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A Review on Clustering Based Algorithm with Fuzzy Logic in Wireless Sensor Network

[1]Akhlaq Ahmed, [2]R.L Yadav

[1]*Research Scholar, Dept Computer Science and Engg, Kautilya Institute of Technology & Engineering, Jaipur*
[2]*Associate Proffesor, Dept Computer Science and Engg, Kautilya Institute of Technology & Engineering, Jaipur*

Abstract—Wireless sensor network (WSN) is an upcoming & promising technology for the future. The cost-effective, as well as smart sensors production which shown in the advancement with the deployment in ease from of the WSNs. Consumption of Energy is an open & major researched form of issue in the WSNs. energy from Sensor is utilized by the data generation, memory accession, & with the processes of input/output. on the other hand, wireless communication among the nodes uses up power in more amount. Therefore, researchers work to build up novel ways which facilitate data processing of intra-cluster through grouping the nodes in the form of clusters. Such methods abolish sensing of data which is redundant in form & transmission cost be lower and lower network load. Formation of Cluster is extensively needed method for the data management, reducing the communication overhead, maintaining a better version of traffic control, also improving the efficiency of energy with the stability of the network. For WSNs, different clustering methods been presented which have targeted to the conservation of energy in maximized form. In the given paper, the complete survey is performed on clustering & fuzzy logic inside the network.

Keywords—Wireless Sensor Network, Clustering, Energy, LEACH, Fuzzy Logic.

I. INTRODUCTION

Technology advances in energy consumption and wireless communication have enabled the development and the deployment of new applications based on WSNs. A WSN is an ad-hoc network which consists of tiny devices by limited energy and computational resources and is equipped with sensors in order to gather physical measures from the monitored environment. A lot of research effort has been spent on WSNs and many architectures and protocols have been developed. The typical form of civil WSNs is generally not being a complex form of monitoring systems, whose uses include the monitoring of environment & habitat, home automation, industrial sensing, and intelligent transportation systems. In given WSNs, sensors collect the needed information, typically in accordance with a fixed form of schedule which is temporal, also transfer it to sink, which interfaces by a server/system. At given point data from sensors which can then be processed, sooner than it is stored.

Wireless communication technologies are experiencing fast developments. The most recent couple of years have encountered a lot of development in research in the field of wireless sensor networks (WSNs). Wireless sensor networks (WSNs) are a standout amongst the most usable and significant technologies in the twenty-first century. Wireless sensor networks are composed of a vast number of inexpensive, low power and multi-functional sensor nodes which are used in an area which we need. For the most part, WSNs are used to gather data from different areas of the physical world and furthermore they are deployed in controlled and uncontrolled locations, so wireless sensor networks are insecure by their applications and deployment nature.

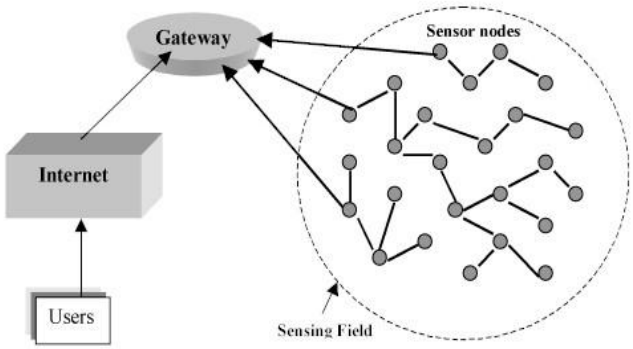

Fig.1. WSN Overview

These networks have various limitations like node (less computational power, less memory, less energy and so on.), network (the network is acting as a mobile ad-hoc network) and physical limitation (deployed in various areas like public and hostile environments) which makes them completely vulnerable against different security attacks. The main challenge which effects on security and reliability of sensor networks is the ad-hoc nature of it. Due to the restricted computational and processing compels ordinary security methods and strategies are not appropriate to look after

Authentication, Availability, and Integrity in WSN. Wireless sensor networks (WSNs) are amazingly vulnerable and helpless to the outside and inside attacks as they comprise of various devices with limitations like; less memory, related low energy, and low battery power. In WSNs the nodes are communicating with wireless links. In WSNs still, there are unsolved issues and security is one of the most important research issues. WSN networks are deployed in hostile areas [1].

II. WSN APPLICATIONS

A. Air Pollution

The chemical form of reactions that include air pollution makes harmful ozone form of gas which influences individuals' well-being and furthermore it could harm plant & creature life as well. So for the prior discovery of such air poisons, WSN is utilized. This aide in the estimation of destructive pollutants of air & fundamental particles of meteorological form. The framework utilizes the air quality file. By contrasting the got information by the value of the index and the list esteem, the framework distinguishes the contaminated air.

