iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** II **Month of publication:** February 2018

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue II, February 2018- Available at www.ijraset.com

Energy Efficient WMN Module for Environmental Monitoring Applications Using Clustering Mechanism

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Abstract: ***Wireless network interfaces became cheap and widely available at the beginning of the millennium. There has been an increased research interest in various types of wireless networks and wireless network applications. Within this research area, the focus initially was on pure adhoc networks, providing solutions at various layers to enable the interconnection of mobile wireless nodes without the need for any form of central infrastructure. Because of the wide applicability of wireless networks, several network subtypes emerged that essentially re-use the idea of the self-forming, self-configuring, infrastructure-less adhoc networks, but operate in specific scenarios using specialized types of hardware. Among several sub-types, wireless mesh networks and wireless sensor networks evolved into independent research topics. Due to the limited transmission range, many pairs of nodes in WMN may not be able to communicate directly, hence they need other intermediate nodes to forward packets for them. Routing in such networks is an important issue and it poses great challenges. This paper presents effective energy saving method in WMN module that provides the clustering approach. The proposed system designs a cluster based routing scheme for WMNs. Also, the proposed module was evaluated by calculating PDR, throughput etc.***

Keywords: ***Wireless network, Sensor devices, Mesh networks.***

I. INTRODUCTION

Environmental Monitoring plays a key-role to show the effects of human behavior on the environment and to disclose its limits. Environmental Monitoring strives to determine the status of a changing environment and the Environmental scientists take advantage of this to facilitate the exploration of our world. Continuous unobtrusive monitoring of the environment is usually performed by a Sensor Network. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them.

The nodes in a wireless sensor network are resource constrained. They have limited processing speed, storage capacity, and communication bandwidth. Wireless mesh networking (WMN) is useful to collect the information from different sensors that are widely distributed over a large area. Wireless Mesh Networks (WMNs) have already become very popular and been receiving an increasing amount of attention by the research community.

Due to the limited transmission range of the radio, many pairs of nodes in WMN may not be able to communicate directly, hence they need other intermediate nodes to forward packets for them. In wireless mesh networks (WMN), the network nodes are considered to be part of the infrastructure and are dedicated to the routing task.

The mobility of the mesh nodes is limited or zero, and their processing, memory and bandwidth capacities generally exceed those of traditional ad hoc network nodes. Additionally, the power consumption requirements are often less stringent than those of wireless ad hoc networks. This paper is organized as follows.

In Section 2, the existing system related to this paper is reviewed. The proposed system is presented in Section 3. In Section 4, 5 and 6 , the architecture, implementation and simulation results of the proposed system were discussed. Conclusions are drawn in the last section.

II. EXISTING SYSTEM

The existing system was open-source in both software and hardware. Therefore, it can not only be integrated into a sensor system for environmental monitoring. In addition to using a low-power RF transceiver. The problem is that the decisions for routing paths in the ZigBee and DigiMesh modules are based on Ad hoc On-Demand Distance Vector routing (AODV), which explores the routing path while a node is attempting to send data. The proposed open-source code of the WMN module should be compact in contrast to the more complex existing design to allow the user to use and test the system without the delay of a steep learning curve.

III. PROPOSED SYSTEM

The proposed system integrates the functions of network discovery, automatic routing control, and transmission scheduling. The system presents an effective energy saving method in WMN module that provides clustering approach. Cluster heads are determined and implemented to enable fast transformation of data packets. WMN module is sensitive to timing control. Performance in an actual experiment was conducted and evaluated.

A. Advantages of the Proposed System

1) Implement the Cluster head to transfer the information to Processor and fast transformation
2) To reduce the Energy consumption in the Mesh Network
3) To analysis the Packet Delivery ratio, Throughput and Average delay.
4) Increase the Performance by using Clustering approach.

