Max.alivenodesfor100%successfulpacketdelivery

Figure6isbargraphformax.alivenodessuccessfullydeliveringthe100%data.itisclearlyshownthatinHUCLonlyupto16nodesi.efrom51nodesto31nodesaredelivering100%datawithoutanydatalossafterthatdatalossstarts.Similarly,inIHUCLtechnique31nodesi.efrom50to19nodesaredelivering100%datapackets.Theoverallimprovementisof48.3%inIHUCL.So,IHUCLtechniquehasmorenetworklifetimeandbetterenergyefficient.

d) **NetworklifeatdifferentsinkpositionsinIHUCLinuniformdistribution:**Locationofthesinkwithinaclusteralsoaffectsthenetworklifetimeincaseofuniformdistributionofnodes.Ifthesinkisinthemiddleofthegroupthanitwillmakethenetworkmuchefficient.Similarly,networklifetimealsoanalyzedatdifferentsinkpositionsi.e50mtsandat100mtswhichisfoundbetterinpresenttechnique.Figure7showsthenetworklifetimewhenthesinkisat50mtsand100mtsinHUCLanditisclearlyshownthatinHUCLmax.nodesarealiveupto500roundsincaseof100mtswhileandin50mtsmax.nodesarealiveupto550roundsofdatatransmissionthenstartsdying.Also,allthe50nodesdiein750roundsin100mtscasewhilein50mtsall50nodesdiein800rounds.Thisshowsnetworkismoreenergyefficientandhasbetternetworklifetimewhenthesinkisatnearerpositionof50mts.

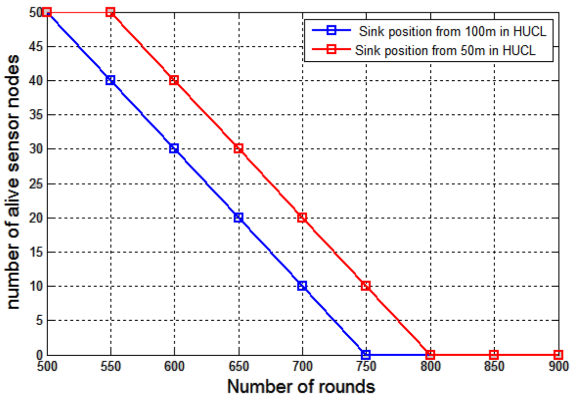

Figure7.NetworklifetimeinuniformdistributionfordifferentsinkpositionsinHUCL

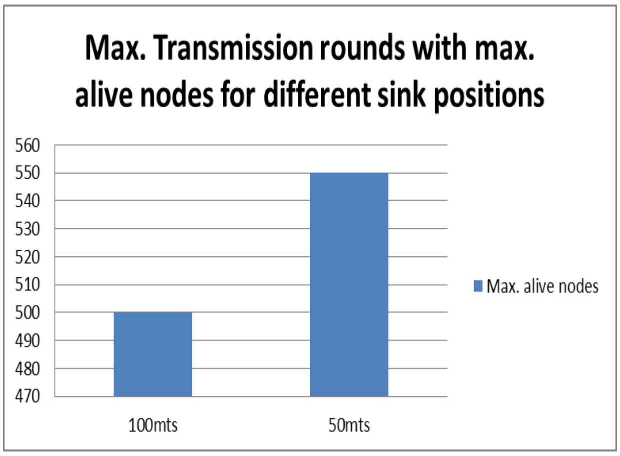

Figure8.BargraphforNo.transmissionroundsformax.alivenodesfordifferentsinkpositionsinHUCL

Figure8givesthebargraphoftheMax.transmissionroundswithmax.alivenodeswhenthesinkpositionisat50mtsand100mts.For100mtitis500roundsandfor50mtitis550roundsafterthatwithincreasingnumberofroundsnodesstartsdying.Thisgraphshowsanimprovementof9%.Henceclearly,betterpositionisnearbypositionof50mtthan100mtsinIHUCL.Thisalsoshowsthatnetworkwithnearbysinkpositionhasbetternetworklifetimeandismoreenergyefficient.

