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Comparative Study on Embedded Systems for Drinking Water Testing based on WSN

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ABSTRACT

At present, water quality monitoring is the essential part to our country's aquaculture. In this paper, different approaches for a real-time water quality environment monitoring system are discussed based on wireless sensor network to acquire data of environmental factors of water quality. The water quality monitoring system is required for the need of environmental protection department in a particular area of the water quality requirements and to inform people about the quality of water they are deinking. Water system should be monitored at frequency that is sufficient to ensure that the system is under control & continues to produce water of an acceptable quality. Different approaches have been discussed to virtually monitor the drinking water quality, measured from the raw water in the river to the tap water of the consumer. This paper introduces the comparative study of different approaches based on the different system architecture for reading the non chemical parameters like ph, color etc and chemical parameters with the set of electrodes.

Keywords

Parameters, WSN, ZigBee, Water quality monitoring.

1. INTRODUCTION

The size and complexity of our global water system raises many safety issues. Microbial contamination of water has been the focus of much attention recently from outbreaks of disease and large recalls of processed water with significant economic losses. With the development of society, people have put forward higher and higher requirements on Environment Quality Monitoring System, especially like farmland irrigation, aquaculture and those which are closely interconnected with our daily life. Water Quality Monitoring System based on WSN can have many different nodes. Every terminal node can have several water quality measurement modules, like the modules of PH value, Pollutant levels, temperature and color etc. [1].

With the help of nodes, WSN gets water quality data, and then sends the data to internet. Once Remote Data Center gets the data through Internet, it will analysis, process and record the water quality data. It is real-time, regional and low cost. Obviously it can meet people's outstanding requirements of environmental monitoring. It is able to grasp the current water quality conditions and predict the future trend of development, through continuous real-time online monitoring etc. [1] [3].

By means of placing wireless sensor node on the surface of the wells and lakes, it makes the networking automatically so as to actualize 24-hour unmanned service monitor on line for pH value, amounts of dissolved oxygen, and Color and heavy metal ions and so on in water quality. [2]. It is estimated that the largest part of the diseases that affect the heath of the people nowadays is because of the poor water quality. In our country as well, as everywhere in the world, the efforts made by specialists for finding solutions that may contribute for improving the water safety level, considering the direct connection between water quality and health. [4].The water is the source of life. With the economic development, there is an expansion of industrial production and the increase in population every year, a number of wastewater produced by various industries is discharged into rivers and lakes. With more and more pollutants put in water, the quality of water is destroyed by a large extent. [5].

The aim of this paper is to study different approaches that uses different architectures implemented on a microcontroller system. As an example application of this system, an analysis can be made on various types of drinking water that have different concentrations and types of salts..This example can be extended to other industrial applications such as quality control department of water purification, wastewater discharges, and, in general, the system is useful in cases where it is essential to conduct quality analysis of water quickly, easily, economically, and especially without any specialized personnel.

A. Parameters of Drinking water.

When the problem of monitoring drinking water consumption and especially drinking water quality is concerned, some of the physical-chemical and bacteriological parameters should be considered as follows:[4].

1. The physical parameters of water are: Color, odour, taste, and pH, free residual chlorine, conductivity, iron, turbidity, total hardness etc.

2. The chemical parameters of water are: Ca, Mg, Cu, Iron, Flouride, Nitrates, Lead, Zinc, Arcenic, Chlorides, residual free chlorine, pesticides etc..

3. The bacteriological parameters of water are: Coli form bacteria, Sulphite reducing clostridia, etc. [4].

For each of these parameters there is an established compulsory calculated concentration. The necessity for a high quality drinking water is justified by a series of implications

like water has a structural role to work as main functioning of an organism. The key principle is to consider the entire supply chain from source to mouth, and to take a risk management approach through the development of drinking Water Safety Plans. The different parameters can be taken into account to perform the online monitoring depending upon the priority of the hazardousness.

2. LITERATURE REVIEW

The main idea is to monitor water quality parameters continuously. This can be done by various approaches discussed in the paper. The paper introduces different architectures for the same. The GPRS DTU is another common transmission technique. In this the system consists of WSN and Remote Data Center. First WSN collects water quality data, and then send the data to Remote Data Center with the help of GPRS DTU. [1].The star network topology is used for a special local area located in near pollution emission port. and the Zigbee cluster-tree network is used for some open and wide river or lake [2]. In the other approach the system contains base station and several sensor nodes. The base station contains a wireless receiver and a PC, where users can receive data from sensor nodes ananalyze it. Same parameters can be detected for harm based on SunSpot technique [3]. One of the way in which the system measures data from sensors sends to data acquisition board and then to PC.Parameters to read are PH, ORP, DO, Conductivity, Turbidity based on Zigbee transmission. [4].The Zigbee and GPRS are two most efficient methods in wireless data transmission.The system can be Made up of data collection monitoring module, wireless communication module and monitor center. In another approach the system is composed of three components: The water quality monitoring stations, the GPRS modem and the monitoring center. The parameters of water to test can be PH, Temperature, Turbidity, Hardness, Clarity and Dissolved oxygen etc [5].Some chemical Contamination in water due to wastewater discharge can also be tested using the set of electrodes.

3. SYSTEM ARCHITECTURE

The water quality monitoring system proposed [3] is made up by a base station and several sensor nodes. The sensor nodes are located in different sites where we need to monitor water quality. The base station contains a wireless receiver and a PC, where users can receive data from sensor nodes and analyze it. The base station can still connect to Ethernet so that users can login and get data faraway.