IV. SYSTEM ARCHITECTURE

The System proposes a clustered solution to the wireless mesh networks to save the energy in wireless sensor networks. The networking module is connected to the host processor. The host processor reads data from its sensors through the cluster heads and sends the collected data to the WMN module. The proposed system designs a cluster based routing scheme for WMNs that most of the algorithm use initially broadcast route request to entire node in networks. It is possible that if network partitioned into the cluster, it can reduce the initial broadcast to all nodes. As each cluster has one cluster head that have all information of its neighbor and so path request only multicast to different cluster heads only. In this design, the host processor communicates only with the cluster head when sending and receiving the data packet.

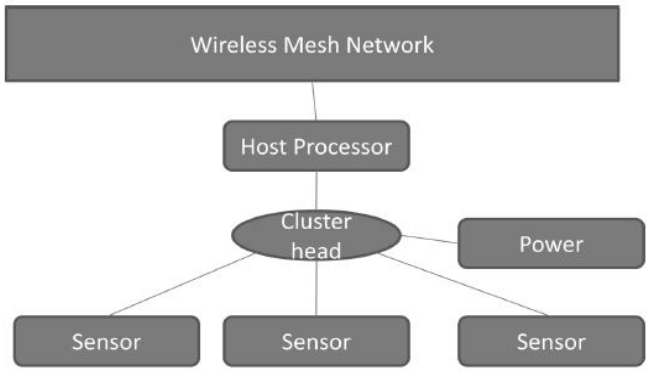

Fig 4.1 System Architecture

V. SYSTEM IMPLEMENTATION

Implementation is the phase where visions and plans become reality. It is a systematically structured approach to effectively integrate services or components into the workflow of the System.

A. Module Design Specification

The proposed System consists of four modules. They are
Creation of Wireless Mesh Network
Transmission of Information in the Network
Creation of Clusters with a head Node for saving Energy

1) *Creation of Wireless Mesh Network:* Create the Wireless Mesh Topology and Sensor nodes, to differentiate Nodes for the process in the network.
2) *Transmission of Information in the Network:* Packet delivery process – Transmit the information one hop to another hop in the Mesh topology
3) *Creation of Clusters with a head Node for saving Energy:* To create Clusters with a head node for saving the Power or Energy and to transfer the information by this way using cluster nod
4) *Analyzing the Performance & energy consumption:* Analyze the Performance and compute the performance measures such as PDR, Throughput, Delay etc

B. Algorithm for implementing the Proposed System

1) Step 1 - The sender node initiates a route discovery by flooding the RREQ packets within the cluster.

2) Step 2 - The cluster head of this cluster that the sender belongs to, receives the packet.

3) Step 3 - The Cluster head extracts the source and destination addresses from the packet, and identify the mode of communication – (a) Intra cluster (b) Inter cluster (c) Intra level or (d) Inter level and also sets the Next_Hop address like follows:

4) Step 3.1 - The cluster head starts matching the receiver address with its own address from the MSB. During the matching the cluster head considers only the non zero bits of the addresses.

5) Step 3.2 - If (mismatch occurs) then

a) Set the Next_Hop address value = Current cluster head address.

b) Replace the first right most non zero bit of Next_Hop address value with zero. Else

c) Set the Next_Hop address value = Current cluster head address.

d) Replace the first left most zero bit value of Next_Hop address with the corresponding receiver address value.

5) *Step 4* - The cluster head sends the packet to the address specified in the Next_Hop address.

VI. RESULTS AND EVALUATIONS

The system is implemented by deploying 25 nodes using NS2 Network Modelling Tool .The languages used are TCL and C++. Awk and Perl scripting languages are used to compare and analyze the performance of the implemented system with the existing system. During simulation time, the events are traced by using the trace files. The performance of the network is evaluated by executing the trace files. The events are recorded into trace files while executing record procedure. In this procedure, we trace the events like packet received, packets lost, packet delivery ratio, throughput and delay time etc. These trace values are written into the trace files.