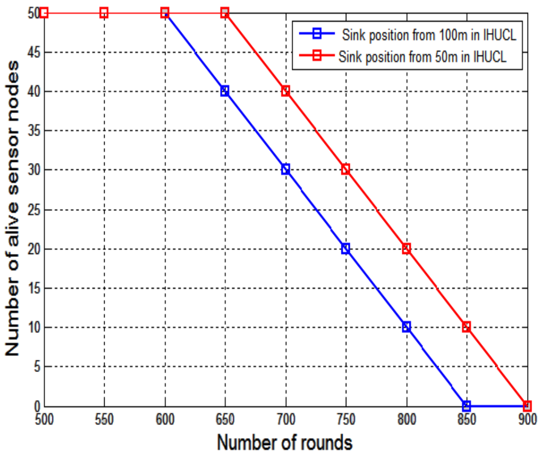

Figure9.NetworklifeatdifferentsinkpositionsinIHUCLinuniformdistribution

Figure9showsthenetworklifetimewhenthesinkisat50mtand100mtsinIHUCLtechnique.Whenthesinkisat100mtsmaximumnodesarealivefor600roundswhilewhenthesinkisat50mtsmaximumnodesarealivefor650rounds.Aftercomparingto50mtssinkpositioninHUCL,IHUCLtechniqueisbetterwhichmakesthenetworkmoreenergyefficientwithbetternetworklifetime.

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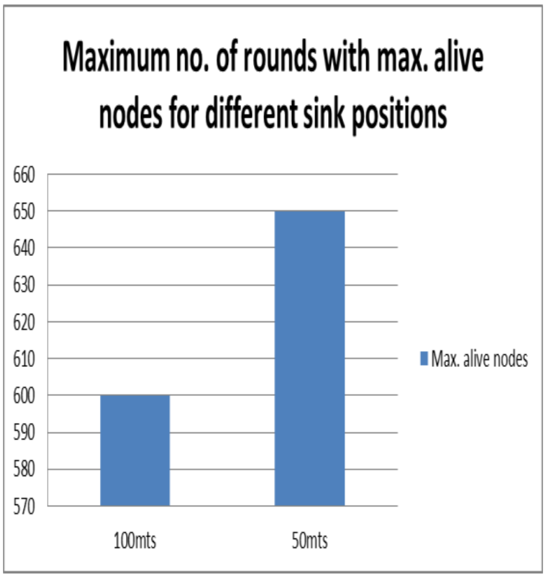

Figure10.BargraphforMax.roundsoftransmissionwithmax.alivenodesatdifferentsinkpositionsinIHUCL

Figure10isgivingthesummarizedbargraphforthemaxno.oftransmissionroundswithmax.alivenodesfordifferentsinkpositionsof50mtsand100mtsinIHUCLtechnique.Transmissionroundsforthedistanceof50mtsare650whilefor100mtsis600whichisclearlygivesanimprovementof7.69%.Hence,nearersinkpositionof50mtsgivesmoreroundsofdatatransmissionwithalivenodesmeansbetternetworklifetimeandmoreenergyefficientthanthesinkdistanceof100mts.

Table2ComparisonTableofMaximumroundsofTransmissionvaluesforHUCLandIHUCL

PerformanceMatrices	HUCL	IHUCL
1. Max.RoundsofTransmissionwithUncompressedData	550	650
2. Max.RoundsofTransmissionwithCompressedData	600	700
3. Max.nodesaliveforSuccessfulpacketdelivery	16	31
4. MaxroundsofTransmissionforsinkpositionat50mt	550	650
5. Max.RoundsofTransmissionforsinkpositionat100mt	500	600

Table2isshowingtheoverallcomparisonofproposedtechniqueIHUCLwiththeprevioustechniqueHUCL.AlltheperformancematricesareshowingthebetterresultsinIHUCLtechniquethanHUCL.WiththeuncompressedandcompresseddataIHUCLis15%and14.2%betterthanHUCLrespectively.IncaseofpacketdeliveryIHUCLis48.3%betterandincaseofnearersinkpositionof50mtsitis15.3%betterthanHUCLtechnique.StudyshowsthatIHUCLisfarbetterincaseofnetworklifetimeandenergyefficiencyasallaboveperformancematricesleadstotheoverallimprovementinlifetime'snetworkaswellasefficiencyofenergyofthewirelesssensornetwork.

