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The Application of Wireless Sensor Network in Ground Water Table Monitoring in the Placer Mineral Mining Areas

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Abstract: Ground Water resources are the principal source of drinking water. Ground water is under increasing stress due to rapid urbanization and industrialization. Beach placer mining is intensive in the coastal stretches and deltaic plain of Tamil Nadu. The water table is highly fluctuating in the indiscriminate mining area. Ground water researchers to have quite access to the ground water data with less effort and cost. We used multisensory system to monitor the ground water table based on wireless network and calibrated remotely. Wireless sensor network is a promising technology in advanced earth science research. The present study is focused to develop research activity in designing and developing wireless sensor networks for environmental monitoring in the mining area.

Key words: Sensor network, water level logger, beach placer mining, ground water table level.

I. INTRODUCTION

Ground water resources are an important source of drinking water. Ground water resources are under increasing stress as there is a rapid growth in their usage. Drought severity and duration and long duration Indices are imprecise in detecting the onset, end accumulated stress of drought because they lack near real time ground-water level data. Almost in all areas, ground water levels are fluctuating. There is a need to monitor continuously in several locations to characterize the aquifer system. A pressure transducer is deployed in different wells and is recorded on an hourly for long periods (12 months). The need for real time ground water level data is proposed to develop a wireless sensor network for acquiring, transferring and analyzing the real time data.

Water level measurement from observation well in the mining area is having diverse anthropomorphic influences. Surficial aquifers are highly vulnerable to salinization of ground water in the area. Intensive mining could significantly draw down water levels in those aquifer zones. Water level is a common surrogate that is widely used as an analog for fluctuation under the premise that fluctuation of water level is depending upon the intensity of mining below static level of water. There have been serious limitations to efficient water table monitoring in the mining areas. Limitation includes lack of aquifer information, lack of reliable and timely impact assessments, Neilson and Bearee,[1].

Wireless sensor network is one of the most important technologies to be adopted in the ground water table monitoring. The network adopted to monitor the water table is covered by sensor nodes, receiver, control node and 3G communications. Since sensor webs have been envisioned as a powerful future technology for earlier science research, Torres_martin et.al [3].The objective of the present paper is to record ground water level fluctuation continuously in mining area for environmental monitoring programme. Consider in this case that we want to measure the status of water level in the mining area to demonstrate the application of wireless sensor network.

A typical commercially available media of 3G cellular is selected to enable two way communications and control between a base station and remotely located ground locate level loggers. A PIC microcontroller is combined with sensors. Here the sensors are static. The routing algorithm is applied by assuming that sensor is homogeneous and static. PEGASIS routing protocol is used. But Brent et al[8] have employed a multi hop routing scheme to enable data transfer using a Bellman Ford. Our priority is to minimize the total cost of the system and to provide reliability and accuracy of the data collected.

II. DEPLOYMENT OF SENSOR AND MONITORING

Wl400 water level sensors were deployed in the well at different locations (Fig.1)For monitoring the ground water level.(Riley and Halfman 2001). At each monitoring

site,(nodes) where ground water levels are to be measured, a set of insitu sensors is needed for providing continuous measurements. Sensors should be positioned so that their measurements are representative of the water table level. Each sensor node consists of insitu stage connected to data logger. The data logger is programmable to collect data every one hour and store it in the data logger memory. In the last few years, there has been significant research activity in designing and developing wireless sensor networks, whose major focus is insitu sensors that collaboratively perform embedded sensing and communications tasks, Estrin et al [4]. Similarly to address the challenges and rapid advancement in sensor networking there should be flexible sensor network with satellite communications call SPAN. This prototype is very useful in ecological research. But in the present investigations we used commercially available WL logger coupled with GPS to obtain water level and geographic location. The sensor node consists of sensors, ADC and microcontroller. The sensed value of water level will be in the analog form. But for the system it needs digital form. So the analog value is converted into digital using Analog to Digital converter which is present in the microcontroller. The microcontroller which is used in this work is PIC16F877.The supply to the sensor will be from the solar cell. The measured data from the different sensor locations has been cluster and the data are transferred by applying PEGASIS routing algorithm. The WL 400 water logger could be used with any number of different sensors. This configuration has the capability of millimeter resolution over a depth range of 30-40m.

