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Performance Enhancement of Wireless Sensor Network with Adaptive Modulation Scheme

Chetan Rathod[1*] and Rahul Sharma[2]

[1]*Department of Electronics & Communication Engineering, RGPV, India*
[2] *Department of Electronics & Communication Engineering, India*
Email: crchetan23@gmail.com, sharma@patelcollege.com

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***Abstract*—** The wireless sensor network refers to a group of spatially distributed and dedicated sensors for monitoring and recording the physical conditions of environment like temperature, humidity, pollution levels, sound, wind speed with direction and pressure. The sensors are self powered nodes which also possess limited processing capabilities and the nodes communicate wirelessly through a gateway. Simulation results based upon this protocol identify some important factors that induce unbalanced energy consumption among sensor nodes and hence affect the lifetime network. This highlights the need for an adaptive clustering protocol that can increase the network lifetime by further balancing the energy consumption among sensor nodes.

***Keywords*—** Wireless Sensor Network (WSN), C-Means, Clustering, QAM, BPSK, QPSK

I. INTRODUCTION

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. The data is forwarded, possibly via multiple hops relaying, to a sink that can use it locally, or connected to other networks (e.g., the Internet). The idea of development of wireless sensor networks was initially motivated by military applications.

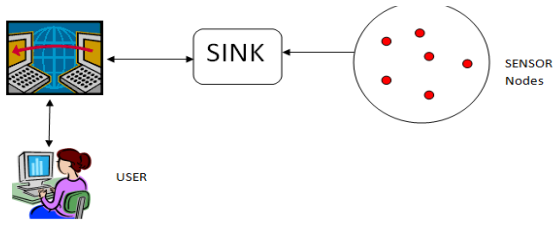

Fig: 1 Wireless sensor Network

Wireless sensor network systems are now being applied by an international community for critical applications in healthcare, industry and security. Amongst all, the requirement of extended lifetime for a Wireless sensor node under limited energy enacts the severe design constraints. In this leads for advanced design methodologies to address the energy content.

A WSN can be defined as a network of nodes, which can sense events in the environment and communicate the information gathered from sensing node to Base station via the cluster head. The nodes can be stationary or moving. It may be aware of their location or not. And they can be homogeneous or not. Many efforts have been taken to increase the lifetime of sensor Networks by optimizing physical layer parameters and to develop an energy efficient communication protocol [N2].

II. OVERHEADS IN WIRELESS SENSOR NETWORKS

In wireless sensor networks (WSN) data produced by one or more sources usually has to be routed through several intermediate nodes to reach the destination. The problems arise when intermediate nodes fail to forward the incoming messages. Using this technique, the traffic increases significantly primary path and therefore expend significantly more energy than that on the primary path. The different network protocols like multi-path based routing, query based routing, negotiation based routing, quality of service based routing etc decides the overheads in wireless sensor network. In authors have carried out a comparative evaluation of communication overhead due to sink mobility with speed variations, the effect of number of nodes used in the wireless sensor networks. It has been demonstrated by authors that the communication overheads increase significantly when sink mobility is high. The communication overheads can be reduced by increasing update time.

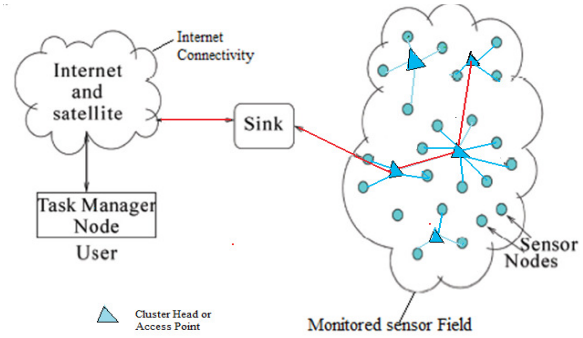

Fig: 2 Communication architecture with WSN

In the past few years, intensive research that addresses the potential of collaboration among sensors in data gathering and processing, and coordination and management of the sensing activity was conducted. In most applications, sensor nodes are constrained in energy supply and communication bandwidth. Thus, innovative techniques to eliminate energy inefficiencies that shorten the lifetime of the network and efficient many power management, routing, and data dissemination protocols have been specifically designed for WSNs. Routing protocols in WSNs might differ depending on the application and network architecture.

