An Augmentation of Data Collection Functioning With Implementation by Pattern Variation Discovery in Wireless Sensor Networks: Novel Overview with Applications

Mohd Muntjir

Research Scholar OPJS University
Churu, Rajasthan, India
Email-muntjir.m@gmail.com

Dr. Vaibhav Bansal
Associate Professor - CSE
OPJS University,
Churu, Rajasthan, India

Abstract— **A few years ago, the applications of Wireless Sensor Network were adequately a fascinating paradigm than an influential expertise. Currently, this technology entices still more and more technical audience. Speculative works from the earlier, where Wireless Sensor Network ideologies were examined, developed into noticeable applications basically incorporated by this time in a real existence. It could be assumed, that Wireless Sensor Network previously protects innumerable application subjects, from army to healthcare. Composed with this technology growth, still innovative and new tasks and stimulating complications are occurring. The Wireless Sensor Network can be distributed into two parts: one that comprises the massive amount of sensor nodes and the other, which comprises the network, designed by those sensor nodes in WSN. The sensor nodes are furnished with limited possessions. Accordingly, WSNs face the difficulties like separated WSNs due to which recognized data gets superfluous by the base station, records irregularity drawback, and energy incompetence. A mobile robot is required to be used that can notice the separated WSNs and can successfully gather the sensed data from the sensor nodes. The main purpose is to reduce the travelling distance of the mobile robots. Therefore that sensed data could be drawn efficiently and with minimum period. We also recommend and appliance a methodology named pattern variation discovery to perceive the anomalies exist in the data composed by the sensor nodes in WSN. Concurrently, such application activities encourage the progress of Wireless Sensor Network concept that at the same time exposes original application opportunities.**

Keywords- Wireless, Wireless Sensor, Wireless Sensor Networks, data inconsistency, Wireless Sensor, robot routing, data mining, travelling salesman problem with neighborhood, and TSPN.

1. INTRODUCTION

This Wireless Sensor Networks (WSNs) is depends on a simple equation: Sensing + CPU + Radio = Thousands of achievable applications. Wireless sensor network is a type of wireless network. It is minor and organization less. Mainly wireless sensor network contain a number of sensor node, called tiny device and these are working together to discover a area to take data about the atmosphere [1]. Wireless Sensor Networks (WSN), as the spatially allocated networks comprised of a number of reasonably ingenuous, low-cost, low-power mechanisms connected equally, deliver fairly wide purpose collection for distinctive branches of economy. Even though, the main examples could be acknowledged the industry, military, agriculture, transport, and healthcare. However, in the near opportunity, even greater development of Wireless Sensor Networks application collection is estimated. Wireless Sensor Networks are a relatively innovative application of ad-hoc networks delivering high attribute observing for enormous environmental areas with comparatively reasonable equipment's. The technology involves deploying a large number of small, low-priced nodes over the area of relevance. Each node is furnished with one or numerous sensors, a short-range radio and a microcontroller. The nodes shape an ad-hoc network efficient of sending the detected data to one ore more base positions that further advancing the data using a long haul link to the checking midpoint. The first applications of Wireless Sensor Networks were military but there are also numerous civilian purposes: habitat monitoring, organization health monitoring, border enforcement, etc. The experiments in Wireless Sensor are accessible to each node. Maximum explanations compelling consolidated handling or comprehensive information are probable extravagant for large Wireless Sensor Networks [2]. Nowadays wireless sensor networks are bi-directional and are intellectual sufficient to control the sensor accomplishments. The foremost reason behind the invention of Wireless sensor networks (WSNs) was the necessity to construct and support military applications like battlefield observation. However, WSNs are used most essentially in observing and sensing much physical sensation scheduled in the atmosphere such as modification in pressure, temperature, humidity, intensity, and even in the field of health care Wireless Sensor Network has grown acceptance.
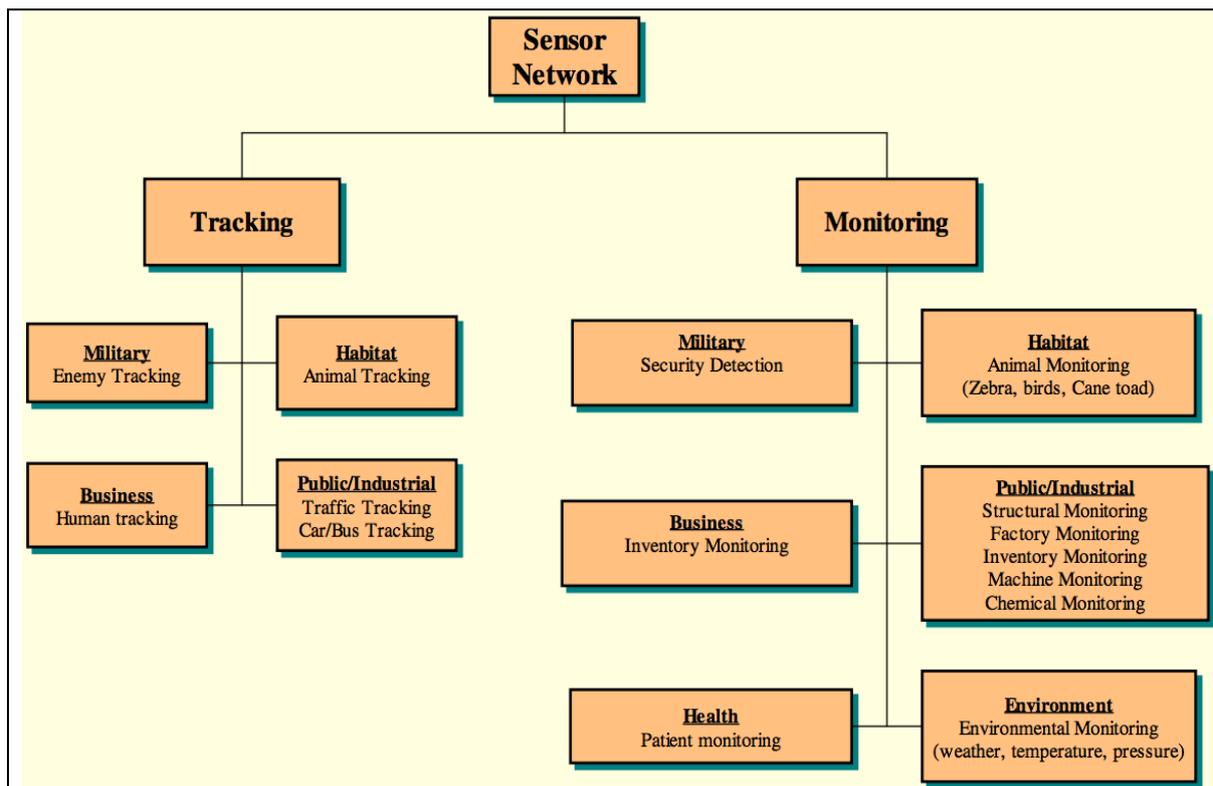
Fig.1. Overview of Sensor Application

