PIPELINE INSPECTION BY OPTIMISATION OF RELAY NODE USING OPTICAL SENSOR

R.Monica*, T.R.Vedhavathy**
*Computer Science Engineering Department, K.L.N. College of Engineering, Pottapalayam, Sivagangai 630 612 INDIA (e-mail: moni6.moni6@gmail.com)
** Computer Science Engineering Department, K.L.N. College of Engineering, Pottapalayam, Sivagangai 630 612 INDIA (e-mail: trveda@gmail.com)

Abstract: Wireless sensor networks (WSNs) provide an effective approach for underground pipeline inspection. Such WSNs comprise sensor nodes (SNs) and relay nodes (RNs) for information sensing and communication. WSNs can perform accurate and real-time inspection, especially in adverse environments. Combined wireless nodes create a network in distributed manner. Even it can detect accurate results in aboveground and underground.The heterogeneous network used has greater coverage range and hence the data can be preserved.It can overcome the signal loss.Relay nodes placed above the mobile node helps in communication with base station. However, transmitting information between underground and aboveground nodes is very challenging. To make the relay nodes work in heterogeneous network and to automatically change the relay nodes coverage range when they fail if in the network.To detect the leak in the network optical sensor is placed in mobile node.High power nodes maximum covers a range compared to low power relay nodes.

Keywords: Relay Node,Sensor Node,Wireless Sensor Node

1.INTRODUCTION

1.1Wireless Networks

Wireless networks provide unprecedented freedom and mobility for a growing number of laptop and PDA users who no longer need wires to stay connected with their workplace and the Internet. Ironically, the very devices that provide wireless service to these clients need lots of wiring themselves to connect to private networks and the Internet. This white paper presents a viable alternative to all those wires - the wireless mesh network. Unlike basic Wi-Fi that simply untethers the client; the wireless mesh untethers the network itself giving IT departments, network architects and systems integrators unprecedented freedom and flexibility to build out networks in record time - with high performance and without the expensive cabling.Wireless means transmitting signals using radio waves as the medium instead of wires. Wireless technologies are used for tasks as simple as switching off the television or as complex as supplying the sales force with information from an automated enterprise application while in the field. Now cordless keyboards and mice, PDAs, pagers and digital and cellular phones have become part of our daily life.Some of the inherent characteristics of wireless communications systems which make it attractive for users, are given below:

Mobility: A wireless communications system allows users to access information beyond their desk and conduct business from anywhere without having a wire connectivity complex as supplying the sales force with information from an automated enterprise application while in the field. Now cordless keyboards and mice, PDAs, pagers and digital and cellular phones have become part of our daily life.Some of the inherent characteristics of wireless communications systems which make it attractive for users, are given below:

Mobility: A wireless communications system allows users to access information beyond their desk and conduct business from anywhere without having a wire connectivity.

Reachability: Wireless communications systems enable people to be better connected and reachable without any limitation of any location.

Simplicity: Wireless communication system is easy and fast to deploy in comparision of cabled network. Initial setup cost could be a bit high but other advantages overcome that high cost.

Maintainability: Being a wireless system, you do no need to spend too much to maintain a wireless network setup.

Roaming Services: Using a wireless network system you can provide service any where any time including train, busses, airoplans etc.

New Services: Wireless communications systems provide new smart services like SMS and MMS.

1.2Wireless Network Topologies:

There are basically three ways to setup a wireless network.Point-to-point Bridge: As you know a bridge is used to connect two networks. A point-to-point bridge interconnects two buildings having different networks. For example, a wireless LAN bridge can interface with an Ethernet network directly to a particular access point.Point-to-multipoint Bridge: This topology is used to connect three or more LANs that may be located on different floors in a building or across buildings.Mesh or ad hoc network: This network is an independent local area network that is not connected to a wired infrastructure and in which all stations are connected directly to one another.