III. CLUSTERING IN WIRELESS SENSOR NETWORK

Due to the large-scale deployment of wireless sensor networks and the need for data aggregation necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime. The clustering has proven to be an effective approach for organizing the network into a connected hierarchy. Sensors in many applications are expected to be remotely deployed in large numbers and to operate autonomously in unattended environments. The nodes can be divided into a number of small groups called clusters or access points to support data aggregation. Each cluster has a coordinator, referred to as a access head, and a number of member nodes. In clustering results in a two-tier hierarchy in which access heads form the higher tier while member nodes form the lower tier. Several WSN applications require only an aggregate value to be reported to the observer. Data aggregation reduces the communication overhead in the network leading to significant energy savings. Most clustering algorithms utilize two techniques which are selecting cluster-heads with more residual energy and rotating cluster-heads periodically to balance the energy consumption of the sensor nodes over the network. These clustering algorithms do not take the location of the base station into consideration. This lack of consideration causes hot spot problems in multi-hop WSN. In order to solve this problem and to balance energy consumption of cluster-heads, in a periodically rotating cluster-head mechanism was proposed by Yu and Chang, namely low-energy adaptive clustering hierarchy, which is a clustering algorithm that utilizes randomized rotation to balance energy consumption of cluster-heads over the network.

IV. DIGITAL MODULATION SCHEMES

A modulation scheme is needed to transmit information over a communication channel. Among the various modulation methods are; amplitude modulation (data encoded by changing the amplitude of the signal), frequency modulation (data encoded by changing the frequency of the signal), and phase modulation (data encoded by changing the phase of the signal). The modulation methods chosen for this paper are: Binary phase shift keying (BPSK), Quadrature phase shift keying (QPSK), and Quadrature amplitude modulation.

1) Quadrature Phase Shift Keying (QPSK):

This is also known as four-level PSK where each element represents more than one bit. In the each symbol contains two bits and it uses the phase shift of π/2, which means 90º instead of shifting the phase 180º. The principle equation 5 is.

$$s(t) = \begin{cases} A\cos\left(2\pi f_c t + \frac{\pi}{4}\right) & \text{for binary 11} \\ A\cos\left(2\pi f_c t + \frac{3\pi}{4}\right) & \text{for binary 01} \\ A\cos\left(2\pi f_c t - \frac{3\pi}{4}\right) & \text{for binary 00} \\ A\cos\left(2\pi f_c t - \frac{\pi}{4}\right) & \text{for binary 10} \end{cases} \quad (1)$$

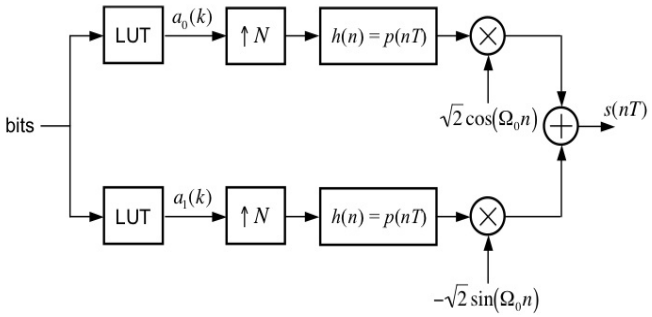

Fig. 3 QPSK System

The constellation consists of four points but the decision is always made in two bits. In this mechanism can ensure the efficient use of bandwidth and higher spectral efficiency.

2) Quadrature amplitude modulation (QAM)

The QAM is popular modulation technique used in various wireless standards communication. It combined with ASK and PSK which has two different signals sent concurrently on the same carrier frequency but one should be shifted by 90º with respect to the other signal. The principle equation 2 is.

