International Journal of Computer Applications in Engineering Sciences
[VOL IV, ISSUE II, JUNE 2014] [ISSN: 2231-4946]

Water Quality Monitoring Using Wireless Sensor Network

Rashmi Choudhury[1], Purabi Kalita[2]

Department of Information Technology,
Gauhati University

[1]rashmichoudhury03@gmail.com, [2]purabikalita3@gmail.com

***Abstract*— This paper attempts to give a brief introduction and review on different research work carried out in the field of water monitoring system using wireless sensor network. With the growth of economy in recent years, the need for secure delivery of clean water becomes a critical issue for human beings. Therefore, it is necessary to have novel analytical systems to control water quality. Water Quality Monitoring has a big influence on the aquaculture management, waste water treatment, drinking water and some other applications. Different wireless underground sensor network (WUSN) monitoring system detects pH, conductivity, dissolved oxygen, turbidity, temperature, ORP (Oxidation-Reduction Potential), BOD (Biochemical Oxygen Demand), Flow and etc. WUSNs can be used to monitor a variety of conditions, such as soil properties for agricultural applications and toxic substances for environmental monitoring along with ground water monitoring. Unlike existing methods of monitoring underground conditions, which rely on buried sensors connected via wire to the surface, WUSN devices are deployed completely below ground and do not require any wired connections. Each device contains all necessary sensors, memory, a processor, a radio, an antenna, and a power source. This makes their deployment much simpler than existing underground sensing solutions.**

***Keywords*— Wireless sensor network (WSN), monitoring, environmental analysis, Environmental Sensor Networks (ESN), WUSN, BOD, ORP, etc.**

I. INTRODUCTION

Monitoring of river water plays a vital role in water protection. Human activities and rapid growth of industries are mostly responsible for the river pollution. In addition to that fish can accumulate heavy metals and toxic substances in river water. Many polluted rivers are used as drinking water sources and so we can see that poor river water quality can degrade the basic health of human beings. Because the water quality is related to regeneration, growth and survival of aquatic organisms, a good supply of river water is essential to drinking water treatment and fish farming operation.

Recent technological developments in the miniaturization of electronics and wireless communication technology have led to the emergence of Environmental Sensor Networks (ESN). Sensor networks are currently a very active area of research. The richness of existing and potential applications from commercial agriculture and geology to security and navigation has stimulated significant attention to their capabilities for monitoring various underground conditions. Wireless sensor networks (WSNs) are an important technology for large-scale monitoring, providing sensor measurements at high temporal and spatial resolution. Underwater sensor networks are envisioned to enable applications for oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation and tactical surveillance applications. Multiple unmanned or autonomous underwater vehicles (UUVs, AUVs), equipped with underwater sensors, will also find application in exploration of natural undersea resources and gathering of scientific data in collaborative monitoring missions. To make these applications viable, there is a need to enable underwater communications among underwater devices. Underwater sensor nodes and vehicles must possess self-configuration capabilities, i.e., they must be able to coordinate their operation by exchanging configuration, location and movement information, and to relay monitored data to an onshore station.

The simplest application is sample and send where measurements are relayed to a base station, but WSNs can also perform in-network processing operations such as aggregation, event detection, or actuation. While many have reported sample-and-send systems with tens of nodes and operational durations from days to years, other features envisaged at the outset such as event detection, sensing and actuation, or the integration of robots and sensor networks have not become commonplace. It seems that the technology is still emerging.

System integration, performance, and productivity are some of the most crucial aspects to be kept in mind while developing WSN applications. The WSN is just one small part of a complex system that includes internet links from the WSN to a server, databases, and web presentation tools. Each of these components are critical for success of the overall system. Performance has many aspects. One is reliability of the node itself: its power source, radio links and overlying protocols, and reliability of the application and operating system software. Lack of performance leads to gaps in the data record, negating the claim about high temporal precision, and incorrect data which leads to a lack of trust and confidence in the system. Productivity has two aspects. Most important is how well it assists the end user to do their science or business, and is largely related to human interface design and the performance of the underlying database and presentation software. Databases and web presentation tools are simple to use with small sets of data but when data volume grows, performance as well as productivity falls drastically.

II. Design Challenges Of WUSN

Power Conservation: Depending on the intended application, WUSN devices should have a lifetime of at least several years in order to make their deployment cost-efficient. This challenge is complicated by the lossy underground channel, which requires that WUSN devices have radios with greater transmission power than terrestrial WSN devices. As a result, power conservation is a primary concern in the design of WUSNs.