B. Forest Fire

In the vast majority of nations such as Australia, the event of forest flame is basic on account of the dry & hot atmosphere. This harm wild lives. So as to avert forest fire to few expand WSN are utilized. The technique utilized WSN to recognize the flame utilizing the sensor proving ground. It takes highlights like vitality productivity, an early form of detection & accurate form of localization, conjecture ability which are energy to cruel natural conditions. The energy utilization of the nodes of the sensor is exceptionally less. The framework is fit for the stage in any sort of ecological circumstances.

C. Gas Leakage

Gas leakage is an unsafe issue which may make harm human life just as creature life. The framework comprises of CPU, air condition sensor arrays, recipient module, GPS, secure computerized memory card storage module, LCD and GPRS. The information put away as well as showed & it likewise has the capacity to give caution if the circumstance goes out of hand. An ultra-wideband of the sensor system is utilized in searching for oil as well as gas. A seismic procurement framework is presented for oil and gas exploration in seas.

D. Coal Mines

Another significant use of WSN is in coal mining. The general population working in coal mines those are confronting numerous dangers form of Cave-ins, gas blast, vehicle or gear impact or crushing, leakage of chemicals, electric shock and fires. So it’s unavoidable to screen given fields constantly for the well-being of general population mines working. The sensors gather the data on earth & the area. As the parameters such as temperature and compound rates those are ceaselessly checked utilizing sensor, it averts chances of threat till a certain level.

E. Water Quality

Another significant utilization of the WSN is also to screen nature of the water. Different parameters of water quality, for example, pH, smelling salts, disintegrated oxygen level, water level, etc can be checked by utilizing WSN. Three sorts of observing techniques are utilized in checking water condition. CDMA techniques based on the remote water quality checking for the fish culture.

F. Vehicle Tracking

Transportation of smart form is another utilization of the WSN. Networked form of cameras also different sensors which are utilized to screen traffic stream to lessen clog, following of the vehicles on the city meant for criminal traffic offense also to distinguish illicit exercises around basic framework like airplane terminals, railroad station and so forth. Mobile sensor device in open transport form of vehicles suggests a helpful way to develop an efficient outcome for a given classification.

G. Health care Monitoring

These days, the utilization of the WSN in the form of the medical field is unavoidable. The framework comprises of the sensors to detect different specification of physiological form. The detected parameters which are further transferred to expert for upcoming examination & conclusion. A few works have been finished by utilizing WSN. The framework comprises of best no: of subjective remote sensors to distinguish the use of electrical gadgets, bed use pattern as well as water stream. Aside since the location, it consolidates panic buttons for patients if there is crisis occurrence. The framework helps in checking the wellness level & exercise limit lessens the hazard elements like corpulence, BP and diabetics and furthermore improves the strength of the cardiovascular framework and consequently guides in extending future. The patient will wear ECG sensor also the sensor will ceaselessly transfer information to an emergency clinic or to the doctor with no fall flat those will produce in constant observing of the patient.

H. Smart Buildings

A keen structure can screen and control its very own form of functionalities, as per structure, indoor/outside condition. The functionalities with their attributes are straightforwardly identified with structure scope. The framework screens the current & voltage devoured through apparatuses of the household. The benefits of a given framework are ease & adaptable in the activity. The methodology proposes the combination of the WSN with remote correspondence methods to help the management of energy in keen structures. WSN empowered brilliant home conditions to make inescapable

and pervasive applications. The framework performs an adaptable administration and setting attention to the end client. The framework likewise builds up an application & reports its acknowledgment in veritable WSN to present remote home security.

I. Military Applications

WSN plays an indispensable component of equipped command, control communication, computing, intelligence, surveillance, reconnaissance by working on (C4ISRT) frameworks. The fast use, self-association & error acknowledgment peculiarity of sensor systems which create them an extremely cheerful detecting procedure for military C4ISRT. Since sensor systems rely on thick exploitation of not reusable & minimal form of effort in sensor hubs, demolition of certain nodes with forceful activities doesn't manipulate a military task as the annihilation of a standard sensor does, which makes sensor nodes through an improved form of methodology for a better field.

