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Environmental Monitoring of Villages Situated near Industrial Zones using Wireless Sensor Network

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Abstract - *A wireless sensor network consists of small devices, which collect information by cooperating with each other. These sensing devices are called nodes and consists of CPU, memory, battery and RF transceiver. Each node consists of processing capability and can accommodate various sensors. The size of each sensor node varies with applications. The nodes communicate wirelessly and often self-organize after being deployed. Wireless sensor networks can be used for variety of applications such as environmental monitoring, surveillance, military purposes etc.*

This work focus upon use of wireless sensor networks to monitor environmental behavior of villages which are situated near industrial zones , as these villages are more prone to face consequences of pollution, which can degrade the fertility of soil and thus reducing crop productivity and even making the whole land barren. Also it analyze the challenges associated with deployment of wireless sensor nodes, the hardware and software used for the purpose and also the socio-economic effects on population living in the area.

Key Words**: Pollution, agriculture, Nodes, Sink, monitoring, Quality-of-service, Implosion, Data duplication, Nodeview, Nodeconfig, TinyOS.**

1. INTRODUCTION

Sensor nodes are small embedded devices which are mainly able to perform simple computation and to send or receive data. Their typical usage is gather information about their surrounding environment via sensors, to potentially preprocess data and finally transmit them to a sink**.** In a typical sensor network, each sensor node operates individually and has a microprocessor and a small amount of memory for signal processing and task scheduling.

Each node is equipped with one or more sensing devices such as acoustic microphone arrays, video or still cameras, infrared (IR), seismic, or magnetic sensors. Each sensor node communicates. wirelessly with a few other local nodes within its radio communication range.

An autonomous set of such nodes are called Wireless sensor nodes. Although sensor networks have many applications , This environmental monitoring is being discussed here due to its practical relevance and the unique integration of technology and society that it provides.

Environmental monitoring of villages which are situated near villages is necessary because of magnitude of risk posed by waste materials of factories especially chemical manufacturing which can change whole topography of the area. Without proper monitoring villages with fertile land will soon become an arid and dry habitat and if we are allowing to increase its magnitude, the consequences will be severe for a country like ours.

As industries continues to grow at rapid pace , it is evident that pollution is caused due to it. Many existing industries are situated near agricultural lands which is a matter of worry of as due to waste dumping and emission the agricultural lands will become unproductive after some period of time , due to this farmers may quit their traditional job and a country of such a large population can't afford this. So, to avoid these conditions a proper monitoring is required.

2. ENVIRONMENTAL MONITORING USING WIRELESS SENSOR NETWORKS

Environmental monitoring like measuring temperature, sunlight, pollution etc. can be achieved by deploying a large numbers of sensors in the targeted area , however the sensors should withstand the harsh conditions of nature such as storms etc., to work properly and send correct data packets to sink.

We can outline the needed characteristics of a sensor network for monitoring such villages as:-

- **Energy efficient** :- Batteries must be able to power the individual nodes during whole deployment. As they use radio signals for communication, which is a huge energy consumer , efficient protocol should be developed and used, for example the Protocols of communication which always keeps radios on should be discarded.

when we are talking about deployments in remote areas like villages the network has to be energy efficient and must use alternative sources of energy.

- **Reliability**:- In deploying of sensor networks in such areas where end user may not have any networking knowledge and when the area of deployment can be very remote such as villages, we must make sure that wireless sensor networks are wise enough to keep themselves working that is they should be able to perform some basic operations on their own and minimum human intervention is required.
  Also we have to keep in mind that reliability can't be very high as nodes will not work properly during harsh weather conditions.

- **Flexibility**:- Many a times after deploying a whole array of sensors we find out that current location is not favorable for data sampling as cluster of new industries get started at any other location or we may want to add new nodes to our network , therefore it is necessary for the network to maintain flexibility needed for all these conditions.

  Quality of service:- As stated earlier energy-efficiency is very important for any network, which determines network lifetime, and the high level QoS, that is met over the course of the network lifetime.
  This QoS is application-specific and can be measured a number of different ways. For example, in our case we know that pollution factor usually doesn't changes abruptly in a short period of time, so it is possible for us to keep only one node active within every sub-region , due to which we will increase our node's life as only one node will be active alternately , which will save precious power and also we can record any abrupt change arising out of exceptional conditions because at least one node in a sub-region is always ac tive.
  As our network will have to deal with large geographical area , the quality of service may be given as percentage of environment actually covered by active nodes at any given time.