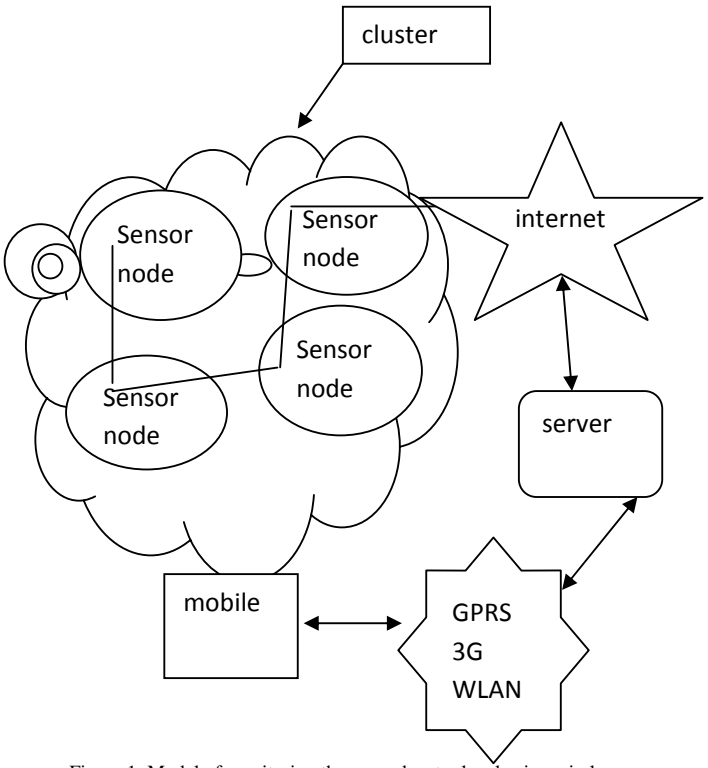

Figure 1: Model of monitoring the ground water level using wireless sensor network

III. DATA TRANSFER

The data from each sensor node are transmitted in near real time to the mining quality control laboratory via a communication network. Communication within the network is managed using loggernet software. Loggernet enables us to monitor sensor node stations in real time, regularly retrieve data from each of the sensor nodes. The logger net server is programmed to connect hourly to each sensor node and download the most recent data to delimited text files. Similar method is adopted in estimation of water quality using sensor network, Jeffery et al [2].The data will be further sent to the project operator's mobile phone using GPRS 3G wireless LAN. Thus the operator can view the measured values for further processing.

IV. DATA INTERPRETATION

To design an appropriate database scheme for the ground water level measured has to be created in database management system. Based on this developed database one can address the cause for water level fluctuation in the mining area. Table 1 shows the water level recorded by the sensor. Analyzing these scenarios will inform possible future scenario and decisions regarding monitoring locations for a network of sensors to provide early warning to indiscriminate mining in the shallow aquifer region. Widespread environment will eventually allow for extensive pulse taking of our world. These data sets generated from the sensor network will require a proper algorithm or a GIS analysis to enable the proper decision on water table fluctuation within the mining area.

Table I : Ground Water Table Levels in the mining Area

Well No.	Latitude	Longitude	Water Table Level in Meter
1	78.41087	11.00135	14.10
2	78.40668	11.00112	12.50
3	78.40755	11.00309	13.65
4	78.40344	11.00667	11.36
5	78.40417	11.00227	11.96
6	78.39044	11.00091	11.82
7	78.38931	11.01337	15.02
8	778.391	11.01353	11.69
9	78.39002	11.0136	13.65
10	78.39171	11.035	15.68
11	78.45419	11.02684	11.63

12	78.45379	11.02388	11.98
13	78.42109	11.03572	13.68
14	78.38318	11.05251	13.22
15	78.42337	11.02796	14.55
16	78.3285	11.0247	12.39
17	78.35266	11.04752	14.25
18	78.3585	11.02183	12.65
19	78.37864	11.03517	14.95
20	78.41977	11.0205	16.35
21	78.38488	11.01504	12.89
22	78.38299	11.01421	15.41
23	78.39046	11.02982	13.25
24	78.39059	11.03504	13.68

V. CONCLUSION

The rise and fall of water level could be seen in the mining area. Long term observation will be useful for finding out the effect of tidal changes in the beach faces and mining area. Similarly the water level is needed to analyze the variation in water quality in the particular environment. It is pertinent to note that data from monitoring stations can be analyzed and communicated by wireless network technology. However, the quality of sensors should be improved by developing in several key locations over long periods of time and capable of automotive operation in the field of future.

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