An incorporation of Wireless Sensor Network within the public data networks as well as within the domains where reliable and private data are administered produces along difficulties associated to the proper and permissible inquiries too. Consequently, the relations as social protection or ethical safety should not be ignored.
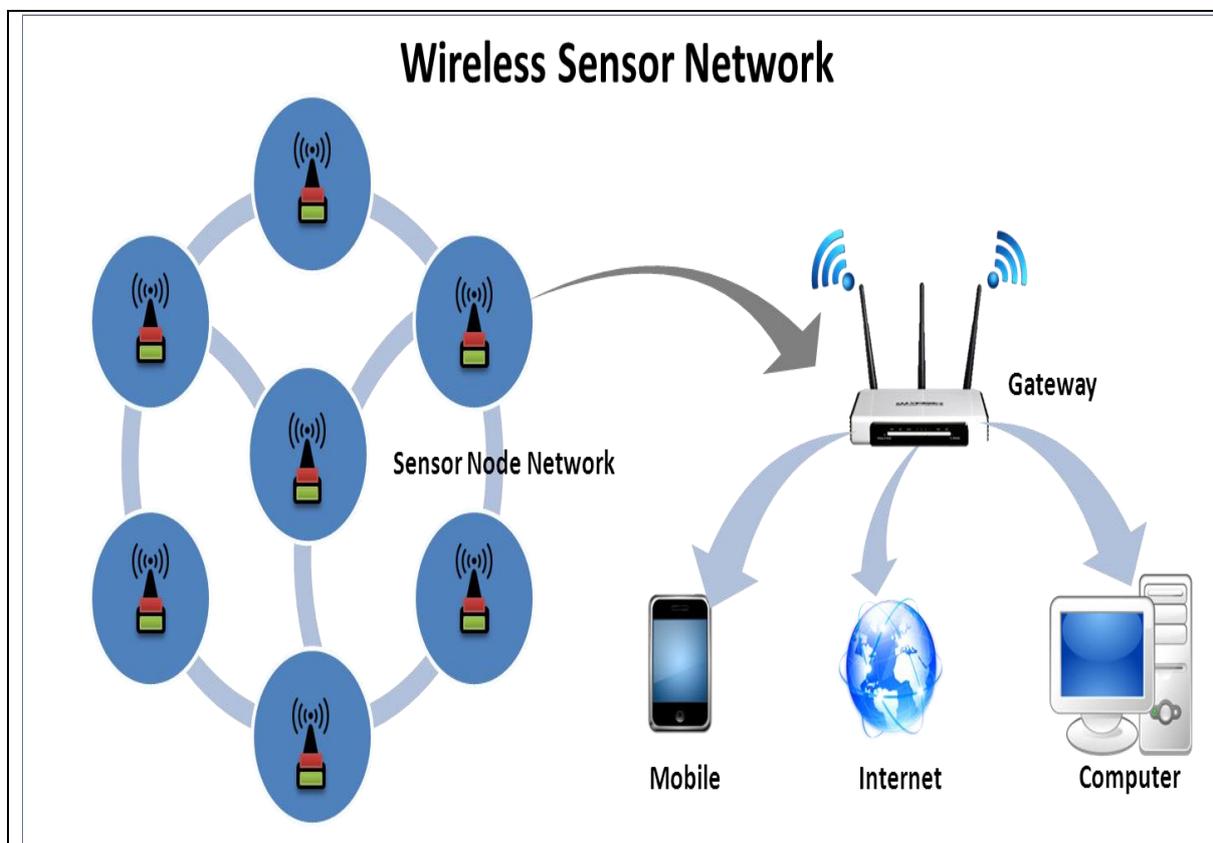

Fig.2. Framework of Wireless Sensor Network

2. CATEGORIES OF WIRELESS SENSOR NETWORKS **(WSNs)**

There are primarily 2 types of WSNs:

A. Unstructured WSN (Wireless Sensor Network)
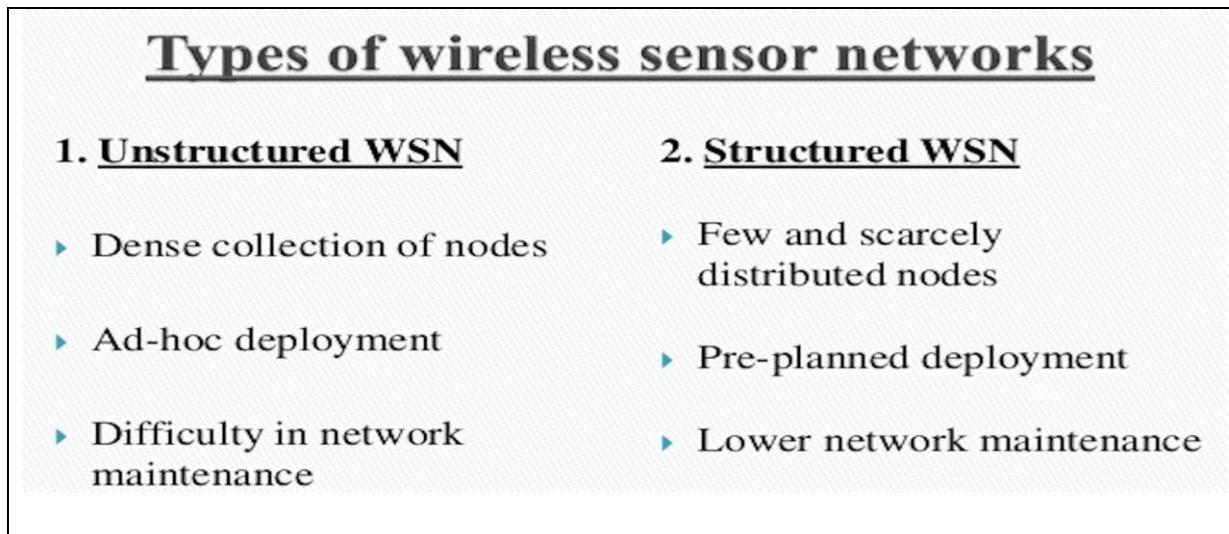
B. Structured WSN (Wireless Sensor Network)

Fig.3. Block diagram that depicts the types of WSNs

3.2 Unstructured Wireless Sensor Network

An unstructured Wireless Sensor Network is one that comprises a compressed collection of sensor nodes. Numerous problems may occur during the employment of a formless sensor network. Likewise the sensor nodes do not have a dependable collision recognition device and they do not have knowledge about the network topology. Disparate structured Wireless Sensor Network; unstructured WSNs acquire a large number of sensors nodes that are distributed casually in the network. Due to its ad-hoc environment and large number of sensor nodes participation, conservation becomes a boring job to do. Furthermore, it is more disposed to connection failure as associated to Structured WSNs and the recognition of connection miscarriage is also an overhead. Consequently, if contrast wants to be made between structured and unstructured WSNs we can say that structured WSNs is more beneficial than unstructured WSNs as it is more cost efficient and comprises less preservation and organization charge [3]. It will be beneficial in developments such as arranging nodes for volcanic activity scrutinizing; military commitments like object pursuing and monitoring conservational situations in remote regions.
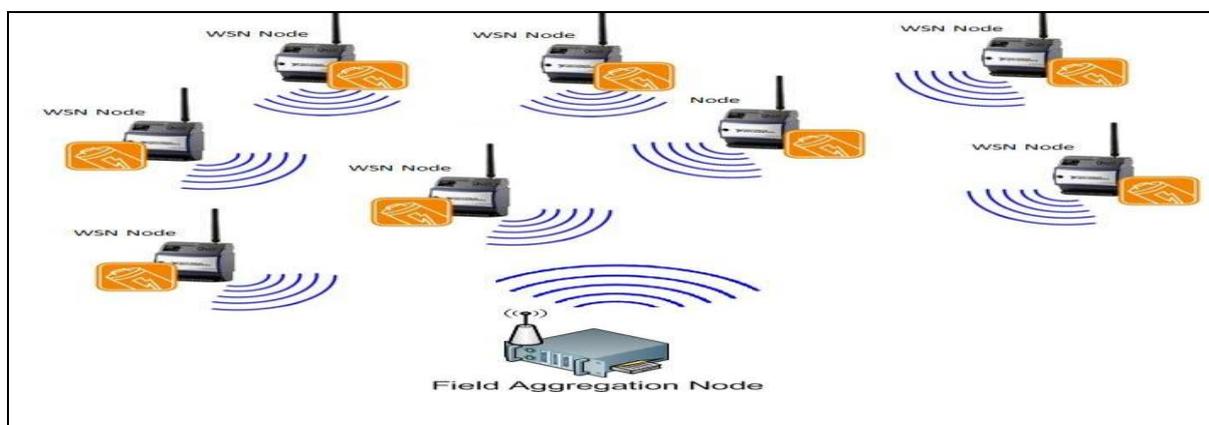

Fig.4. Unstructured WSN

3.3 Structured Wireless Sensor Network

In a structured Wireless Sensor Network, all or particular of the sensor nodes are organized in a pre-planned

method The benefit of a structured network is that fewer nodes can be organized with lower network preservation and administration price. Structured Wireless Sensor Networks has limited number of sensor nodes that are dispersed in predefined approach. Therefore, continuance is pretty simpler dissimilar in unstructured WSN and due to lesser number of sensor nodes intricate.
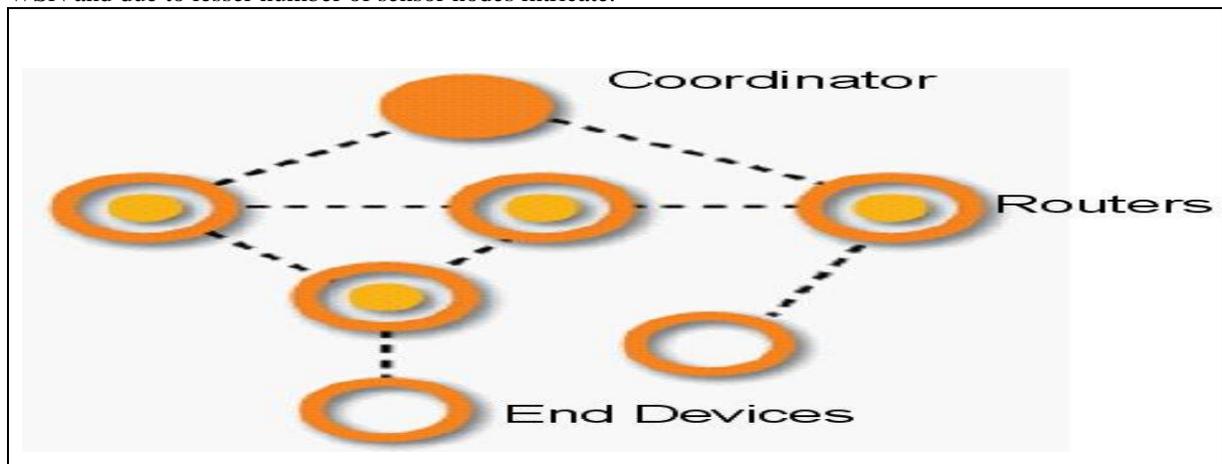