J. Animal Tracking

Creature following is another utilization of WSN N/W in which sensor is appended to creatures' body with the goal that transportation & position of creature can be recognized. A case of utilizing WSN in creature following is the Zebra Net that is utilized to follow zebras in the field. The sensors are appended in the creature's body with the goal that position, area & sort of sustenance they are expending can be checked. Zebra tracking is one of the fundamental uses of WSN in creature raising. The neckline mounted form of sensors is connected to zebra's neck. This sensor helps in following of zebra constantly. Numerous looks into are going on in the creature following and transportation field utilizing sensor Networks [18].

III. ENERGY EFFICIENT IN WSN

The recent form of advances within the low power transceivers as well as dimensions of a microprocessor which take us to cost-effective small devices of sensor which gather sensing by the computation, storage as well as communication. However, the key issues in the WSNs are power consumption, knowing the fact about sensors which are normally battery powered. For example, a battery-operated sensor device that wakes up once every few minutes to check an environmental parameter needs to consume as little power as possible in order to minimize the battery replacement. In many of the cases, nodes being deployed in the harsh environments, like the underwater, where a battery of replacing be an operation of unfeasible form. Extending lifetime of the n/w is a key concern. In fact, there is the main requirement that makes a wireless protocol ideal for use in the WSNs that is energy efficiency. A lot of exertion has been made by scientists to discover powerful systems so as to build a lifetime of the n/w. These methodologies incorporate system node organization, directing components and information aggregation. Truth be told, a suitable node organization is presumably the most basic issue to be tended to diminish correspondence costs inside a WSN.

Accordingly, when the network is conveyed, the utilization of a suitable routing mechanism could help to impressively expand its lifetime the fact that an advantageous selection of paths to route information may result in huge energy protection. Along these lines, arrange lifetime streamlining can be accomplished not just with the decrease transmission of packet control, yet in addition with the inclusion of information handling so as to lessen the measure of information transferred to sinks; this is the guideline behind protocol node clustering [2].

IV. CLUSTERING IN WSNS

The SNs are assembled into gatherings of distinct or arbitrary quantity. This strategy is recognized as clustering. [3] The gatherings of hubs are known as clusters. For each group, a hub is chosen as a Cluster Head (CH). This CH is chosen arbitrarily from all hubs of a group. For the choice of CH different systems are utilized. The CH ought to be qualified for keeping up the group. In a group, there is single CH & the rest of the hubs are Member Nodes (MN). The main task of the CH is, to sum up, the information from the Member Nodes and send it to the BS. While the different hubs persistently since the zone & send the data to the CH. The lifetime of CH is shorter when contrasted with MNs. Subsequently, the hub chose as CH ought to have a high energy level. Hubs with less energy are unsuccessful rapidly. In clustering, there are 2 types of communication happens like inter & intra cluster. The individuals from the group can speak with the CH & the CH can speak with the different CHs. Additionally, the clustering strategy includes the meaning of the group estimate. The hub thickness close BS ought to be less contrasted with the hubs far away. The BS ought to be equipped for detecting the distant bunches or else information is lost [4].

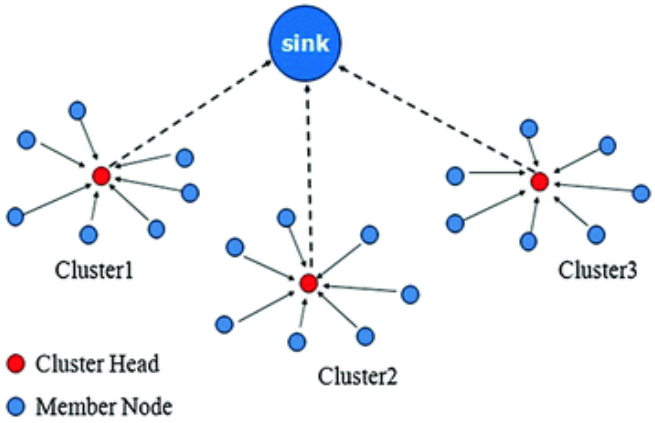

Fig.2. Clustering approach

A. LEACH

Low-Energy Adaptive Clustering Hierarchy (LEACH) is the initiating grouping coordinating strategies for the WSNs. The crucial idea of the LEACH has an inspiration for a few, bringing about bunching directing conventions. The basic objective of the LEACH is to pick sensor hubs as CHs by unrest, so abnormal state of vitality dispersal in talking with BS is being spread to the entire of sensor hubs in the framework. The assignment of LEACH is isolated into loads of rounds, where each round is separated into 2 arranges, the set-up stage and steady-state organize. In set-u, organize gatherings are dealt with, while in the persevering state arrange data is passed on to BS. At the season of the set-up stage, each hub chooses whether to transform into a CH for the flow around. This choice depends on the proposed type of dimension of CHs for a framework and the events the hub been a CH till this point. This determination is set up by center point picking a self-assertive number someplace in the scope of 0 and 1. The hub transforms into a CH for the current round if the number is less from the limit:

$$T(n)=\begin{cases}\dfrac{P}{1-P\left(r \bmod \dfrac{1}{P}\right)}, & \text{if } n \in G \\ 0, & \text{otherwise}\end{cases}$$