1.3Wireless Technologies:

Wireless technologies can be classified in different ways depending on their range. Each wireless technology is designed to serve a specific usage segment. The requirements for each usage segment are based on a variety of variables, including Bandwidth needs, Distance needs and Power.

1.3.1Wireless Wide Area Network (WWAN)

This network enables you to access the Internet via a wireless wide area network (WWAN) access card and a PDA or laptop.These networks provide a very fast data speed compared with the data rates of mobile telecommunications technology, and their range is also extensive. Cellular and mobile networks based on CDMA and GSM are good examples of WWAN.

1.3.2Wireless Personal Area Network (WPAN):

These networks are very similar to WWAN except thier range is very limited.

1.3.3Wireless Local Area Network (WLAN):

This network enables you to access the Internet in localized hotspots via a wireless local area network (WLAN) access card and a PDA or laptop.It is a type of local area network that uses high-frequency radio waves rather than wires to communicate between nodes.These networks provide a very fast data speed compared with the data rates of mobile telecommunications technology, and their range is very limited. Wi-Fi is the most widespread and popular example of WLAN technology.

1.3.4Wireless Metropolitan Area Network (WMAN):

This network enables you to access the Internet and multimedia streaming services via a wireless region area network (WRAN).These networks provide a very fast data speed compared with the data rates of mobile telecommunication technology as well as other wireless network, and their range is also extensive.

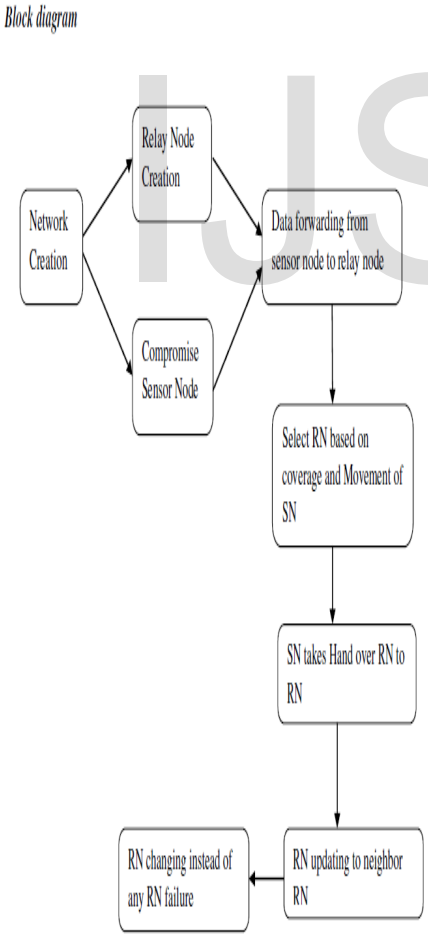
2.PROPOSED WORK

- In this proposed system, relay nodes are specially designed as a heterogeneous network. High power nodes has maximum coverage range compared to low power relay nodes.
- But each high power nodes cover minimum two low power nodes so on.Sensor nodes collect the data and it will forward to corresponding relay node.
- Sensor nodes collect the data and it will forward the data to Base Station through Relay node.
- If any sensor node senses emergency data it will forward the data to relay node. So we can avoid emergency data loss.
- Here the mobile node moving with optical sensor it is used to find the leak.
- The optical sensor sends the light rays end to end of the pipes when leakage occurs there will be change in the PH value of water.

2.1Advantages

- Highly distributed, improved packet delivery.
- Channel strength is selected by nature of the surface.
- Minimum energy is used by relay nodes.
- The path loss model provides the proper Relay Node replacement and Sensor Nodes transmission power.
- It provides the two hop communications.
- We can easily identify the pipeline leakages at a time.