Topology design: The design of an appropriate topology for WUSNs is of critical importance to network reliability and power conservation. The application of WUSNs will play an important role in dictating their topology, however, power usage minimization and deployment cost should also be considered in the design.

Antenna design: The selection of a suitable antenna for WUSN devices is another challenging problem. In particular, the challenges are:

- Variable requirements
- Size
- Directionality

III. Analysis Of Previous Research Works

In the paper titled “Sensor Placement in Municipal Water Networks” by Jonathan Berry, Lisa Fleischery, William E. Hart ,Cynthia A. Phillips and Jean-Paul, they presented a model for optimizing the placement of sensors in municipal water networks to detect maliciously injected contaminants. They formulated this problem as a mixed-integer program(MIP), which can be solved with generally available solvers. A MIP is the minimization (or maximization) of a linear objective function subject to a set of linear and integrality constraints on the variables. In this case, the integrality constraints represent decisions of where to place a limited number of sensors. They adopted optimal sensor placements for three test networks with synthetic risk and population data. Their experiments illustrates that this formulation can be solved relatively quickly, and that the predicted sensor configuration is relatively insensitive to uncertainties in the data used for prediction.

Main conclusions drawn from the paper:

Temporal Effects: Their model is well suited for applications where water flow is quick, or where water flow does not change direction.

Placement Locations: It is easy to adapt this model to place sensors on nodes of the network, or a mixture of both.

Sensor Costs: Their model treats cost issues by limiting the number of sensors used.

“Environmental wireless sensor network” by Peter Corke, Tim Wark, Raja Jurdak, Wen Hu, Philip Valencia and Darren Moore.

They developed a small network with nine nodes, located 2000 km from their lab. Its purpose was to monitor the salinity, water table level, and water extraction rate at a number of bores within the Burdekin irrigated sugar cane growing district. This is a coastal region and over extraction of water leads to saltwater intrusion into the aquifer. The area they monitored was approximately 2 _ 3 km2. They conducted a radio survey to determine achievable communications distances in the environment, bu they did this when the fields were bare. They neglected to account for the sugar cane which is up to 4.5 m tall when fully grown and interferes with line-of-sight wireless communication. The network was deployed in 2006 and operated for 1.5 years, delivered more than 1 million water quality readings, and required only two maintenance visits. One visit was to repair a number of nodes damaged in a violent electrical storm.

IV. Conclusion

While large-scale WSNs offer some clear potential for improved environmental sensing into the future, there are competitive technologies which will also improve over the next 5–10 years. Satellite remote sensing is already used extensively to infer a lot of information about the planet. Increased demand for connectivity in rural and remote regions should also see an increased spread of 3G, 802.11, and 802.16 coverage into regions where this has never been previously available. At the moment, the power consumption of 3G and 802.11 class devices is too high to be practical for most long-term environmental monitoring applications, however new generations of low-power 802.11 and 3G radios are expected to grow in the market, making these potentially viable for applications where multi hop wireless nodes are currently the only option. Further R&D in sensor networks could represent a shift in data flow, storage, and communication. Sensor networks have been so far treated as data gathering tools. While the initial wave of sensor network deployments has focused on periodic sample-and-send applications, the next wave will rely increasingly on performing in-network processing for a higher degree of adaptability to dynamic physical environments.

In summary, the next wave in environmental and agricultural sensor networks will combine commercialization of current technology and development of more advanced functionality. Adaptive power management strategies that efficiently manage these activities without compromising performance quality also remain an open direction for continued investigation.

REFERENCES

[1] Jane K. Hart, Kirk Martinez ; Environmental Sensor Networks :A revolution in the earth system science?, Available online at www.sciencedirect.com from 7 July 2006.

[2] Peter Corke, Tim Wark, Raja Jurdak, Wen Hu, Philip Valencia and Darren Moore, Environmental wireless sensor network

[3] Jonathan Berry, Lisa Fleischery, William E. Hart ,Cynthia A. Phillips and Jean-Paul, Sensor Placement in Municipal Water Networks

[4] Ian F. Akyildiz , Dario Pompili, Tommaso Melodia, Underwater acoustic sensor networks: research challenges, Available online 2 February 2005 at www.sciencedirect.com

[5] Ian F. Akyildiz , Erich P. Stuntebeck, Wireless underground sensor networks: Research challenges, Available online 12 July 2006 at www.sciencedirect.com

[6] Guenther Proll, Jens Tschmelak, Joachim Kaiser, Peter Kraemmer, Frank Sacher, Jan Stien and Guenther Gauglitz, Automated Water Analyzer Computer Supported System

[7] Teng Wang, Water quality monitoring system using WSN, iPack Vinn Excellence Center, ICT School of KTH