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PERFORMANCE ASSESSMENT OF COMMUNICATION OVERHEAD FOR DIFFERENT CLUSTERING ALGORITHM USING WIRELESS SENSOR NETWORKS

Vandana Yadav[1], Mr. Devendra Patle [2]
EC Department, SSSUTMS University, Sehore, M.P./466001, India[1]
EC Department, SSSUTMS University, Sehore, M.P./466001, India[2]

Abstract

Currently, WSN (Wireless Sensor Network) is the most standard services employed in commercial and industrial applications, because of its technical development in a processor, communication, and low-power usage of embedded computing devices. The WSN is built with nodes that are used to observe the surroundings like temperature, humidity, pressure, position, vibration, sound etc. The clustering is an efficient technique used to achieve the specific performance requirements of large scale wireless sensor networks. We have carried out the performance analysis of cluster-based wireless sensor networks for different communication patterns. In this work we are using fuzzy clustering; k-mean and self organizing map (SOM) based clustering method. It is observed that overhead in cluster based protocol is not much dependent upon update time. Simulation a result indicates that a cluster based protocol has low communication overheads compared with the velocity based protocol.

Keywords: WSN, k-mean, fuzzy, SOM, Protocol, Communication overheads.

1. Introduction

The wireless sensor networks are interesting network to study due to the fact that large number of applications are being developed using these networks system. A wireless sensor network of the type investigated here refers to a collection of sensors, and nodes that are linked by a medium which is wireless in nature system.
A wireless sensor network (WSN) in its simplest form can be defined as a network of (possibly low-size and less complex) devices which are denoted as nodes that can sense the environment and communicate the information gathered from the monitored field through wireless channel or link. In the data is forwarded, possibly via multiple hops relaying, in sink network that can use it locally, or connected to other networks. The idea of development of wireless sensor networks was initially motivated by military applications. Wireless sensor network provides a reliable, low power method for making measurements in applications where cabled sensors are impractical or otherwise undesirable, low maintenance. In the nodes are connected in senor, wireless sensor network (WSN) is a large network of resource-constrained sensor nodes with multiple preset functions used, sensing and processing, to fulfill different applications.
The wireless network sometimes more specifically referred as wireless sensor and actuator networks as described in a Wireless sensor networks (WSNs) enable new applications and require non-conventional paradigms for protocol design due to several constraints. Wireless sensor network are using Global Positioning System (GPS) and local positioning algorithms can be used to positioning information and obtain location. Straight and non-direct static and dynamic examination and configuration program for three dimensional structures. The application has numerous highlights for taking care of a wide scope of issues from straightforward 2-D supports to complex 3-D structures. Creation and change of the model, execution of the examination, and checking and enhancement of the plan are completely done through this single interface. Graphical showcases of the outcomes, including ongoing activities of time-history removals, are effectively created.

1.1 Wireless Sensor Network

Network to a main location or sink where the data can be observed and analyzed. One can be retrieve required information from the network by injecting queries and gathering results from the sink. The sensor nodes can communicate among themselves using radio signals. For

typically a wireless sensor network contains hundreds of thousands of sensor nodes. It have individual nodes in a wireless sensor network (WSN) are inherently resource constrained they have limited processing speed, communication bandwidth and storage capacity. After the sensor nodes are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication.

Wireless sensor devices in respond to queries sent from a "control site" to perform specific instructions or provide sensing. The working mode of the sensor nodes may be either continuous or event driven. Wireless sensor devices can be equipped with actuators to "act" upon certain conditions.