Fig.5. Structured WSN

3. OVERVIEW OF AN ARCHITECTURE FOR WIRELESS SENSOR NETWORKS (WSNs)

   Wireless sensor network objective is to deliver well-organized association among the physical conservational situation and Internet domains. The sensor nodes of the wireless sensor network is permits arbitrary arrangement in unapproachable landscapes, it means protocol of the wireless sensor is self structured,

   These are very elastic to accept any kind of topology. It can be organized either by using any simple topology like star topology or by expending a complex one for example multi-hop wireless mesh network. Additional significant feature of the wireless sensor network (WSN) is supportive effort of the sensor nodes. Sensor nodes are collecting data around atmosphere, behind assembling it they procedure it and then communicate to the base station. Furthermore, base station stipulates a boundary between user and Internet. Essential standard of the wireless sensor network (WSN) are inadequate energy, active network topology, lesser power, node disaster and flexibility of the nodes, short-range broadcast communication and multi-hop routing and large measure of distribution. In the wireless sensor network design comprises both a hardware proposal and an operating system planned.
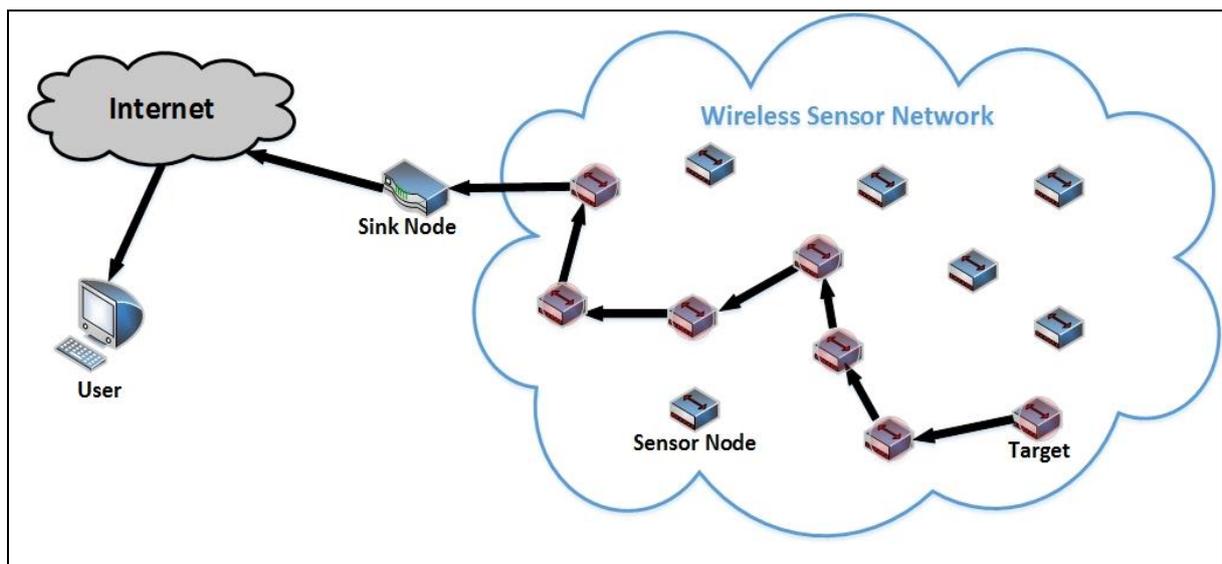

Fig.6. Typical wireless network architecture

As the diagram represents, Wireless Sensor Network architecture is mostly distributed into three essential objects:

1. Sensor Nodes

2. Sink Node (Gateways)

3. Software installed on host computer

3.3   The technique with that the process works:

In a WSN, the sensor nodes are allocated into the real world in order to sense the data and fold the communication by monitoring its environments. That detected data are required to be directed wirelessly hop-by-hop across the gateway nodes, that is in additional associated to the host computer. Essentially, gateway nodes communicate the data acknowledged from sensor nodes to the host computer over wired broadcast. As soon as the mobilized data grasped at host computer, we can investigate it; existent it and can accomplish some other computational tasks in order to change into expressive information by using the software connected on the host communication.