5. BLOCK DIAGRAM



2.2 Description

Recent advances in the development of Wireless Sensor Networks (WSNs) reveal a new paradigm for monitoring infrastructure health and environmental conditions owing to the availability of low powered millimeter-scale CPUs, highly integrated wireless transceiver circuits and various iniature sensors. These provide end users with benefits such as inexpensive installation and maintenance costs, and easy network scalability compared with a wired network. Therefore, the deployment process can be rapid and flexible. Large civil engineering infrastructure such as bridges, highways and tunnels are expected to last for decades or even centuries. However, most of them suffer from significant levels of deterioration. Therefore, early warning regarding any potential damage of the infrastructure can be promptly reported. Wirelessly gathered data will be analyzed remotely for prediction of catastrophic collapses or tunnel movement. However, a real deployment of operational WSNs is a challenging task and aspects such as routing protocols, fault tolerance, scalability, data integrity and network lifetime need to be addressed. Fundamentally, sensing coverage and radio connectivity among the wireless sensor nodes in the field of interests are the primary concerns in all applications etc. Underground tunnels are extremely Radio Frequency (RF) hostile owing to their geometry and the roughness of the tunnel walls. The underground wireless channel is one of the main factors that make realizing WSNs a challenge in the tunnel environment. Therefore, an accurate and appropriate radio propagation model for the prediction of the link connectivity is paramount in the planning and deployment of WSNs if acceptable Quality of Service (QoS) is to be achieved. A particular application plays an important role in determining network topology, for example, a multi-hop clustered network is effective for the deployment of WSNs in long and usually empty tunnels. Direct transmission from data source to sinks is usually not practical because sinks are generally far away from the data sources and the Sensor Nodes (SNs) have a limited communication range. Therefore, a multi-hop network is a good choice for data routing, and the clustering topology is appropriate to achieve network scalability. Careful node placement is important for successful deployment of WSNs while meeting QoS requirements. The network architecture under consideration consists of SNs, Relay Nodes (RNs) and a Base Station (BS). SNs located in specified predetermined sensing locations send the gathered physical information to their local cluster head, i.e., a RN, which in turn forwards the data to the BS either directly or via multihop routes. This paper proposes a

new strategy of minimizing the cost of deployment under the constraint of coverage, connectivity and link outage probability by minimizing the number of RNs. The contribution of this paper is as follows. An accurate empirical mean path loss propagation model and appropriate fading distribution model determined from a large number of field measurements are used to predict link connectivity specifically for tunnel environments. It has been illustrated that the choice of an appropriate propagation model in the environment of interests is vital for determining the number and the positions of RNs in the optimization process. This could lead to the misguided decision making if an inappropriate propagation model is derived or carelessly selected. The two-tier cluster based multi-hop network model is adapted to address the proposed communication coverage based constraint. In the future it will be extended to address energy efficiency and network scalability. A search-and-find algorithm is proposed to sub-optimally find the minimum number of additional RNs in the second tier of the network and place them to ensure that all SNs have connectivity with the BS. The remainder of this paper is organized as follows. Section II is dedicated to an overview of work related to RN placement and propagation models for wireless underground channels, and their applicability for the tunnel application.

3.DESIGN

We consider a WSN network consisting of a mobile in-pipe SN, a BS, and multiple aboveground RN. The SN along with an optical sensor is inserted into a fully operational pipeline. Once released, the SN moves in the water flow inside the pipeline and performs data acquisition. To reduce the amount of data to be transmitted, the SN performs on-board data processing. Only the summarized data or the extracted useful information will be transmitted to the aboveground BS to reduce the energy cost of data transmission. The BS is the sink node for the information stream from the SN.The RNs play the role of relaying information between the SN and the BS.. Compared with the case without using the RNs, the major advantage of placing the RNs is to reduce the transmission distance of the signal from the SN, thereby decreasing the amount of signal attenuation and the required transmission power at the SN. In different environments, different feasible sites may impose different limits on the heights of the RNs' receiving antennas. When the SN transmits the sensed information to a RN, the radio wave propagates through different media, including the in-pipe water, the plastic of the pipe body, the soil, and the air.. The SN will pass by each RN to BS

4.MODULES

- Communication Model
- Relay Selection
- Emergency message case
- Choosing Different RN

Communication Model :

In this model, we create a group of sensor nodes and relay nodes. Sensor nodes detect the data and it will forward to corresponding relay node.