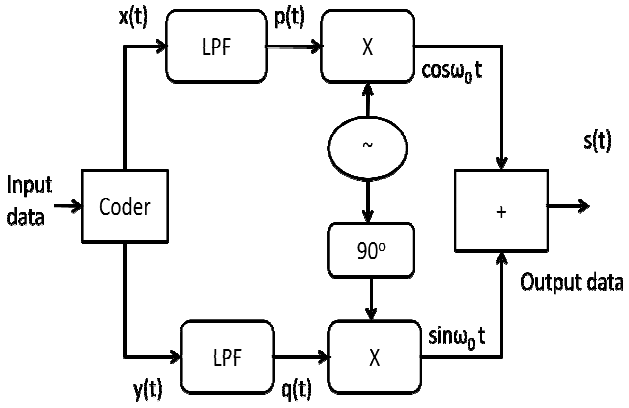

Fig. 4 QAM System

$$s(t) = d_1(t)\cos 2\pi f_c t + d_2(t)\sin 2\pi f_c t \qquad (2)$$

3) Binary Phase Shift Keying (BPSK)

This is also known as two-level PSK as it uses two phases separated by 180º to represent binary digits (0, 1). This kind of phase modulation is very effective and robust against noises especially in low data rate applications as it can modulate only one bits/symbol. The principle equation 3 is.

$$s(t) = \begin{cases} A\cos(2\pi f_c t) & \text{for binary 1} \\ A\cos(2\pi f_c t + \pi) & \text{for binary 0} \\ A\cos(2\pi f_c t) & \text{for binary 1} \\ -A\cos(2\pi f_c t) & \text{for binary 0} \end{cases} \quad ----(3)$$

V. METHODOLOGY

The System has been implemented in the MATLAB. The wireless sensor network is design with following specification.

Table 1: Specification Fuzzy and K-Means

S.NO	SPECIFICATION	VALUE	
		FUZZY	K-MEANS
1	NO. OF NODE and cluster	100 node	50
2	Length of network area	1×1m	1×1m
3	Maximum range	500 m	500m
4	noise power in dBm	50 dbm	
5	transmitted power	1 Mw	
6	operating frequency	2.4 GHZ	

System description

The method of design simulation has been given below:

1. WSN network generate with randomly place the node.
2. In clustering is number of node N or 5 clusters.
3. Cluster head placement and connection mention generation.
4. Find the physical layer parameter with modulation type depend on the distance.
5. Study the case of individual modulation and adaptive modulation.
6. Simulate the WSN performance for independent and adaptive modulation.
7. Repeated of the 1-6 for Fuzzy and k-means clustering separately.