3.2 Wireless Sensor Node in Wireless Sensor Network:

A wireless sensor node is a widespread solution when it is challenging or unbearable to run a mains supply to the sensor node. Furthermore, a wireless sensor node can be surrounded in arrangements, such as bridges or buildings. By using willingly accessible technology, similar energy harvester procedures, small and effective storage procedures, single-chip, wireless sensors node explanations will soon be commercially feasible and ordinary technology. A wireless sensor network is collected of various sensor nodes, that are accountable of sensing, following and gathering the valuable data. The underneath block diagram supports to deliver the strong vision about the mechanisms of a sensor node in WSN [10].
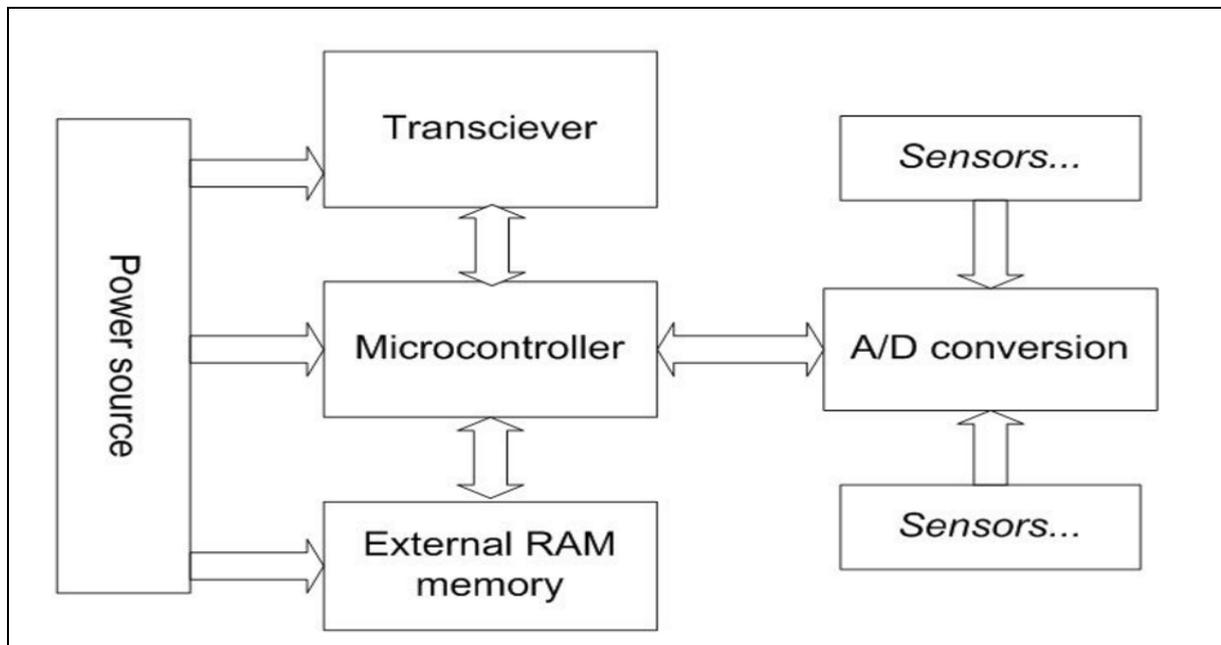

Fig.7. Block Diagram of components of a Sensor Node

3.3   Issues Elaborate in Wireless Sensor Networks

Wireless Sensor Networks are comprised of large number of sensor nodes that are delivered with inadequate possessions. Furthermore, Wireless Sensor Networks work wirelessly in the punitive atmosphere. So, Wireless Sensor Networks not only face the reserve concerns but also the network issues like connection disaster, alteration in topology etc. Underneath is the short-lived conversation of the subjects that Wireless Sensor Networks confront while employed its responsibilities:

3.3.1 Restricted Power Supply for Sensor node:

In a Wireless Sensor Network, the sensor nodes are provided with the partial power reserve, which affect its power competence. Sensor nodes need energy to execute its all the tasks like compilation of data, synchronization with other sensor nodes, broadcast of sensed data and monitoring of any vary happening in the atmosphere. However with the inadequate power, the life distance of the sensor nodes gets abbreviated. The main troubles, which arise when the energy of a sensor node start depleting is that it won't be persist its work additional and won't be able to organize with the other sensor nodes obtainable in the surroundings [12]. Eventually, that meticulous sensor node will be stated as dead node. Due to which, the exaggerated Wireless Sensor Network will separate itself from the other Wireless Sensor Networks accessible in the network and all

the data composed by that portioned Wireless Sensor Network will not be transmitted to the sink node as this portioned Wireless Sensor Networks can't be seen by the sink node [4].

3.3.2 *Steadiness of Data in sensor Node:*

In a Wireless Sensor Network (WSN), the sensor nodes not for all time gather the significant data. Hence the cause after this can be intervention occurs in wireless surroundings, and connection failure, harsh network situation can cause the compilation of unpredictable data. Furthermore, it is not forever necessary to sense data, which in turn consume the energy that is not at all compulsory. Therefore there is a requirement to investigate when the data should be composed and how it should be twisted into the significant sequence. A variety of data mining techniques can be used to execute this assignment [3].

3.3.3 *Wireless Sensor Nodes routing and preservation:*

In WSN, due to the enormous sensor nodes association and wireless environment, preservation and administration of these nodes are become essential. Hence, the working of sensor nodes and the synchronization between them keep on going efficiently, not including any obstruction. Furthermore, Wireless Sensor Networks should be competent sufficient to regulate and restore itself if there is any modifications in topology and routing has been occurred [9].

3.3.4 *Diverse description of sensor nodes in Wireless Sensor Network:*

As already conversed, Wireless Sensor Networks are collection of a huge amount of sensor nodes each of which has their own prospective in terms of recollection, dispensation power and sensing capability [4]. Therefore, while distributing the loads to the sensor nodes in WSN, system should reflect on the abilities of each node and give them load according to their abilities and prospective. The partitioned Wireless Sensor Networks difficulty, that is caused due to the energy reduction of energy of the sensors nodes and can be optimized by using the mobile robots [2]. Furthermore, these mobile robots can collect and propel the sensed data composed by the partitioned Wireless Sensor Networks to the sink node. However for this the position of the partitioned Wireless Sensor Network is essential to be recognized. Analyst take many significant decision based on the data composed by sensor nodes in the Wireless Sensor Networks. Therefore, the date requires being precise and advanced. On behalf of this, different data mining techniques can be implemented to investigate and pull out consequential data from the database dump [3]. In a WSN, If mobile robots are being used to gather the sensed data from the partitioned Wireless Sensor Networks, afterward there is a requirement of using a appropriate navigational approach that can not only help the mobile robots to perceive the partitioned Wireless Sensor Networks but also conduct it to how to covenant with the snags comes into its pathway. [6]

4. SOME RELATED WORKS DONE FOR DATA COLLECTION PERFORMANCE IN WSN

Khushboo Sharma, Manisha Rajpoot and Lokesh Kumar Sharma in "Nearest Neighbor Classification for Wireless Sensor Data" Has used a Nearest Neighbor Classification technique to classify the data expected by sensor nodes in WSNs. This technique solves the problem of data irregularity, which occurs due to the refusal of sensed data composed by partitioned Wireless Sensor Networks and the unrelated data composed by the sensor nodes of Wireless Sensor Networks. Furthermore, a Nearest Neighbor Trajectory is used for the classification of data sensed by sensor nodes. Moreover, nearest neighbor classifier procedures the patterns only when the demand is made to categorize a query vector in WSN. Hence, the technique works in two parts: I) predicts the classes of sensor data and II) nearest neighbor trajectory begin the training of sensor data and create a model with a finest representation [4].