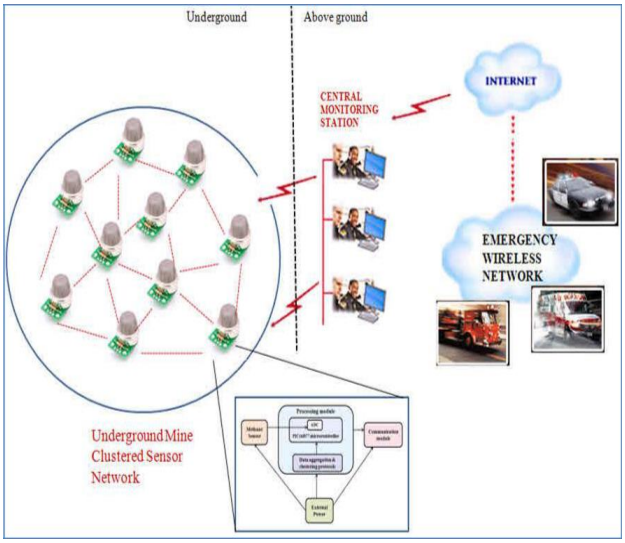

Figure 1.1 Seismic Pounding between Adjacent Buildings.

1.2 Sensor Network

We are developing algorithms and software tools that facilitate the monitoring and protection of civil infrastructure using sensor-actuator networks. Wireless Sensor Networks typically consists of a large number of sensor nodes distributed over a certain region. The radio frequency (RF) transceiver, analog to digital and digital to analog Converters, baseband processors, and other application interfaces into one device which is called as sensor node. In a sensor network a unique power efficient modulation technique is used for all the sensor nodes in a cluster is not suitable for energy efficient operation of sensor nodes. Instead of using the same modulation for all sensors and node, depends on the position of sensor node different modulation techniques are used along with channel codes to reduce energy consumption. In the localization for outdoor wireless sensor networks (WSNs) is a fundamental middle-ware service for many wireless sensor networks applications. For example, in military surveillance location information of each node is essential to determine a target's position.

1.3 Cluster Head

Clustering is used in order to advance the scalability of network performance. Clustering is useful in several sensor network applications such as inter cluster communication, node localization and so on. Clustering algorithms have extensive applications in the precedent years and common clustering algorithms have been proposed for energy consumption in recent years in all of these algorithms, and nodes are structured as clusters, superior energy nodes are called as CH and other nodes are called as normal sensor nodes.

1.4 Energy Consumption

Wireless Sensor Network (WSN) plays an extremely significant role in usual lives. Wireless Networks in provisions of constraints of their resources. The energy consumption is the principal concern in Wireless Sensor Network (WSN). Therefore, a numerous researchers focused on energy efficient algorithms in WSNs for extending the life time of sensors. These differ depending on the deployment of node, the network design, the characteristics of the cluster head nodes and the network operation. Energy is proficient of save by grouping nodes as clusters.

1.5 WSN Applications

Although wireless sensor networks were first proposed and supported by the U.S. military department, they have various applications as below.

A. Military surveillance: In a battlefield, there is no fixed infrastructure and sensor nodes can be deployed in a self-organized manner to collect dynamic information like sniper's position, solder and tank's movement etc.

B. Healthcare: WSNs provide another kind of treatment and care for the disabled or old people. Small sensor devices can be attached to a person to measure his/her physical condition like EEG (electroencephalogram), heart and pulse rate etc. Some high level information like a person's gesture, motion and feeling can also be deduced through WSNs.

C. Wildlife monitoring: One of the famous examples here is the Great Duck Island experiment which collected

information about a special seabird named petrel living on the island. The petrel had once been a very difficult subject for zoologists to study due to the bad climatic condition on the island and abnormal lifestyle. With the help of WSNs, detailed study of such wildlife species can be provided.

D. Environmental: Some environmental applications of sensor networks include tracking the movements of species, i.e. habitat monitoring, and monitoring environmental conditions that affect crops and livestock, macro instruments for large-scale of Earth monitoring and planetary exploration and chemical/biological detection.

E. Commercial: There are many potential and emerging commercial WSN applications such as inventory management, smart offices, product quality monitoring, patient and elderly monitoring, and material fatigue monitoring and environmental control in office buildings. They are also some more futuristic WSAN applications such as medical implant communication, where numerous sensors and actuators are implanted in the human body. This is various purposes such as continuous monitoring, an artificial immune system creation and paralyzed muscle stimulation.