Relay nodes are heterogeneous nodes, it has classified into two different manner high power and low power nodes.

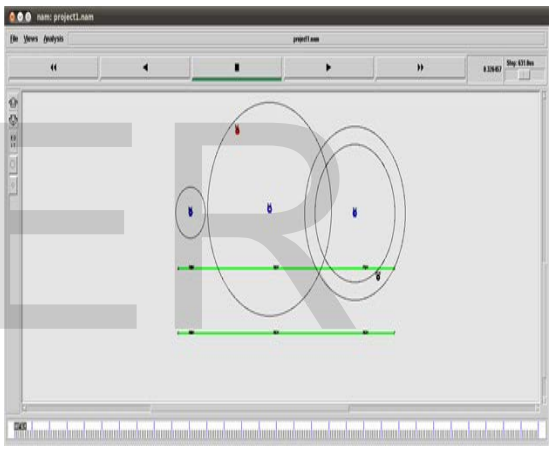


Fig.2 Network Formation

Relay Selection:

Relay node will select by coverage range of the node and movement of sensor nodes.

The sensor nodes will move depending upon water flow of the pipe line.

The relay selection will be based on energy of the neighbour node.

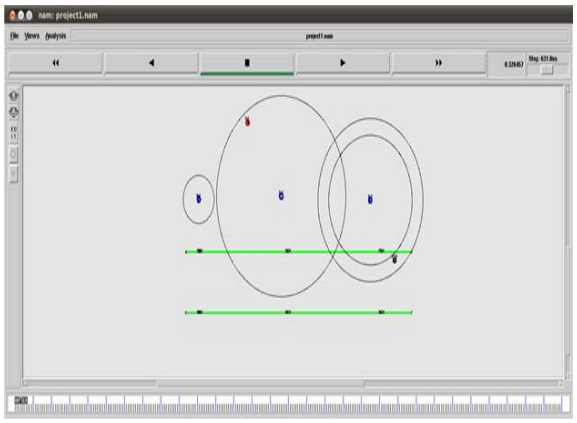


Fig.3 Route request for communication

Emergency message case:

If sensor detects any emergency message but relay node not available on this coverage area then nearest neighbour node will take incharge of communication.

So mobile node will send the data through the relay node

Optical sensor in mobile node helps to detect the leak in the nework.

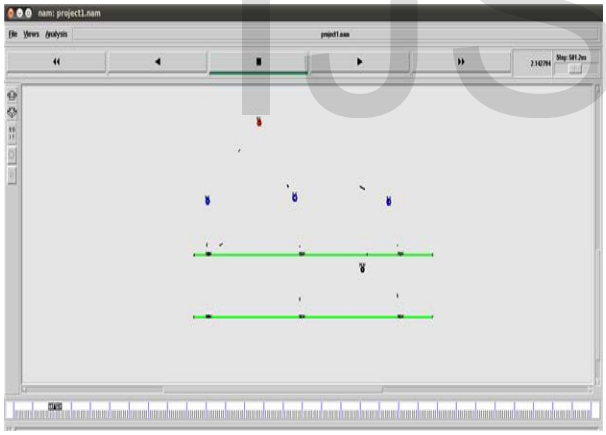


Fig. 4 Optical sensor communication

Choosing different RN:

If any RN node failed in the network, sensor node can select different RN node.

Because here the network has heterogeneous nature.

So easily network will hand over to different RN.