Cheng Chen, Tzung-Shi Chen and Ping-Wen Wu in "Overview On Data Collection Using Mobile Robots In Wireless Sensor Network" in 2011 have projected a data collecting algorithm that conducts the mobile robot to gather the sensed data from the partitioned Wireless Sensor Networks which previous used to be redundant by the base station as it could not be proficient to establish the partitioned Wireless Sensor Networks. Furthermore, due to the refusal of the sensed data of partitioned Wireless Sensor Networks by base station, troubles like data discrepancy comes into the play. Hence, to determine such issues, authors have projected two approaches for the direction finding of island Wireless Sensor Networks: I) Local based approach and II) Global based approach. Moreover, authors have also précised scheduling techniques that are essential to program the navigational system of mobile robot. Hence, the scheduling techniques are based on three things: I) time, II) location and III) dynamic moving based. Furthermore, Ns-2 simulator has been used to create the scenarios and approach with advancement [5].

Bo Yuan, Member, IEEE, Maria Orlowska, and Shazia Sadiq in "Optimal Robot Routing Problem In Wireless Sensor Networks" .in 2007 have proposed how the mobile robots can be used to visit given sensor nodes dispersed in Euclidean plane in order to collect data from that sensor nodes. Moreover, the authors have

projected a method which can be used to solve NP-hard problem which is a unique case of Travelling Salesman Problem and Neighborhoods which in turn helps in minimizing the total travelling distance enclosed by the mobile robot while assembling the sensed data in WSN [7].

Marcelo B. Soares, Mario F. M. Campos, Dimas A. Dutra, Vector C Da S. Campos and Guilherme A. S. Pereira in "Hybrid Mobile Robot Navigational Strategy For Efficient Data Collection In WSN" in 2007 have proposed the Hybrid Mobile Robot Navigational approach, that is used to notice the correct location of partitioned Wireless Sensor Networks in order to conduct the mobile robot to accumulate the sensed data from that approach. Moreover, this hybrid mobile robot navigational approach works at two different layers: I) Reactive Layer and II) Planning Layer. Furthermore, the reactive layers help in assembling the representation of composed data and planning layer offers the strategy for the mobile robot in WSN. Hence, it can accumulate the data from partitioned Wireless Sensor Networks without any obstruction [8].

Shruti Kaushik, Baninder Singh in "An Efficient Data Collection Technique In Wireless Sensor Networks" in 2105 have emphasized that, in many of the applications is necessary to excavate the sensor reading for pattern in real time in order to make intellectual decision. Furthermore, the irregularities in sensory data are of interest of observing the choose applications in WSNs. Hence, for this kind of applications in WSNs, the communication charge can be condensed if only normal sensory values as conflicting to all values in WSN are broadcasted [11]. Moreover, the detection of irregularities is strongly consistent to modelling of sensor data. Hence, the problem of irregularities detection is to find those sensory values that diverge extensively from the standard [13].

Rouhollah Maghsoudi et al.in 2011[14] Data mining knowledge in reaction to technological advances in various Rmynh, base arena is built there. Data Mining face a different situation that the data size is large and want to make a small model and not too complicated and yet the data as well as describe. The Requisite is to use data analysis to reduce the amount and the huge volume of information. One important and sensible facts in the world of machine intelligence and is robotics robots routing. Robot router has obstacle recognition and how to deal with the decision with barrier. For routing, algorithms including probabilistic methods (filtering particulate), evolutionary algorithms like as genetic, ant's social and optimization particle mass, neural methods - Fuzzy, inequality of matrix method relayed on gradient methods combined sensor information, etc. There are data mining schemes in the years 2010-2008 as a technique for routing and a absolute robot has been used and still is in progress. Overview of the methods in the paper mentioned in diverse articles since 2000 has so far. Although many data mining methods comprise, but mentioned in this article with precise literature data mining will deal with the routing problem.

Laxmi Choudhary in 2012[15] with the rapid improvement of computer and information technology in the last many years, an enormous amount of facts in science and engineering has been and will continuously be produced in massive scale, either being stored in gigantic storage strategy or flowing into and out of the system in the type of data streams. Moreover, such data has been made widely available, e.g., via the Internet. Such tremendous quantity of data, in the array of tera- to peta-bytes, has fundamentally changed science and engineering, transforming several disciplines from data-poor to increasingly data-rich, and calling for new, data-intensive methods to conduct research in science and engineering. In this paper, author discuss the research challenges in science and engineering, from the data mining perspective, with a center on the following issues: (1) information network analysis, (2) discovery, custom, and understanding of patterns and knowledge, (3) stream data mining, (4) mining moving object data, RFID data, and details from sensor networks, (5) spatiotemporal and multimedia data mining, (6) mining text, Web, and other unstructured data, (7) facts cube-oriented multidimensional online analytical mining, (8) visual data mining, and (9) data mining by combination of sophisticated scientific and engineering domain knowledge.