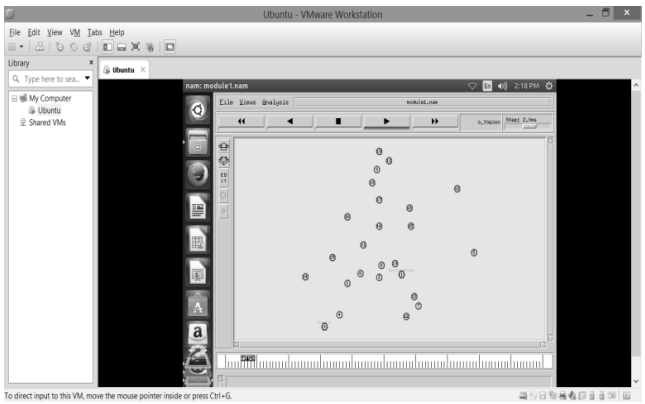

Fig 6.1 Node Creation & Configuration

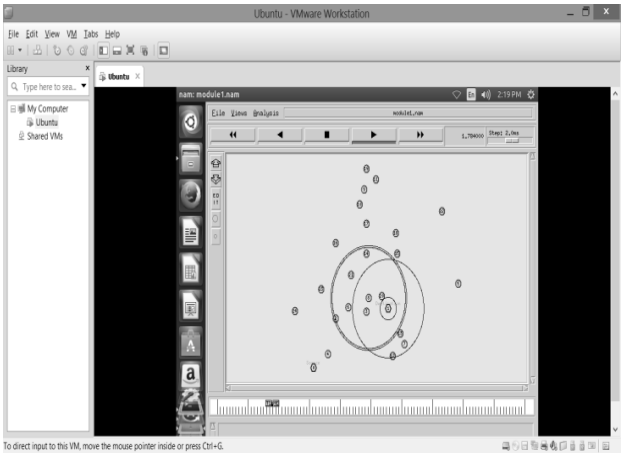

Fig 6.2 Finding the Shortest Path for packet transmission based on communication Range