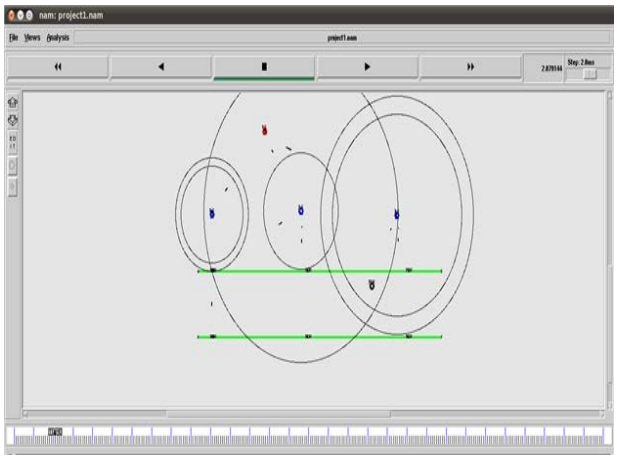


Fig.5 Choosing Relay Node

5.PERFORMANCE MEASURES

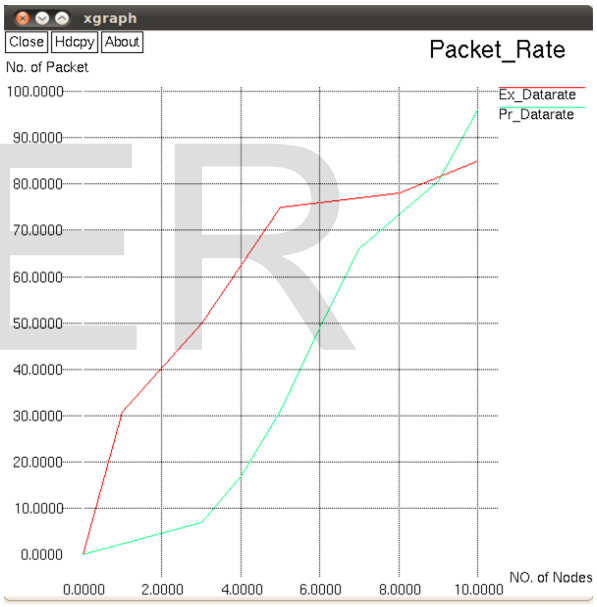


Fig.6 PDF or Data rate

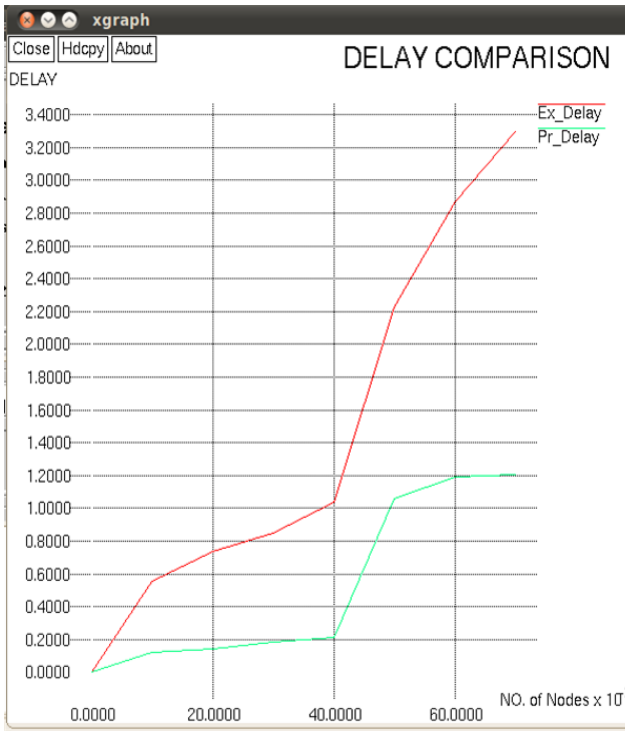


Fig.8 Delay Comparison

6. CONCLUSION

We presented a pipeline surveillance method for RN placement method in WSNs for underground water pipeline inspection. First, an WSN architecture was introduced, comprising of one in-pipe mobile SN, multiple aboveground RNs, and one BS. Then, a path loss model was developed to characterize the wireless communications between the SN and the RNs. Based on the path loss model, an optimization problem was formulated to minimize the SN's energy consumption while taking into account both the pipeline coverage requirement and the SN's transmission power limit.It works in the heterogeneous network.

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