1.6 Scope and Objective of Work

This objective of the proposed network structure is to minimize delays in the data collection processes of wireless sensor networks which extends the lifetime of the network. In this work we are discussed two objectives related to wireless sensor network.
1. Performance analysis of communication overhead in WSN for 50, 100 and 150 Nodes and its performance observed by using MATLAB R2013a tool.
2. Analyzing the resulting performance of energy consumption in WSN for different numbers of nodes by using clustering methods such as K-mean, Fuzzy and SOM. In the rest of work in this thesis are in chapter-2 discussed the literature survey, chapter-3 explore the WSN technology, chapter-4 explore the methodology, chapter-5 simulation results and last chapter-6 conclusion and future scopes of this work.

2. Literature review

1. Gadamsetty, S et.al (2022) Ship detection plays a crucial role in marine security in remote sensing imagery. This paper discusses about a deep learning approach to detect the ships from satellite imagery. The model developed in this work achieves integrity by the inclusion of hashing. This model employs a supervised image classification technique to classify images, followed by object detection using You Only Look Once version 3 (YOLOv3) to extract features from deep CNN. Semantic segmentation and image segmentation is done to identify object category of each pixel using class labels. Then, the concept of hashing using SHA-256 is applied in conjunction with the ship count and location of bounding box in satellite image. The proposed model is tested on a Kaggle Ships dataset, which consists of 231,722 images. A total of 70% of this data is used for training, and the 30% is used for testing. To add security to images with detected ships, the model is enhanced by hashing using SHA-256 algorithm. Using SHA-256, which is a one-way hash, the data are split up into blocks of 64 bytes. The input data to the hash function are both the ship count and bounding box location. The proposed model achieves integrity by using SHA-256. This model allows secure transmission of highly confidential images

2. Sharma, R.; Kaushik, B.(2022) Even though several advances have been made in recent years, handwritten script recognition is still a challenging task in the pattern recognition domain. This field has gained much interest lately due to its diverse application potentials. Nowadays, different methods are available for automatic script recognition. Among most of the reported script recognition techniques, deep neural networks have achieved impressive results and outperformed the classical machine learning algorithms. However, the process of designing such networks right from scratch intuitively appears to incur a significant amount of trial and error, which renders them unfeasible. This approach often requires manual intervention with domain expertise which consumes substantial time and computational resources. To alleviate this shortcoming, this paper proposes a new neural architecture search approach based on meta-heuristic quantum particle swarm optimization (QPSO), which is capable of automatically evolving the meaningful convolutional neural network (CNN) topologies. The computational experiments have been conducted on eight different datasets belonging to three popular Indic scripts, namely Bangla, Devanagari, and Dogri, consisting of handwritten characters and digits. Empirically, the results imply that the proposed QPSO-CNN algorithm outperforms the classical and state-of-the-art methods with faster prediction and higher accuracy.

3. Shuaib, M.; Hassan, (2022) Providing an identity solution is essential for a reliable blockchain-based land registry system. A secure, privacy-preserving, and efficient identity solution is essential but challenging. This paper examines the current literature and provides a systematic literature review in three stages based on the three research questions (RQ) that show the assessment and interpretation

process step by step. Based on the parameters and RQ specified in the research methodology section, a total of 43 primary articles have been selected from the 251 articles extracted from various scientific databases. The majority of these articles are concerned with evaluating the existing self-sovereign identity (SSI) solutions and their role in the blockchain-based land registry system to address the compliance issues in the existing SSI solutions with SSI principles and find the best possible SSI solution to address the identity problems in the land registry. The existing digital identity solutions cannot handle the requirements of the identity principle and are prone to various limitations like centralization and dependency on third parties that further augment the chance of security threats. SSI has been designed to overcome these limitations and provide a secure, reliable, and efficient identity solution that gives complete control to the users over their personal identity information (PII). This paper reviews the existing SSI solutions, evaluates them based on the SSI principles, and comes up with the best possible SSI solution for a blockchain-based land registry system. It further provides a detailed investigation of each SSI solution to present its functionalities and limitations for further improvement.