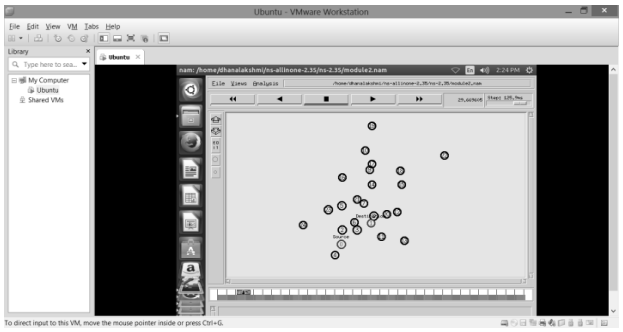

Fig 6.3 Data Transmission

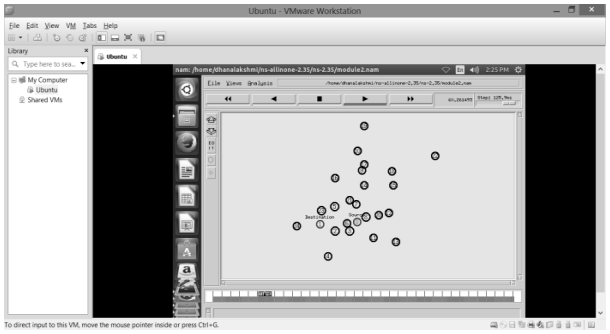

Fig 6.4 Mobility of Nodes during data Transmission

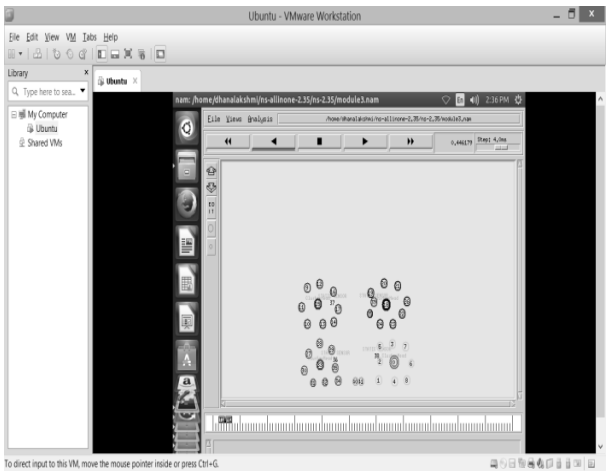

Fig 6.5 Creating Clusters with Cluster Head

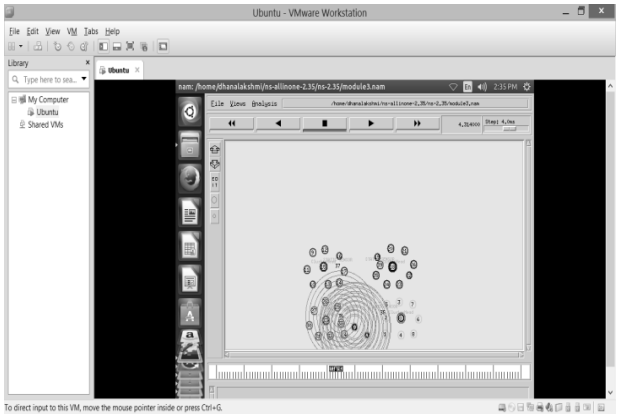

Fig 6.6 Data Collection with Replica Keeper

Fig 6.7 Calculating PDR

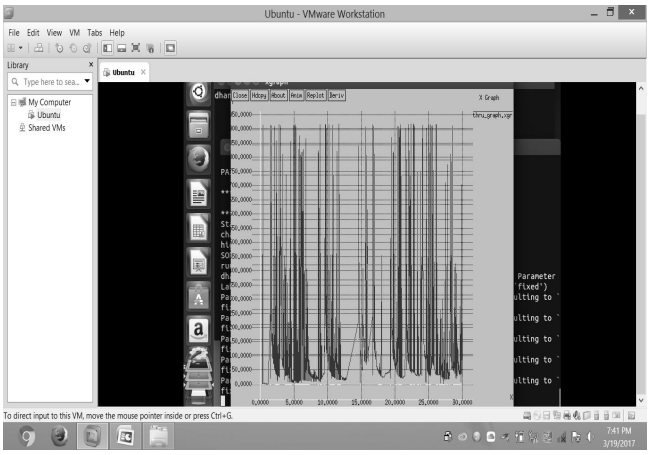

Fig 6.8 Calculating Throughput

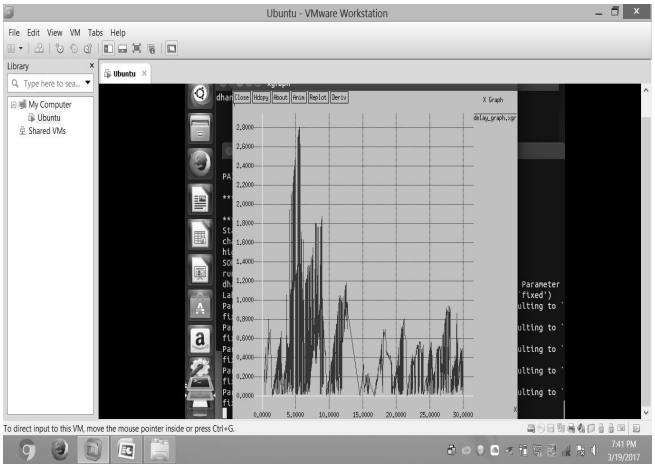

Fig 6.9 Calculating Delay

VII. CONCLUSION

The implementation of a prototype WMN module is presented, and its performance in an actual experiment was evaluated. The average PDR and throughput of the proposed WMN module is calculated. The results support that the proposed WMN module can offer better performance leading to prolonged network lifetime and better utilization of the channel bandwidth. It is a hardware-independent design because no special hardware capability is required. In addition, the design is available as open-source and can help to promote the use of wireless mesh networks for environmental monitoring.