R. Sivaranjini et al.in 2013[16] Nowadays Wireless sensor networks playing vital role in all are Which is used to sense the environmental monitoring, Temperature, Soil erosion etc. Low data delivery competence and high-energy consumption are the inherent problems in Wireless Sensor Networks. Finding precise data is more difficult and also it will lead to added expensive to collect all sensor readings. Clustering and prediction techniques, which develop spatial and temporal correlation among the sensor data, provide opportunities for reducing the power consumption of continuous sensor data collection and to achieve network energy efficiency and stability. So as recommend Dynamic scheme for energy consumption and data collection in wireless sensor networks by combining adaptively enabling/disabling forecast scheme, sleep/awake method with dynamic scheme. Our framework is clustering based. A cluster head demonstrate all sensor nodes inside the region and collects data values from them. Our framework is common enough to incorporate many advanced features and show how sleep/awake scheduling can be applied, which takes our scaffold approach to designing a practical

dynamic algorithm for data aggregation, it avoids the need for rampant node-to-node broadcast of aggregates, but rather it uses faster and more efficient cluster-to-cluster propagation.

Neelamadhab Padhy et al. [17] suggested that In this paper author have focused a variety of techniques, approaches and various areas of the research which are helpful and marked as the important field of data mining Technologies. As we are awaken that many MNC's and large organizations are operated in different places of the different countries. Each place of operation may produce large volumes of data. Corporate decision makers require access from all such sources and take planned decisions .The data warehouse is used in the significant business value by improving the effectiveness of managerial decision-making. In a uncertain and highly competitive business environment, the value of strategic information systems such as these are easily renowned however in today's business environment, efficiency or speed is not the only key for competitiveness. This type of vast amount of data's is available in the form of tera- to peta-bytes, which has radically changed in the areas of science and engineering. To analyze, manage and make a decision of such type of vast amount of data we need techniques called the data mining, which will transform in many fields. This paper imparts extra number of applications of the data mining and also o focuses scope of the data mining, which will helpful in the further research.

5. PROPOSED WORK FOR ENHANCING DATA COLLECTION PERFORMANCE IN WSN

5.1 The Main Research Objectives For Data Collection Performance:

In the terminology of WSN ,the given a set of sparsely dispersed sensors in the plane a mobile robot is needed to visit all sensors to download the data and return back to his desired location. Furthermore,the well-organized range of each sensor is summarized and the robot must at least reach the border to start communication again and again. Hence the major target of optimization is to minimize the travelling distance by the robot. So that,the problem can be observed as a individual case of the Travelling Salesman Problem with Neighbourhoods,tiny sensor nodes thar is equipped with sensing with the communication capabilities and calculation can be organized in large numbers in geographical regions to observe, detect and report proceedings. Wireless networks having of such sensors generate stimulating prospects for major scale and inspection applications.Hence, in many of the applications it is necessary to extract the sensor readings for patterns in real time in order to make intellectual conclusions. Furthermore,the detection of sensor data irregularities is helpful for practical applications because the patterns originate can be used for both decision-making in applications and system performance tuning in a plane. i.e. irregularities in sensory data are of interest of observing applications. Hence,for this type of applications, the communication cost can be condensed if only ordinary sensory values as disparate to all values in WSN, are spreaded. Moreover,the main difficulty of irregularities detection is to find those sensory values that diverge drastically from the norm. So,this problem is significant in the sensor network setting because it can be used to recognize abnormal or attractive events or defective sensors in WSNs.

5.2 Research Methodology Used to Solve this Approach:

A new approach named pattern variation discovery is used to solve this problem. *In WSNs,* We have emphasized a new methodology named pattern variation discovery is expended to resolve this drawback. In this approach, first of all we require to provide the definition of normal patterns. In this definition ,can be models of several sensory attributes or constraints among numerous features. Moreover,the next step contains the discovery of irregularity. When a normal pattern is fragmented at some points, irregularity develops. i.e, the pattern variation occurs. Recognition of sensor data irregularities i.e, we need to determine the irregular distribution pattern among multiple sensory attributes along time. Formerly, for each time fact, we can put the charges of a group of sensory attributes at a series of sensor nodes into a matrix, that signifies a distribution status.

Our approach works in the following three steps:

5.2.1 *Selection of a reference frame:.* This frame consists of the directions along which we want to look for irregularities among multiple sensory attributes. An analyst can explicitly specify the reference frame. It is also possible to discover the reference frame that results in a lot of irregularities.

5.2.2 *Definition of normal patterns:* This definition can be models of multiple sensory attributes or constraints among multiple attributes.

5.2.3 *Discovery of irregularity;* whenever a normal pattern is broken at some point along the reference frame, irregularity appears. That is, the pattern variation happens.

Furthermore,the difficulty then becomes to discover the irregular matrix among a set of matrices in WSN.
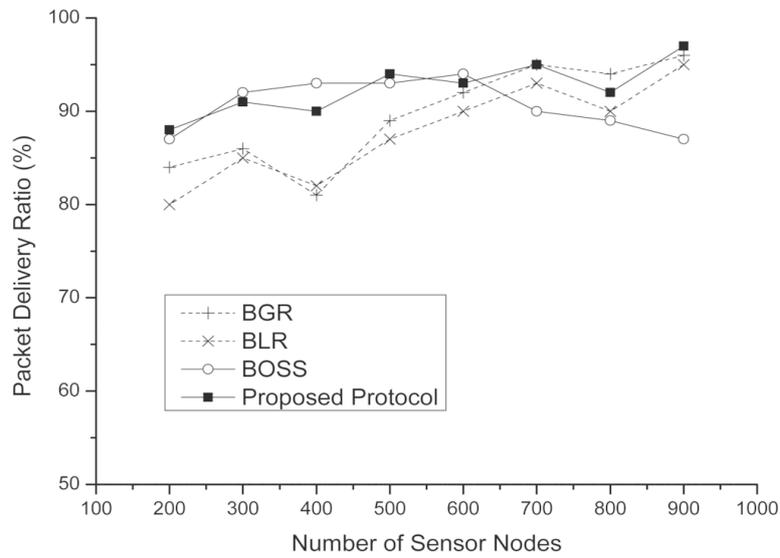
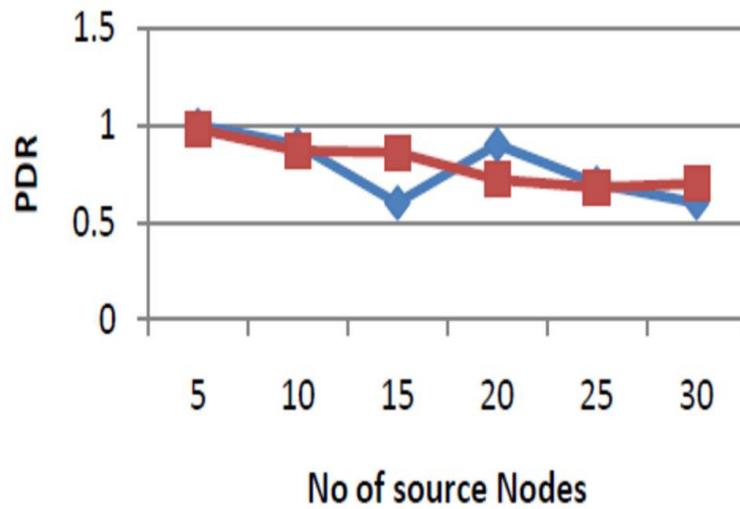Fig.8. the packet delivery ratio vs. the number of sensor nodes