4. Shuaib, M.; Hassan, (2022) The land registry system is one of the essential components of any governance model required to ascertain the ownership records uniquely. This paper reviews the existing literature and provides a detailed literature review consisting of 3 stages based on three research questions (RQ) that highlight the step by step evaluation and analysis. We selected 48 primary articles out of 477 extracted from different scientific databases based on criteria and RQ defined in the research method section. The majority of these papers focus on assessing the identity issues related to the land registry system and reviewing the existing identity models to find the best possible identity model to resolve the identified identity problems in the land registry. This paper examines the current land registry model and its shortcomings. It explains the various blockchain types and their characteristics. It further evaluates the usability of blockchain technology in different aspects of the land registry. Identity management is one of such weaknesses in the blockchain-based land registry model that has been assessed in detail. Identity issues of blockchain-based models have been further evaluated on defined criteria. The paper ends with a discussion on possible identity models and their comparative analysis to ascertain the most suitable identity model to resolve the identity issues of land registry systems.

5. Shuaib, M.; Hassan, (2022) Providing a system user with a unique and secure identity is a prerequisite for authentication and authorization aspects of a security system. It is generally understood that the existing digital identity systems store the identity details in centralized databases, and users store the identity details in centralized databases in which users do not have any control over them. These vulnerabilities in the traditional digital identities make them susceptible to various malicious assaults and modifications. Users' personally identifiable information (PII) may leak through these identity solutions that can consequently affect other applications being used by the users, and they have no control over them. Land registration is a major domain of governance that defines civilians' well-being and needs to be handled properly to avoid conflict and to support Environmental Sustainability. These traditional land registry applications also lack identity parameters due to weaknesses in identity solutions. A secure and reliable digital identity solution is the need of the hour. Self-sovereign identity (SSI), a new concept, is becoming more popular as a secure and reliable identity solution for users based on identity principles. SSI provides users with a way to control their personal information and consent for it to be used in various ways. In addition, the user's identity details are stored in a decentralized manner, which helps to overcome the problems with digital identity solutions. This article reviews existing SSI solutions and analyzes them using SSI principles.

6. P. K. Pandey, V. Kansal, and A. Swaroop,(2021) Vehicular ad hoc networks (VANETs) are eminent class of mobile ad hoc networks due to their applications. However, mobility management and network scalability are still addressable problems in VANETs. In the current paper, a hierarchical approach has been designed for handling significantly large VANETs by providing better mobility management. The formation of multiple overlapped clusters from large VANETs using k-means algorithm is major characteristics of this approach. Additionally, an addressing architecture has been introduced using two data registers. The derived algorithm allows preparing an appropriate route between source and destination vehicles. Correctness and performance of the approach have been discussed.

7. Rahmani, M.K.I. (2021), Image processing is an important field in the computer vision domain. A lot of work has been done for the processing of image data in various fields like science and technology, defense, medical, space science for satellite imagery analysis, seismology, traffic control, crime control, publishing, and other emerging research areas. There are different levels of

complexities for the accurate retrieval of images as most of the images are affected by different kinds of noise and other factors. In this proposed work, I have performed the work of image retrieval using two methods: firstly, processing for denoising and filtering of the dataset of images taking density parameter 0.7 and adaptive gamma parameter constant value 0.5. The obtained images are then processed by Convolutional neural networks (CNNs). The 5-layer convolutional neural network has been used for the best features extraction and then the algorithm is finally optimized using GA (Genetic Algorithm). In my work I have used 5*5 fold convolutional layers and compared the results with the previous approach Deep Convolutional neural network (DCNN). Finally, the Genetic Algorithm is implemented to obtain the best-optimized value. The proposed work is validated with a graphical-based approach using the mathematical results in terms of peak signal-to-noise ratio (PSNR), mean-squared error (MSE), and the processing time of the algorithm. The result parameters of the proposed algorithm clearly show better performance as compared to the previous approach.