Here P is the perfect dimension of the CHS, r is current round, and G is a game plan of the hubs which haven't been picked CHs in last adjusts of 1/P. Right when the hub is picked CH adequately, it imparts a promotion message to various center points. According to the got sign nature of the advertisement, various hubs decide to which bunch it will join for this round and send an enlistment message to its CH. In order to fairly proper vitality load among sensor center points, CHs turn is performed at each round by creating another notice arrange. At the season of the consistent state organize, sensor hubs sense likewise transmits data to CHs. The CHs pack data touching base from center points that have a spot with the individual bunch and send a gathered or joined bundle to the BS direct. In addition, LEACH utilizes a TDMA/ (CDMA) MAC termed as code-division multiple access to lessen between the collision of inter-cluster or intra-bunch. After a specific time, which is resolved from the earlier, the network returns into set-up stage again & enters an additional round of CH decision.

The LEACH advantages consist of the following:

(1) few nodes which served as CH in the convinced round can't be chosen as the CH once again, so every node share an equal amount of the load imposed on to the CHS to few levels;

(2) TDMA Utilization schedule avert CHs as of collisions which is not necessary;

(3) members of Cluster can open communication else close communication interfaces inside the compliance through their assigned time slots so as to avert the numerous dissipation of energy.

Therefore, there present a few forms of disadvantages in the LEACH as follows.

(1) It plays out single-jump between inter-cluster, straightforwardly from CHs to BS, technique of routing, which isn't pertinent to enormous district n/w. It isn't generally a sensible supposition for single-jump between inter-cluster directing with long correspondence extends. other then, long-extend communication legitimately from CHs to the BS can breed an excess utilization of energy;

(2) In spite of the way that CHs revolution is performed at every round to accomplish load balancing (LB), LEACH can't guarantee genuine LB on account of sensor nodes with various measures of beginning energy, on the grounds that CHs are chosen as far as probabilities without considering the energy. Sensor nodes, lower initial clustering, which go about

as CHs for indistinguishable no: of rounds from further sensor hubs, with the higher introductory energy, will prematurely die. This could achieve energy level holes as well as issues of covering;

(3) as CH decision is performed as far as probabilities, it's tough for foreordained CHs to consistently appropriated all through the n/w. Thusly there exist the picked CHs that are assembled in one bit of the framework and a couple of center points that have no CHs in their locale [5].

Table I. Comparison of clustering approaches in wireless sensor network [6]

Clustering mechanism	Pros.	Cons.
Static clustering	• Illustrations stable presentation • Offers minimal latency in transmission	• Obtains low-efficiency data aggregation • New nodes are not permitted to join system
Dynamic clustering	• Monitoring vitality of hubs • Data collection is constantly performed adjoining the objective	• Delay experienced in cluster head race • More control bundle overhead
Combined clustering	• High exhibitions for following the objective in the single accumulation area	• It debases execution in a couple cases as a result of checking of the objective in dynamic clustering area when there are various or exceptionally versatile targets
Adaptive clustering	• Adaptive selection of data aggregation based on applications and environments	• The adaptive clustering device demonstrates incompetence in large-scale network

V. FUZZY LOGIC

FL is being efficient inexperience of modeling and behavior of decision making of the individual.

1) Fuzzifier: In Fuzzy applications, framework data sources are a form of a crisp set that should be changed into the fuzzy sets. Every fuzzy set is doled out level of the membership. Consequently, change of the crisp set into linguistic esteem which is suitable is finished with fuzzifier.

2) Fuzzy Rule Base: It contains the guidelines IF-THEN dictated by the customer. Standard base by methods for on the off chance that demonstrates the conduct of dynamic structure fluffy framework. The base of the fuzzy standard is named as information level base.

3) Inference Engine: fuzzy interference engine by i/p & IF-THEN guidelines attempt to reproduce the derivation arrangement of the individual. Fuzzy interference engine assumes a crucial job inducing and drawing determination from conditions principle base.