CONCLUSION:

Itisbeenobservedthatgroupofsensornodesplaysavitalroleinwirelesssensornetwork.Thus,implementingclusteringtechniqueinabetterway,theenergyefficiencycanbeincreasedthenetwork,decreasethetransmissiontimeandalsoimprovenetworklifetime.Butaswehaveseenclusteringcanbeusedeitherstaticordynamicform.Dynamicclusteringtechniquecanenhancenetworklifetimeandresidualenergybutalsoincreasethenetworkoverheadswhichseemtobenotacceptableinrealtimedatatransmissions.Toovercomethisfacet,anewtechniquehasbeenintroducedhereandnamedasIHUCL(ImprovedHybridUnequalClusterLayeringprotocol).ThemathematicalexpressionsobservesitsimprovementstowardsnetworkoverheadswhichconsequentlyincreasetheNetworkLifetimeandEnergyEfficiencyisbetterinpresenttechnique.

REFERENCES

1. V.Geetha,P.V.Kallapur,S.Tellajeera,ClusteringinWirelessSensorNetworks:PerformanceComparisonofLEACH&LEACH-CProtocolsUsingNS2,ProcediaTechnol.4(2012)163–170.doi:10.1016/j.protcy.2012.05.024.
2. S.He,Y.Dai,R.Zhou,S.Zhao,AClusteringRoutingProtocolforEnergyBalanceofWSNbasedonGeneticClusteringAlgorithm,IERIProcedia.2(2012)788–793.doi:10.1016/j.ieri.2012.06.172.
3. R.Mhemed,N.Aslam,W.Phillips,F.Comeau,AnEnergyEfficientFuzzyLogicClusterFormationProtocolinWirelessSensorNetworks,ProcediaComput.Sci.10(2012)255–262.doi:10.1016/j.procs.2012.06.035.
4. R.Dutta,S.Gupta,M.K.Das,Efficientstatisticalclusteringtechniquesforoptimizingclustersizeinwirelesssensornetwork,ProcediaEng.38(2012)1501–1507.doi:10.1016/j.proeng.2012.06.185.
5. S.Bayrakli,S.Z.Erdogan,Geneticalgorithmbasedenergyefficientclusters(GABEEC)inWirelessSensorNetworks,ProcediaComput.Sci.10(2012)247–254.doi:10.1016/j.procs.2012.06.034.
6. M.Dhivya,M.Sundarambal,LifetimeMaximizationinWirelessSensorNetworksusingTabuSwarmOptimization,ProcediaEng.38(2012)511–516.doi:10.1016/j.proeng.2012.06.063.
7. N.Javaid,T.N.Qureshi,A.H.Khan,A.Iqbal,E.Akhtar,M.Ishfaq,EDDEEC:Enhanceddevelopeddistributedenergy-efficientclusteringforheterogeneouswirelesssensornetworks,ProcediaComput.Sci.19(2013)914–919.doi:10.1016/j.procs.2013.06.125.
8. S.P.Singh,S.C.Sharma,Asurveyonclusterbasedroutingprotocolsinwirelesssensornetworks,ProcediaComput.Sci.45(2015)687–695.doi:10.1016/j.procs.2015.03.133.
9. M.Mirsadeghi,A.Mahani,M.Shojaee,ANovelDistributedClusteringProtocolUsingFuzzyLogic,ProcediaTechnol.17(2014)742–748.doi:10.1016/j.protcy.2014.10.193.
10. S.E.L.Khediri,N.Nasri,A.Wei,A.Kachouri,Anewapproachforclusteringinwirelesssensorsnetworksbasedon LEACH,ProcediaComput.Sci.32(2014)1180–1185.doi:10.1016/j.procs.2014.05.551.
11. S.Mahajan,J.Malhotra,S.Sharma,AnenergybalancedQoSbasedclusterheadselectionstrategyforWSN,Egypt.InformaticsJ.15(2014)189–199.doi:10.1016/j.eij.2014.09.001.
12. S.Dehghani,M.Pourzaferani,B.Barekatain,ComparisononEnergy-efficientClusterBasedRoutingAlgorithmsinWirelessSensorNetwork,ProcediaComput.Sci.72(2015)535–542.doi:10.1016/j.procs.2015.12.161.