8. Alam, S.; Shuaib, (2021) Blockchain is a modern technology that has revolutionized the way society interacts and trades. It could be defined as a chain of blocks that stores information with digital signatures in a distributed and decentralized network. This technique was first adopted for the creation of digital cryptocurrencies, such as Bitcoin and Ethereum. However, research and industrial studies have recently focused on the opportunities that blockchain provides in various other application domains to take advantage of the main features of this technology, such as: decentralization, persistency, anonymity, and auditability. This paper reviews the use of blockchain in several interesting fields, namely: finance, healthcare, information systems, wireless networks, Internet of Things, smart grids, governmental services, and military/defense. In addition, our paper identifies the challenges to overcome, to guarantee better use of this technology.

9. Naeem, A.; Javed, (2021) Wireless Sensor Networks (WSNs) are comprised of multiple sensor nodes deployed in an ad-hoc manner to sense or observe physical phenomena by collecting real-time data. These sensor nodes are battery-enabled with limited energy constraints affecting network lifetime. Energy conservation of these nodes is vital in designing a routing protocol to maximize network lifetime. Heterogeneity of the network plays an important role in prolonging the network lifetime by making use of dissimilar nodes in terms of energy, power, and processing capabilities. In this paper, a hybrid approach, named as Distance Aware Residual Energy-Efficient Stable Election Protocol (DARE-SEP), is proposed that combines features of Residual Energy Efficient Stable Election Protocol (REE-SEP) with Direct Transmission (DT) and Distance-Based protocol (DP). The proposed protocol is aimed to provide an optimal transmission route from sensor nodes to the Cluster Heads (CHs), considering the network dynamics. Multi-hop routing is used between CHs and sinks nodes to reduce energy consumption. The results show a 10% increase in energy efficiency,

10. Iwendi, C. Jalil, Z.(2020) Cyber-attacks are evolving at a disturbing rate. Data breaches, ransomware attacks, cryptojacking, malware and phishing attacks are now rampant. In this era of cyber warfare, the software industry is also growing with an increasing number of software being used in all domains of life. This evolution has added to the problems of software vendors and users where they have to prevent a wide range of attacks. Existing watermark detection solutions have a low detection rate in the software. In order to address this issue, this paper proposes a novel blind Zero code based Watermark detection approach named KeySplitWatermark, for the protection of software against cyber-attacks. The algorithm adds watermark logically into the code utilizing the inherent properties of code and gives a robust solution. The embedding algorithm uses keywords to make segments of the code to produce a key-dependent on the watermark. The extraction algorithms use this key to remove watermark and detect tampering. When tampering increases to a certain user-defined threshold, the original software code is restored making it resilient against attacks. KeySplitWatermark is evaluated on tampering attacks on three unique samples with two distinct watermarks. The outcomes show that the proposed approach reports promising results against cyber-attacks that are powerful and viable. We compared the performance of our proposal with state-of-the-art works using two different software codes.

11. Tariq, R.; Iqbal, Z.; 2020 T Cyber-attacks are evolving at a disturbing rate. Data breaches, ransomware attacks, cryptojacking, malware and phishing attacks are now rampant. In this era of cyber warfare, the software industry is also growing with an increasing number of software being used in all domains of life. This evolution has added to the problems of software vendors and users where they have to prevent a wide range of attacks. Existing watermark detection solutions have a low detection rate in the software. In order to address this issue, this paper proposes a novel blind Zero code based Watermark detection approach named KeySplitWatermark, for the protection of software against

cyber-attacks. The algorithm adds watermark logically into the code utilizing the inherent properties of code and gives a robust solution. The embedding algorithm uses keywords to make segments of the code to produce a key-dependent on the watermark. The extraction algorithms use this key to remove watermark and detect tampering. When tampering increases to a certain user-defined threshold, the original software code is restored making it resilient against attacks. KeySplitWatermark is evaluated on tampering attacks on three unique samples with two distinct watermarks. The outcomes show that the proposed approach reports promising results against cyber-attacks that are powerful and viable. We compared the performance of our proposal with state-of-the-art works using two different software codes. Our results depict that KeySplitWatermark correctly detects watermarks, resulting in up to 15.95 and 17.43 percent reduction in execution time on given code samples with no increase in program size and independent of watermark size..