4) Defuzzification: De-fuzzification procedure complete the fuzzy set gained mapping from inference engine form of crisp set esteem that can be utilized for making few inferences. The centroid is determined through de-fuzzifier for registering likelihood [7].

VI. CLUSTERING USING FUZZY LOGIC

Lingering type of vitality and required vitality is 2 phonetic elements for data being used as a fuzzy logic framework. In the principle organize, every SN satisfies the vitality expected to transmit the no: of bits signified by 'k' to BS subject to pick up the quality of the sign of the conveyed message through BS. Hubs set its time conflictingly regard relating to getting variable of the fluffy type of a rationale framework called as 'possibility'. The ascent in the estimation of probability, the significantly more be a probability of hub to transform into group type of the head. Each SN sets commencement, and on off chance that gains zero, the node publicizes CH itself & clusters are being framed dependent on separation among the sensors. In the 2nd stage, TDMA calendar is being gained by the head of the cluster also transfer it to a cluster of persons [8].

VII. LITERATURE SURVEY

In this paper [8], a FUZZY based form of balanced expense CH selection algo shortly termed as (FBECS) is method those contemplate over remainder vitality, fairness through sink also the thickness of hub into its region as a contribution to Fuzzy Inference System. Qualification file is determined for every hub for the choice of CH job. This convention LB adjusting by picking the best contender for the job of the facilitator of CLUSTER from letting likelihood relegated to every sensor node. The test o/c approves presentation of the FBECS to its partners BCSA with the LEACH based on better strength period, draw out lifetime help of LB & huge data sending to the sink.

In paper [9], appropriate CH determination issue is tended to. It broadens LEACH through actualizing FL. Contributions to FIS are the remainder level battery, BS mobility & clusters' centrality. Mamdani's standard is utilized to choose super type CH. The convention performance is improved in lifetime & dependability.

Singh et al. [10] proposed HEED Regard with various dimension heterogeneity which depends on the model parameters & displays energy productivity with the better throughput with the packet conveyance to the BS.

In EEFL-CH, [11] the author has improved LEACH convention with diminishing energy utilization by utilizing Fuzzy based methodology. This convention utilizes 3 forms of parameters specifically anticipated productivity, closeness to the BS and leftover energy for the cluster arrangement.

Mehra et al. [12] proposed a basically zonal based cluster arrangement in which field is apportioned into 3 equitized zones. The arrangement of CH is being dynamic so as to offset heap through uniform squandering of vitality through conveyed SN. The planned work diverges from Z-SEP, SEP, DEEC and LEACH & recreation show all-inclusive stable period & delayed range with a bigger number of bundle conveyance to BS.

FZSEP-E [13] has worked on Fuzzy logic in a group arrangement. Factor like separation to BS, node thickness & lingering energy form of SN are considered as well as altogether builds adequacy in the energy utilization and n/w lifetime.

In [14] creator proposed fuzzy-based routing convention for adjusting load / limiting energy exhaustion. The CH determination 6 parameters viz. form of separation to the BS, thickness, leftover vitality, weakness record, remove among CH & Significance.

Alami et al. [15] proposed CAFL which is an upgrade of CFFL. In given methodology, the creator has picked remainder energy / BS of Closeness for CH determination & for cluster arrangement, Closeness to CH & energy remnant of speculative CH are being considered in case of effectiveness.

In [16], the author proposed energy cognizant protocol into which 2 forms of BS is situated on the other side of the objective region. In given convention, 2-dimension energy heterogeneity being utilized for the maximizing system lifetime.

Rajkumar & Chandrakanth [17] In this paper, we then propose a novel grouping algo for the WSN that decline systems energy use & impressively expand its lifetime. Here principle pretends the allotment of the CHS (Cluster Heads) from the one corner to other of system. Recreation result demonstrates broad abatement in system energy usage & in this manner increment the lifetime of the network.

Conclusion

WSNs have turned into the most tremendous territory of research. A typical WSN is made out of a great deal of the sensor nodes(SN) that pleasantly check the physical or natural conditions and produce a ton of information that ought to be then routed by methods for various jumps to sink or base station(BS) from the framework. vitality usage is open likewise the most issue with the inquired about structure in the WSNs. Sensor vitality is eaten up by the information age, memory advancement, and I/p or yield process. WSN is a gathering of the huge form of measure of minor gadgets for example sensor nods, circulated over a huge region. node is the collaborated device of the WSN which is merged up with the processing, communication and sensing capacities. The essential segments of the nodes are battery (limited), processor (restricted), energy (constrained), transceiver & memory in limited quantity. In this paper, we have focused on clustering technique and fuzzy logic in WSN.

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