REAL TIME MONITORING OF WATER QUALITY OF DAL LAKE USING WIRELESS SENSOR NETWORKS

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Abstract:

The world famous Dal Lake is truly regarded as the nerve centre of Kashmir Tourism. Unfortunately its water quality has deteriorated considerably in the last two decades due to various extraneous factors. The conventional mechanism (discrete and mechanical) adopted for monitoring the water quality is unsuitable under various hostile climatic conditions experienced in Kashmir. Water quality monitoring system using Wireless sensor networks (WSN) has the potential to provide a pro-active solution for observing quality parameters in a real time environment. The parameters to be monitored in real time include pH value, conductivity, dissolved oxygen, turbidity, temperature, ORP/Redox which could be transmitted to a base station or control/monitoring room over a TCP/IP network for an appropriate intervention.

Keywords: *Wireless Sensor Networks;Dal Lake, Water Quality Monitoring;Under Water Sensor;Data Acquisition;Automated Water Quality Monitoring (AWQM).*

Introduction:

The importance of world famous water body like Dal Lake, Srinagar cannot be undermined in any situation. Over a period of time the quality of water of Dal Lake has deteriorated considerably. This is attributed to number of factors including increase in the number of house boats, large number of residential buildings, restaurants and hotels coming up along the lake front. This could be important from the Tourism Perspective but the improper sewage disposal from these sources has taken the toll on the quality of water. With growing emphasis on the management of water quality and preservation of Dal Lake, proper technology interventions are required for its preservation and restoration of its past glory. The importance of maintaining good water quality highlights the increasing need for advance technologies to help monitor water and manage water quality.

The paper aims at developing a real time water quality monitoring system of the Dal Lake by making use of wireless sensor networks. The parameters of water quality proposed to be monitored include pH value, Conductivity, Dissolved Oxygen, Turbidity, Temperature, ORP/Redox

Proposed system:

The recent advances in Micro-Electronic-Mechanical-Systems (MEMS), Wireless Communications and low cost manufacturing technologies have resulted in a heterogeneous

network system called Wireless Sensor Network (WSN). A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location

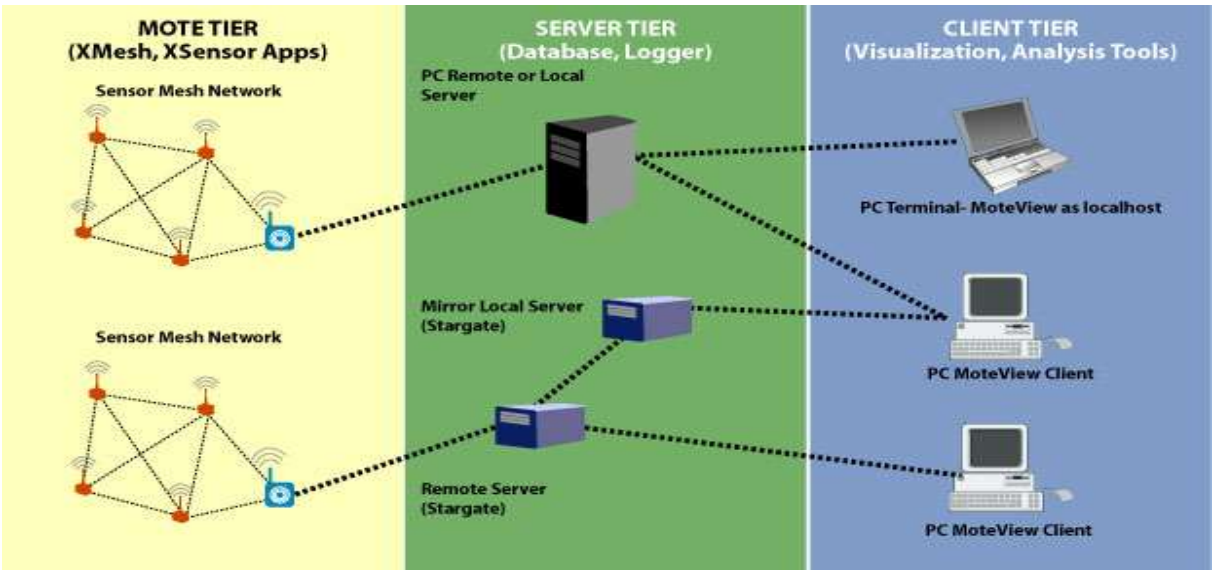
The proposed system shall be built around crossbow motes like MicaZ. Using such motes an adhoc network based on Xmesh networking protocol, a proprietary protocol of crossbow will be created. XMesh is a full featured multi-hop, ad-hoc, mesh networking protocol developed by CrossBow for wireless networks. An XMesh network consists of nodes (Motes) that wirelessly communicate to each other and are capable of hopping radio messages to a base station where they are passed to a PC or other client.

A wireless sensor network deployment in Xmesh is composed of the three distinct software tiers:

1. The Mote Tier, where the Xmesh resides is the software that runs on a cloud of sensor nodes forming mesh network.

2. The Server Tier is an always-on facility that handles translation and buffering of data coming from the wireless network and provides the bridge between the wireless Motes and the internet clients.

3. The Client Tier provides the user visualization software and graphical interface for managing the network. . Crossbow provides free client software called Mote View, but XMesh can be interfaced to custom client software as well



Software Framework for a Wireless Sensor Network

The actual architecture of the system will be built around Global waters underwater sensor. The typical features of these sensors are: Fully encapsulated electronics, 4-20 mA output ,Marine grade cable with strain relief ,Stainless steel housing

Global Waters WQ series Ph Sensor

These sensors will be interfaced with MDA 320 data acquisition card integrated with a processor and a radio like NPR 2400 CA based on atmal atmega L.The underwater sensors to be used for sensing pH value, Conductivity, Dissolved Oxygen, Turbidity,Temprature ,ORP/Redox shall give an current output in the range 4ma to 19 ma proportional to the physical parameters.