12.A. Mohamed, (2020). During disasters, social media platforms such as Twitter, Facebook, and YouTube are widely used by people to share information, opinions, experience, and request for urgent needs. These platforms provide tremendous opportunities to detect disaster situations and give insight into their severity. Since disaster happens suddenly, people face a significant challenge to find credible information and take suitable reactions. The focus here is to reach the affected persons with personalized recommendations to prevent them and save their lives. In this paper, we propose a framework of a social media-based platform that aims to detect emergent disaster and improve communication with citizens before, during and after a disaster by generating personalized recommendations in a timely manner.

3. Wireless sensor networks

Wireless sensor networks are generally assumed to be energy restrained because sensor nodes operate with small capacity DC source or may be placed such that replacement of its energy source is not possible. Wireless sensor networks represent a new technology that has emerged from developments in ultra low power microcontrollers and sophisticated low cost wireless data devices.

Their small size and power consumption allow a number of independent nodes (known as Motes) to be distributed in the field, all capable of ad-hoc networking and multi-hop message transmission. New routing algorithms allow remote data to be passed reliably through the network to a final control point. This occurs within the constraints of low power RF transmissions in a congested 2.4GHz radio spectrum. A Wireless Sensor Networks form a subset of Ad-hoc networks,

3.1 Details of the Models

The wireless sensor network nodes can only be equipped with a limited energy source. In some application scenarios, replenishment of power resources might be impossible. Therefore, sensor node lifetime shows a strong dependence on battery lifetime. Hence, power conservation and power management take on additional importance. In other mobile and ad hoc networks, power consumption has been an important design factor, but not the primary consideration, simply because power resources can be replaced by users. In sensor networks, power efficiency is an important performance metric, directly influencing network lifetime. Power consumption in sensor networks can be divided into three domains: sensing, communication and data processing. Sensing power varies with the nature of applications. Data communication is a major reason for energy consumption. This involves both data transmission and reception. It can be shown that for short-range communication with low radiation power, transmission and reception energy costs are nearly the same. Another important consideration related to data communications concerns the path loss exponent, λ. Due to the low-lying antennae; λ is close to 4 in sensor networks. Therefore, routes that have more hops with shorter distances can be more power efficient than routes that have fewer hops with longer distances. Energy expenditure on data processing is much lower than on data communication. The example described in Pottie and Kaiser (2000) effectively illustrates this disparity. Assuming Rayleigh fading and fourth power distance loss, the energy cost of transmitting 1 Kb a distance of 100m is approximately the same as that for executing 3 million instructions with a 100 million instructions per second (MIPS)/W processor.

4. Methodology

4.1 Clustering

Clustering means dividing sensor nodes in virtual group according to some rules (called cluster) and then, sensor nodes belonging in a group can execute different functions from other nodes. It is a main task of exploratory data mining, and a common technique for statistical data analysis, used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bioinformatics.

4.1.1 Hard Clustering versus Soft Clustering

In hard clustering, each example is placed definitively in a class. The class is then used to predict the feature values of the example. The alternative to hard clustering is soft clustering, in which each example has a probability distribution over its class. The prediction of the values for the features of an example is the weighted average of the predictions of the classes the example is in, weighted by the probability of the example being in the class. Hard: same object can only belong to single cluster, Soft: same object can belong to different clusters, E.g. Gaussian mixture model.

4.1.2 Flat versus Hierarchical

A hierarchical method creates a hierarchical decomposition of the given set of data objects. Here tree of clusters called as dendrograms is built. Every cluster node contains child clusters, sibling clusters partition the points covered by their common parent. In hierarchical clustering we assign each item to a cluster such that if we have N items then we have N clusters. Find closest pair of clusters and merge them into single cluster. Compute distance between new cluster and each of old clusters. We have to repeat these steps until all items are clustered into K no. of clusters, Flat: clusters are flat, Hierarchical: clusters form a tree.