3. CHALLENGES FACED IN SENSOR NETWORKS

- **Limited hardware configuration**:- Due to cost related issues many a times we have to settle for hardware with limited capabilities such as less processing speeds , less storage , and poor communication capabilities. As many of us know that processing a bit is much more energy efficient than transmitting it , and if we want long life of nodes we will have to use smart nodes , with higher processing and storage capabilities.

- **Short lifetime**:- In these types of implementations where nodes have to suffer environmental factor it is natural that the sensors will face the problem of short lifetime due the weather and also the pollutants from industries will play a big role in this. Due to this problem we generally go for cheap sensors in any huge deployment.

- **Data duplication**:-Having more number of nodes is most of the times quite good as it provides more points of data collection which helps in random data sampling and also due to more number of nodes the network is not affected much if one node becomes inactive, but when we deploy highly connected node network the problem of implosion comes into picture.

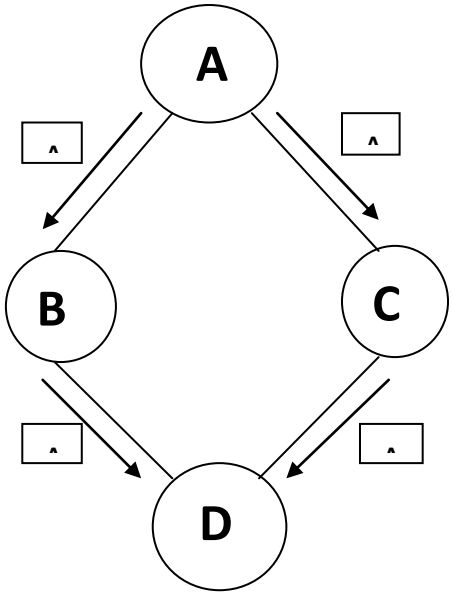

Fig -1: Showing the problem of Data Implosion

As seen in the above figure , in this network node D is receiving two copies of same data which results in energy and bandwidth resource wastage and also incorrect data sampling. So, we have to engineer the routing of nodes in such a way that these kind of situations doesn't arise at all or are negligible.

- **Missing packets:-**
  During certain harsh conditions such as heavy rain , humidity we don't get exact and reliable supply of data packets. Most of these missing packets are due to failure in hardware such as short circuits, which leads to the damage of several consecutive packets. This is shown in the below diagram, as it shows the time correlation of packet losses per station, where each black line representing a missing packet. Subsequent failures were less pronounced, and the corresponding stations were able to recover after some time.

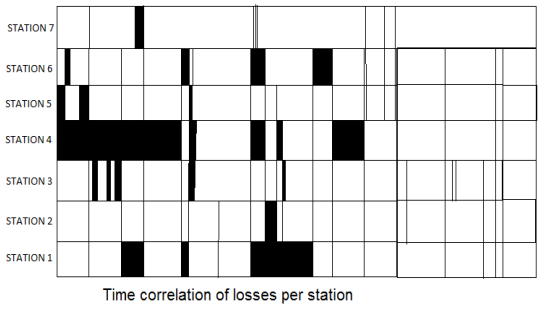

Fig -2: Showing the inactive nodes through black streaks.

4. HARDWARE AND SOFTWARE USED

One of the latest hardware in sensors is TELOS ,Its major features are :-

1. A microcontroller from texas instruments.
2. An internal antenna build into printed circuit boards.
3. An onboard USB for easier interface with PC.
4. Integrated humidity , temperature and light sensors.

The micaZ is the latest node sensor from cross bow technology.The MPR2400(2400 mh z to 2483.3 Mhz band) uses Atmega 128L microcontroller.