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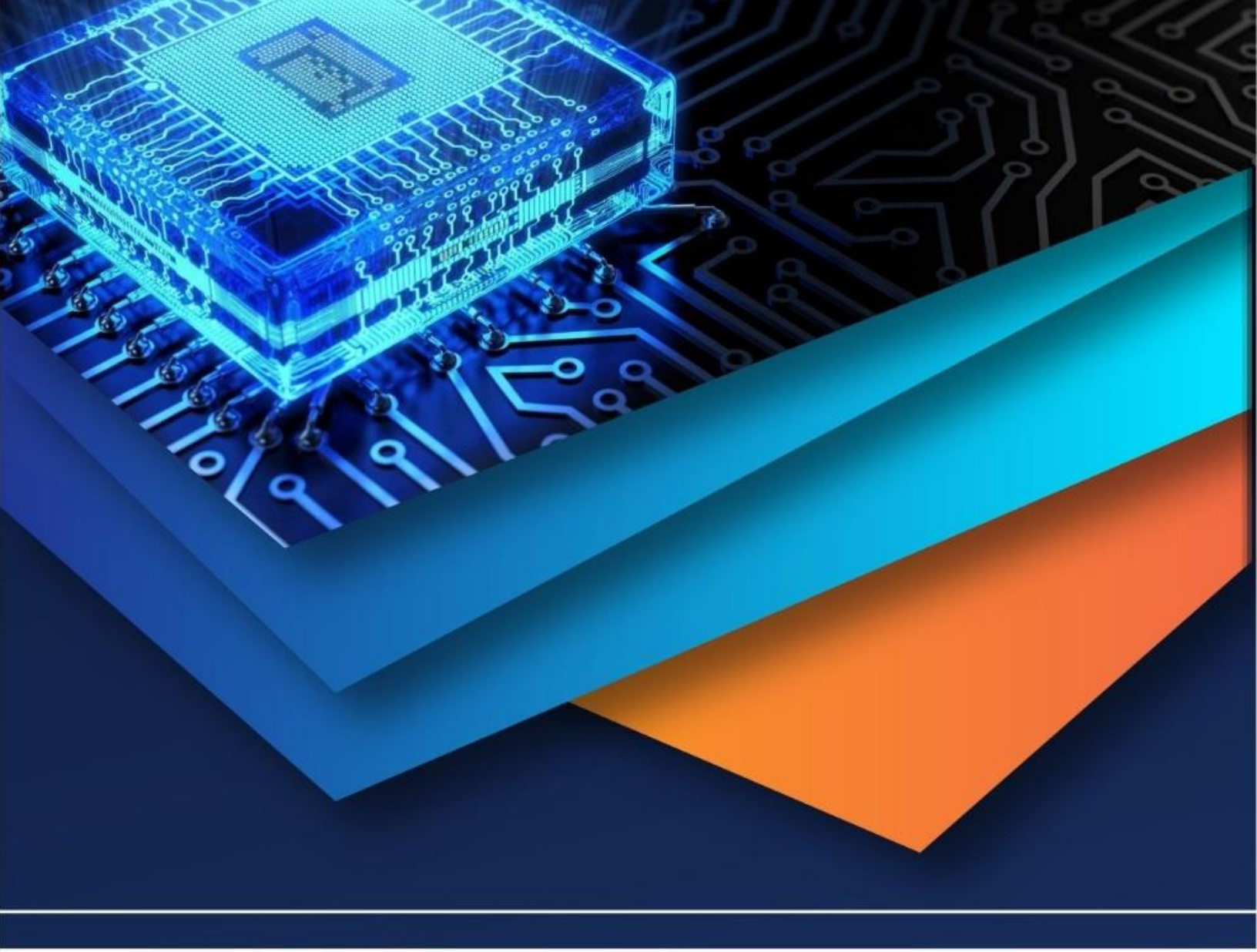

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