13. F.Boutekkouk,F.Taibi,K.Meziani,Ahybridapproachtoextendthelifetimeofheterogeneouswirelesssensornetworks,ProcediaComput.Sci.63(2015)136–141.doi:10.1016/j.procs.2015.08.323.
14. R.Sharma,N.Mishra,S.Srivastava,AproposedEnergyEfficientDistanceBasedClusterHead(DBCH)Algorithm:AnImprovementoverLEACH,ProcediaComput.Sci.57(2015)807–814.doi:10.1016/j.procs.2015.07.481.
15. S.Salehian,S.K.Subraminiam,UnequalClusteringbyImprovedParticleSwarmOptimizationinWirelessSensorNetwork,ProcediaComput.Sci.62(2015)403–409.doi:10.1016/j.procs.2015.08.433.
16. N.Mazumdar,H.Om,Coverage-awareUnequalClusteringAlgorithmforWirelessSensorNetworks,ProcediaComput.Sci.57(2015)660–669.doi:10.1016/j.procs.2015.07.437.
17. L.Malathi,R.K.Gnanamurthy,K.Chandrasekaran,Energyefficientdatacollectionthroughhybridunequalclusteringforwirelesssensornetworks,Comput.Electr.Eng.48(2015)358–370.doi:10.1016/j.compeleceng.2015.06.019.
18. S.Sirsikar,K.Wankhede,Comparisonofclusteringalgorithmstodesignnewclusteringapproach,ProcediaComput.Sci.49(2015)147–154.doi:10.1016/j.procs.2015.04.238.
19. G.Raval,M.Bhavsar,N.Patel,AnalyzingthePerformanceofCentralizedClusteringTechniquesforRealisticWirelessSensorNetworkTopologies,ProcediaComput.Sci.57(2015)1026–1035.doi:10.1016/j.procs.2015.07.516.
20. V.Gupta,R.Pandey,Animprovedenergyawaredistributedunequalclusteringprotocolforheterogeneouswirelesssensornetworks, Eng.Sci.Technol.anInt.J.19(2016)1050–1058.doi:10.1016/j.jestch.2015.12.015.
21. M.Arioua,Y.elAssari,I.Ez-zazi,A.elOualkadi,Multi-hopClusterBasedRoutingApproachforWirelessSensorNetworks,ProcediaComput.Sci.83(2016)584–591.doi:http://dx.doi.org/10.1016/j.procs.2016.04.277.
22. J.Tsiligaridis,C.Flores,ReducingEnergyConsumptionforDistributedEM-basedClusteringinWirelessSensorNetworks,ProcediaComput.Sci.83(2016)313–320.doi:10.1016/j.procs.2016.04.131.
23. A.Shankar,N.Jaisankar,ANovelEnergyEfficientClusteringMechanisminWirelessSensorNetwork,ProcediaComput.Sci.89(2016)134–141.doi:10.1016/j.procs.2016.06.022.
24. S.Potthuri,T.Shankar,A.Rajesh,LifetimeImprovementinWirelessSensorNetworksusingHybridDifferentialEvolutionandSimulatedAnnealing(DESA),AinShamsEng.J.(2016).doi:10.1016/j.asej.2016.03.004.