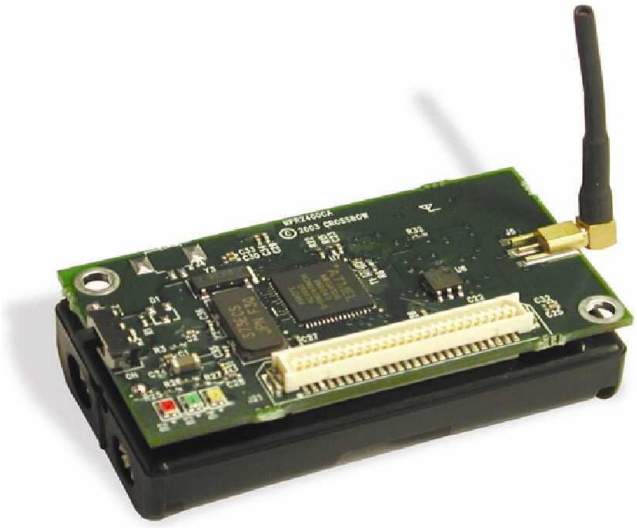

Fig -3: The MPR2400 sensor node with inbuilt antenna.

Softwares used:-

UC berkeley developed a specialized OS called tinyOS which is suitable for programming with small embedded nodes. The combination of nodes and TinyOS is gradually becoming a popular experimental platform for many research efforts in the field of WSNs.
Also, it uses nodeConfig which is a windows based GUI for programming nodes. This will provides an interface for downloading and configuring precompiled TinyOS firmware applications onto nodes. Nodeconfig allows the user to configure the node ID, Group ID, RF channel and RF power. Each of these node has a 512kB external non-volatile flash divided into 4 slots. These slots have a default size of 128 KB. Slot 0 is reserved for the OTAP (Over-The-Air-Programming). OTAP feature allows users to reprogram a node over a wireless link. Slots 1, 2 and 3 can be used for user-specified firmware.

Supported Platforms:-

NodeConfig is supported on the following operating systems:

i. Windows Vista
ii. Windows 10

Installing NodeView on a Windows PC

It is necessary to install NoteView on a PC before its' use. The requirements for the installation of NodeView is described as below:

1. A PC with one of the above mentioned operating systems
2. An NTFS file system.
3. Screen resolution must be at least 800 × 600pixels.
4. Administrative privileges to write to Windows registry.
5. 5. Before installing NodeView, it is recommended to shut down all the programs running on the computer.

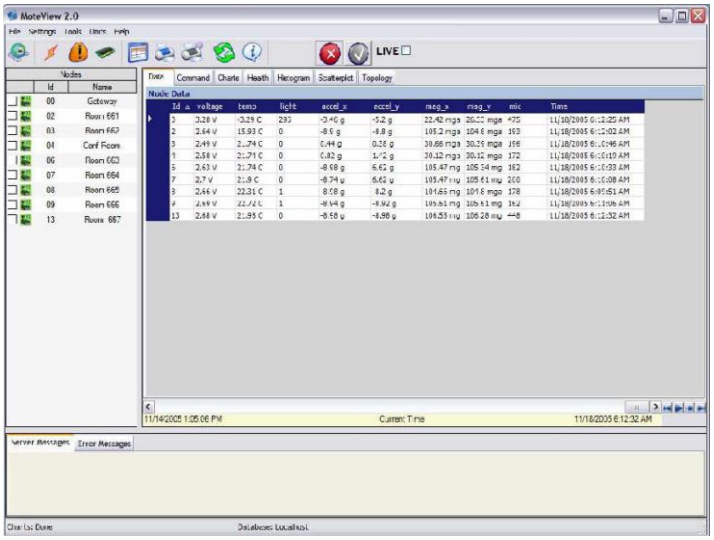

Fig -4: A typical NodeView environment.

Above diagram shows a typical Nodeview environment which shows all the data streams such as temperature, collected from sensors. NodeView is designed to be an interface between a deployed wireless sensor network and a user.

5. CONCLUSIONS

Wireless sensor networks have potential to change the lifestyle of people in a big way through its numerous applications .

The environmental monitoring of villages through them will not only safeguard our crop production but also help in avoiding catastrophic geographical change in long run.

REFERENCES

[1] Guillermo Barrenetxea, Francois Ingelrest, Gunnar Schaefer, and Martin Vetterli ,"Wireless Sensor Networks for Environmental Monitoring: The Sensor-Scope Experience", 2008 IEEE International Zurich Seminar on Communications, 10.1109/IZS.2008.4497285

[2] Mark A. Perillo and Wendi B. Heinzelman, "Wireless Sensor Network Protocol (2005)",

[3] Rohit vaish, "Application of Wireless Sensor Networks and development of energy efficient cluster based computing".