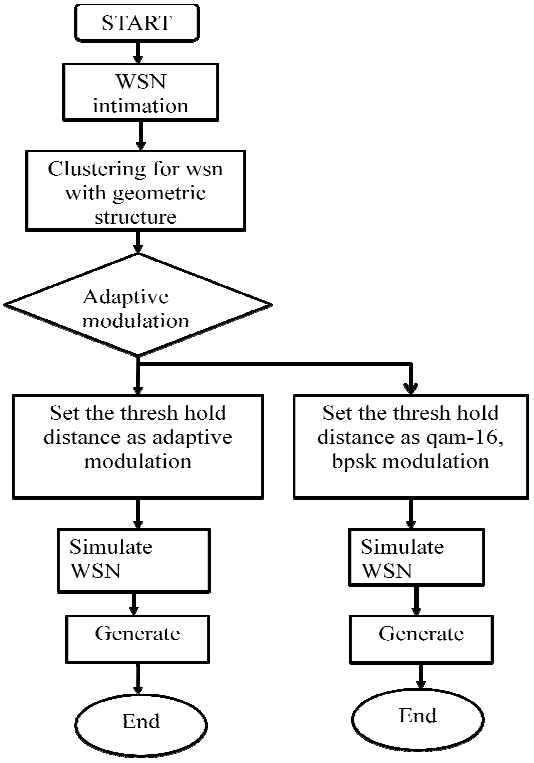

Fig: 5 System flow chart

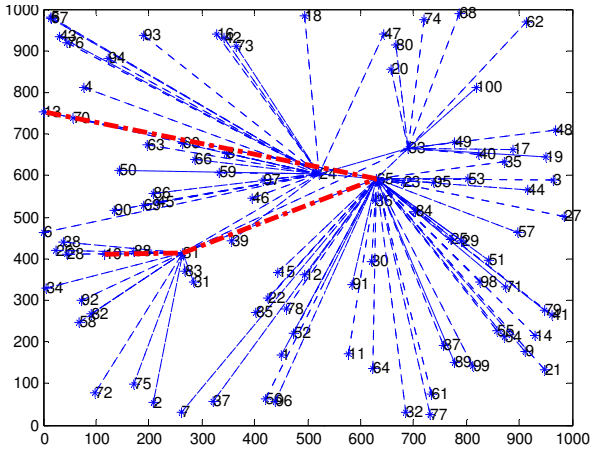

Fig. 6 The performance fuzzy clustering

The physical layout of nodes spread over a 1000 metre square area with 4 access points. In figure 5.1 shows the topology of access points in hexagonal distribution.

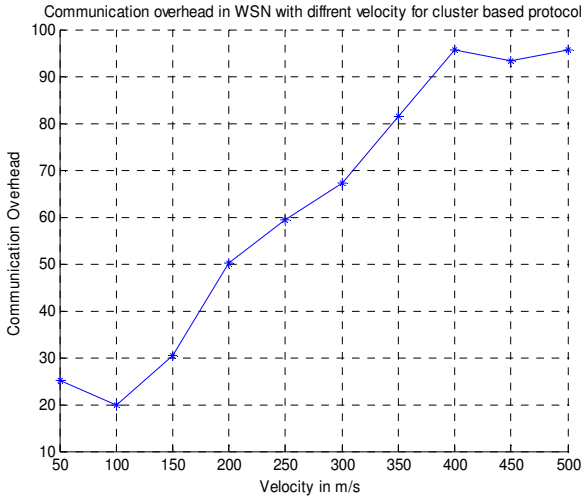

Fig.7 The cluster based protocol in communication overhead WSN with velocity

Figure shown communication overhead in cluster based protocol as the velocity of nodes increases. In cluster based protocol overhead increases almost linearly with nodes velocity.

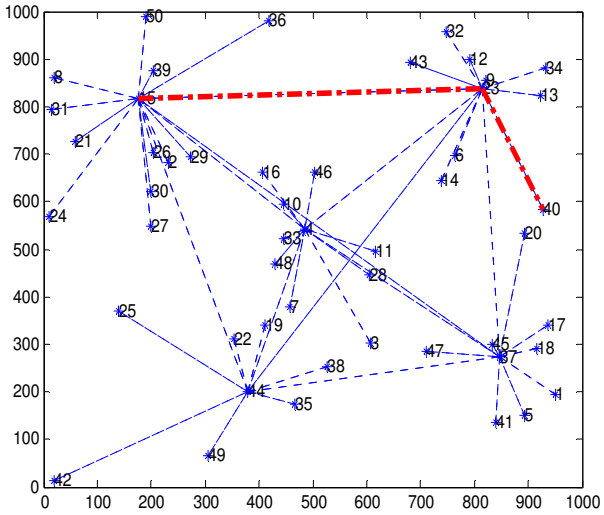

Fig. 8 The performance of K-means clustering

The physical layout of nodes spread over a 1000 meter square area with 5 access points. In figure 5 shows the different nodes communication with K-means.