Fig.9. Packet delivery ratio vs. the number of source nodes

To complete the evaluation, we applied our data mining technique to achieve the consequences that demonstrate that this technique is quite cooperative to prevent the energy of wireless sensor networks(WSNs). Furthermore,there are total 30 nodes in the network and out of that only 10 are using the energy of comprehensive Wireless Sensor Networks.

Fig.10. Total energy and average energy consumed by the 10 nodes in WSN

Fig.11. Results based on the number of flows, total run time involved, total load, average delay faced, and average throughput achieved

6. CONCLUSION

A pattern variation discovery is used to recover the energy proficiency of Wireless Sensor Networks. The packets with irregularities are redundant to prevent the energy and recover the quantity of the Wireless Sensor Networks. The screenshots construct it much clear that if a pattern variation discovery technique is expended, the total load can also be condensed. Moreover,in spite of 30 nodes only 10 nodes are intensing the energy that carries pertinent data. Therefore, the summary of this data mining technique can recover the sensed data collecting and energy competence of Wireless Sensor Networks. . The data collected consists all the information about the region. But sometimes users need only the specific information and for users remaining information is handled as immaterial.

ACKNOWLEDGMENT

REFERENCES

[1] Kiran Maraiya,Kamal Kant,Nitin Gupta,"Application based Study on Wireless Sensor Network", International Journal of Computer Applications (0975 – 8887) Volume 21– No.8, pp 9-15,May 2011

[2] I.F. Akyildiz and W. Su and Y. Sankar asubramaniam and E. Cayirci, "Wireless Sensor Networks: A Survey" IEEE Computer, vol. 38, no. 4, pages 393-422, Mar. 2002.

[3] Jennifer Yick, Biswanath Mukherjee, DipakGhosal, Department of Computer Science, University of California, Davis, CA 95616, United States

[4] Khushboo Sharma, Manisha Rajpoot, Lokesh Kumar Sharma, Department of Computer Science and Engineering, Rungta College of Engineering and Technology, Kohka Road, Kurud, Bhilai, India.

[5] Tzung-Cheng Chen, Tzung-Shi Chen, Member, IEEE, and Ping-Wen Wu.

[6] AdiMallikarjuna Reddy V AVU Phani Kumar, D Janakiram, and G Ashok Kumar, Distributed and Object Systems Lab, Department of Computer Science and Engineering, Indian Institute of Technology Madras, Chennai, India – 600036,fadi, phani, d.janakiram,ashokg@cs.iitm.ernet.in, May 3, 2007

[7] Bo Yuan, Member, IEEE, Maria Orlowska, and Shazia Sadiq, School of Information Technology and Electrical Engineering, The University of Queensland, QLD 4072, Australia, E-mail: {boyuan, maria, shazia}@itee.uq.edu.au.

[8] Marcelo B. Soares, Mario F. M. Campos, Dimas A. Dutra,V´_ctor C. da S. Campos and Guilherme A. S. Pereira

[9] H. Park, W. Liao, K. H. Tam, M. B. Srivastava, and L. He. A uni_ed network and node level simulation framework for wireless sensor networks. Technical report, September 7 2003.

[10] L. K. Sharma, O. P. Vyas, S. Schieder, and A. K. Akasapu,"A NearestNeighbour Classification for Trajectory Data", Springer CCIS, Volume 101, Part 1, pp. 180-185, 2010.

[11] E.M. Arkin and R. Hassin, "Approximation Algorithms for the Geometric Covering Salesman Problem," Discrete Applied Math., vol. 55, no. 3, pp. 197-218, 1994.

[12] Wang Zhangqi ,Zhu Xiaoguang ,Han Qingyao, School of Mechanical Engineering,North China Electric Power University.071003 Baoding, China

[13] Shruti Kaushik, Baninder Singh, "An Efficient Data Collection Technique in Wireless Sensor Networks", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 6,pp 176-181,2015

[14] Rouhollah Maghsoudi,, Somayye Hoseini , Yaghub Heidari," Surveying Robot Routing Algorithms with Data Mining Approach", Vol .2 No.2 (2011) 284-294

[15] Laxmi Choudhary," CHALLENGES FOR DATA MINING", Volume 2, Issue 2 (February 2012)

[16] R.Sivaranjini, E.Dinesh,"An Adaptive scheme for energy consumption and data collection in Wireless Sensor Networks", Volume 2 Issue 3 ‖ March. 2013 ‖ PP.50-55

[17] R. Shah, S. Roy, S. Jain, and W. Brunette, "Data MULEs: Modelling a Three-Tier Architecture for Sparse Sensor Networks," Elsevier AdHoc Networks J., vol. 1, pp. 215-233, Sept. 2003