MDA320

MicaZ

The current output from the underwater sensors shall be changed to appropriate voltage levels to be fed to ADC channel of MDA 320 after proper signal conditioning .MDA 320 supports up to 8 channels of 16 bit analog input with single ended 0 to 02.5 volt inputs or 4 differential 0 to 2.5 volt ADC channel. The MDA 320 will be integrated with Micaz Crossbow mote .The typical characteristics of these motes are:

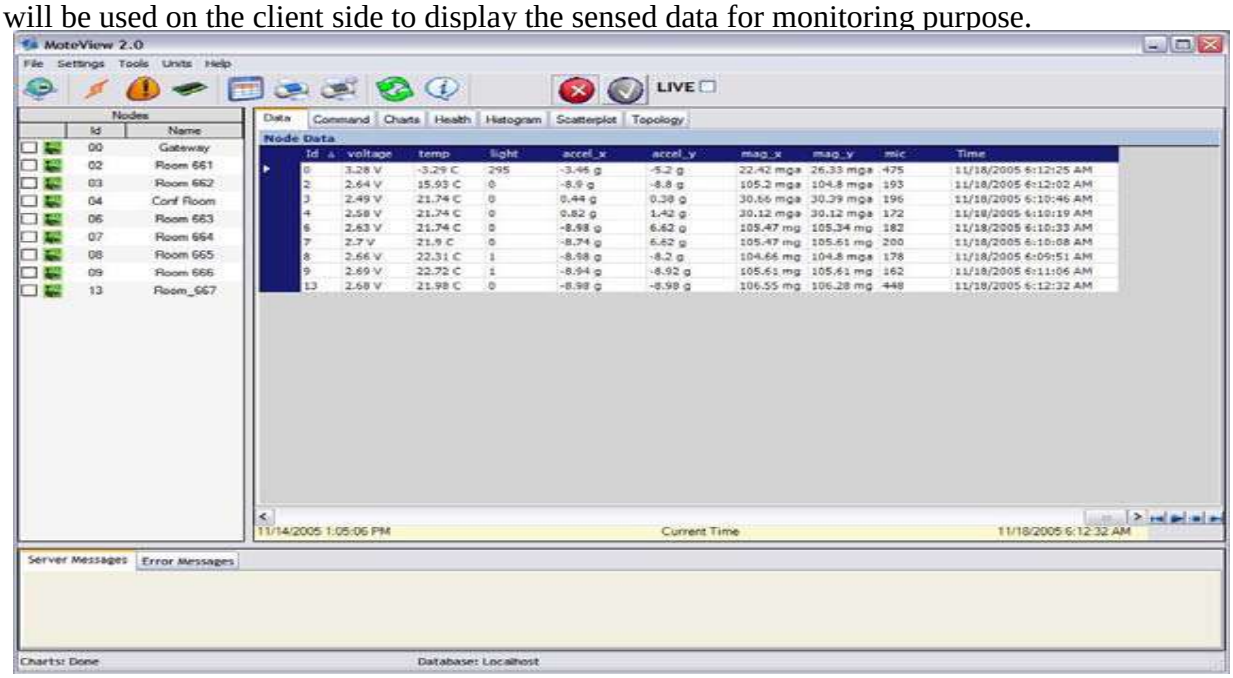
MICAZ Cross Bow	
CPU	8 bit (Atmel Atmega 128)
Storage	128 K bytes Program flash 512 K bytes Measurement (Serial)flash 4 K bytes EEPROM
Communication	868/916 MHZ radio
Bandwidth	250 Kbps
Transmit power	0,-1,-3,-5,-7,-10,-15,-25 dbm
Indoor/outdoor range	30 m/100 m
Maximum data load per packet	102 bytes
Operating system	Tiny OS
Security	802.15.4 default security protocol MAC encryption (AES-128)

The sensor node's will be connected to a Crossbow Stargate NetBridge gateway. The Stargate NetBridge is an embedded Sensor Network gateway device. Its purpose is to connect Crossbow Sensor Nodes to an existing Ethernet network. It is based on the Intel IXP420 XScale processor running at 266MHz. It features one wired Ethernet and two USB 2.0 ports. The device is further equipped with 8MB of program FLASH, 32MB of RAM and a 2GB USB 2.0 system disk.

StarGate NetBridge

The Stargate NetBridge allows remote access to sensor network data via TCP/IP .The gateway directly connects to the 10 Base –T LAN like any other network devices. Stargate NetBridge contains a built-in Web server (MoteExplorer) and Sensor Network management tool (XServe) which can utilized for monitoring the network on spot. For remote transmission a TCP /IP link will be established between the onsite sensor network and the control room to

be established initially at NIELIT Srinagar using the Stargate NetBridge.Moteview software will be used on the client side to display the sensed data for monitoring purpose.



MoteView

Conclusion:

The proposed system for Real Time Monitoring of Water Quality of Dal Lake using Wireless Sensor Networks is under implementation at National Institute of Electronics and Information technology (NIELIT) Srinagar / Jammu.Expermentation related to acquisition of data using MDA 320 and transmission of sensor data to base station has been carried out successfully. The data has been visualized on Mote view platform and also logged in the Postgress database. Simulation are been carried out on Qualnet to generate and visualize various scenarios

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