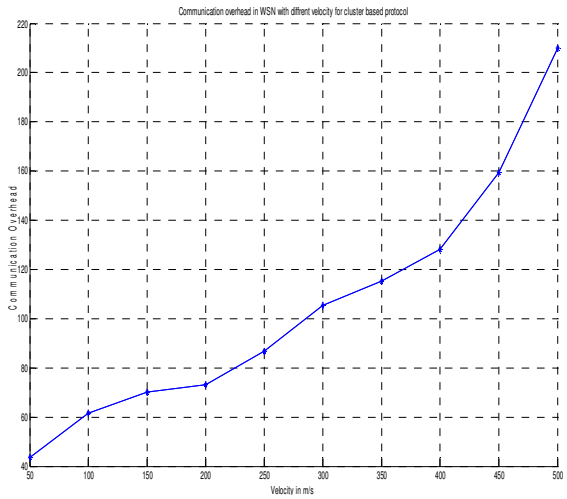

Fig.9 Communication overhead in WSN with velocity cluster based protocol

Figure shown communication overheads increases significantly when velocity of sinks nodes increases linearly.

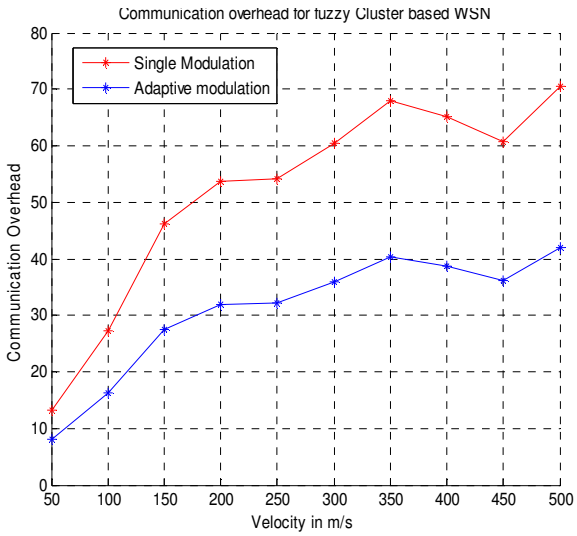

Fig.10 Communication overhead compare with single and adaptive modulation

Figure shown The Communication overhead is significantly reduce with adaptive modulation for achieving the maximum speed in network.

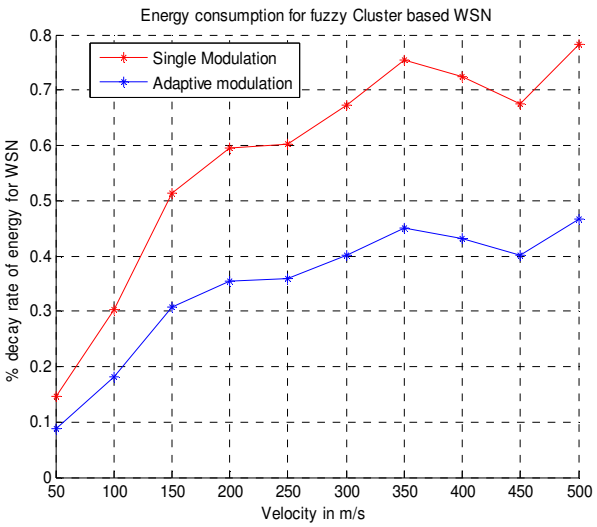

Fig.11 Energy consumption for single modulation and adaptive modulation

In this figure Energy consumption is significantly reduce with adaptive modulation for achieving the maximum speed in network

CONCLUSION

The performance wireless sensor network using clustering method. In simulation results show that the use of wireless sensor networks (WSNs) system gives better performance. There is large growing list of civil and military applications of WSNs especially in hostile and remote areas. For examples include disaster management, border protection.. In these applications a large number of sensors are expected, requiring careful architecture and management of the network. The grouping nodes into clusters have been the most popular approach for support scalability in wireless sensor networks**.** Further communication overhead and energy consumption is significantly reduced with adaptive modulation for achieving the maximum speed in network compare to single modulation.

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