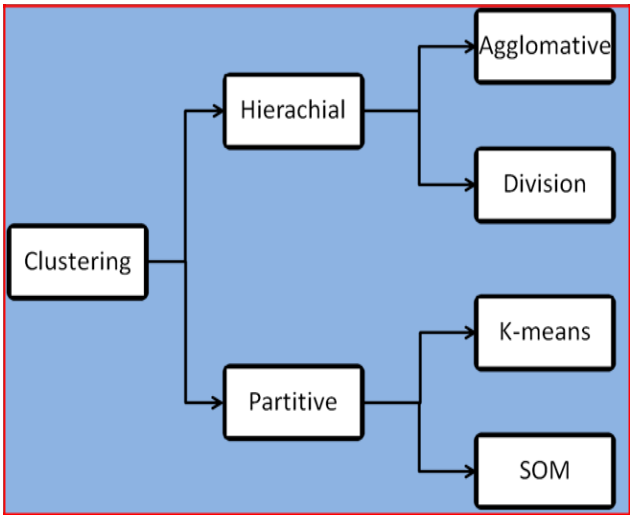

Fig: 1 Types of Clustering Techniques

5. Result and Discussion

5.1 Simulation flow-Chart

1) WSN parameter definition like number of nodes, network length, number of cluster etc.
2) Generate WSN and Cluster the network using SOM, K-means / fuzzy C-means clustering
3)Simulate the Packet transmission over network from sink to arbitrary node at a velocity.
4)Calculate the communication overhead
5)Calculate energy consumption for the overhead
6)Take the another velocity of sink and repeat the step 1 to
7)Evaluate the communication overhead performance.

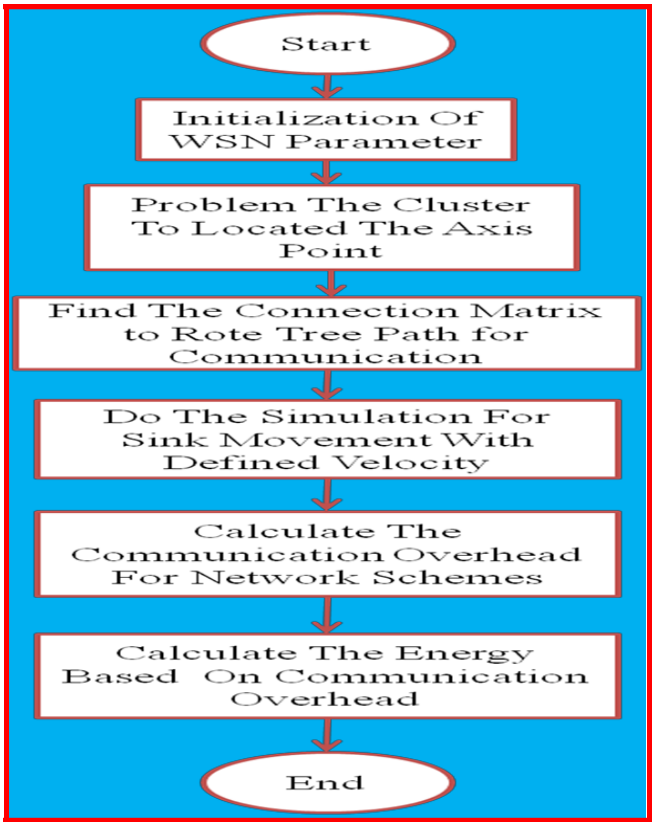

Fig: 2 Flow chart for system

6. Conclusions

The life of wireless network is strongly depends on the energy consumption of network per unit time. The energy consumption reduction has been taken as a objective in this project. The clustering based network architecture has been proposed in this project to reduce the communication overhead which in turn reduces the energy consumption. The various clustering techniques are available for locating the access point for WSN. The K-means, Fuzzy C-mean and self organizing map (SOM) based techniques are used in this project. The optimum location of AP is important due to communication overhead depends on the moving distance between sink location and AP.

The sink velocity from 50 m/s to 300 m/s has been taken into the account for finding the energy consumption and a

comparative analysis is presented in the result section of the thesis. The performance of wireless sensor networks system for Self organizing map has performed better than other two methods. It is also observed that overhead pattern in cluster based protocol is not much dependent upon update time.

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