The basic water parameters are transmitted through a multi-sensor system and registered in a local data logger (server), then they are transmitted by radio connection (wireless network), at regular intervals, to the central station. Here they are permanently displayed on LCD monitors and then to other electronic systems using the internet network in

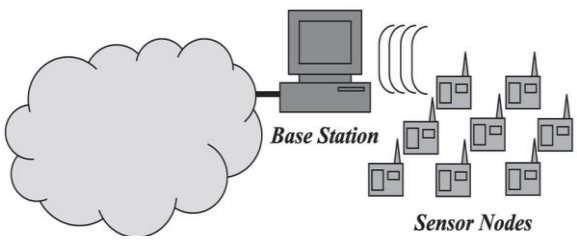

Fig 1: system Architecture

order to be visible to the public. At the central station the data is processed and filed in order to facilitate the monitoring, to carry out long-term statistics regarding the operation of the data collection network. [4].

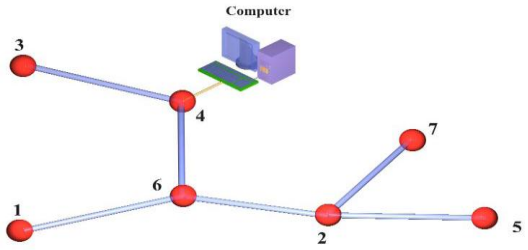

Fig II: Structure of system for monitoring water parameters

The entire system consists of two parts: the WSN and Remote Data Center [3].Frist WSN collects water quality data, and then send the data to Remote Data Center with the help of GPRS DTU. System structure is shown in Figure. Terminal node has four different sensor modules.They are the modules of PH value, Pollutant levels,water temperature, turbidity value.

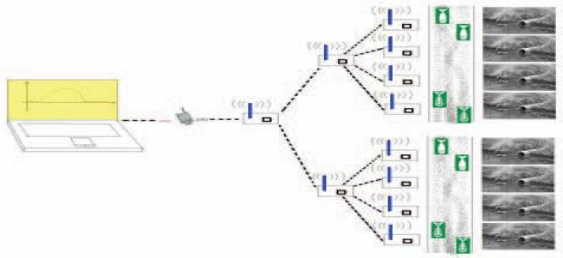

Fig III: system Architecture

Long-distance water quality monitoring system block diagram is shown in following Figure IV, it consist of Data Acquisition Layer, Management layers and sharing of layers.[6].

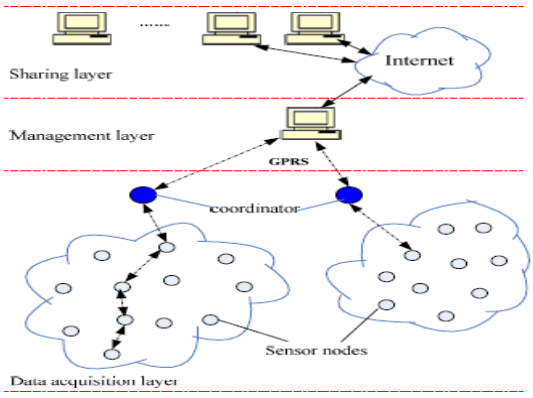

Fig IV: system block diagram

Another design of the monitoring system structure is as given below in fig V. It is made up of data collection monitoring

module, wireless communication module and monitor center [2].

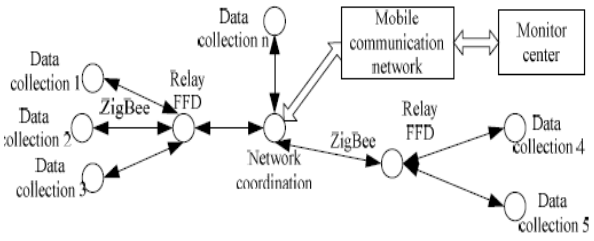

Fig V: system Architecture

4. METHOD

The quality of drinking water varies due to the origin and quality of the raw water, untreated surface or ground water, and also due to efficiency variations in the drinking water production process Problems can be related to the occurrence of algae, bacteria, pesticides and herbicides, industrial contamination, etc. in the raw water. The character of the raw water, the biological activity at the production plant as well as in the distribution net may all cause quality problems, like bad taste, or could be unhealthy.[6].Controls are repeatedly done on the performance of the drinking water production process, but due to a rather low sampling frequency, an effective monitoring of occasional changes is hard to detect. A method for monitoring variations in the raw water quality as well as the water quality before entering the consumer would therefore be of considerable value.

By using the electrolysis process all the chemical contamination of the water can be detected. For some of the physical parameters of water like colour, odour, taste, turbidity, hardness etc can be detected by the different sensors available in the market. In order to perform the water quality monitoring following can be useful [4].

1. Sensors for detecting ph, conductivity, turbidity, temperature, dissolved oxygen and colour.

2. Data collection board, LCD to display the data.

3. ZIGBEE modules required for wireless transmission and reception.

4. Electronic computing system with software for the Display of analyzed parameters, e.g. PROTEUS soft, CODE VISION AVR soft.

5. TOPOLOGY STRUCTURE OF ZIGBEE NETWORK

ZigBee networks can be configured to operate in a variety of different ways to suit the application and environment. Supported topologies include: Star, Mesh and Cluster Tree. Zigbee is an IEEE802.15.4 standard low cost, low data rate (< 250 KBPS) and works in 2.4 GHz and 868/928 MHz wireless technology. It is used for personal area network and a peer-to-peer network. It is the base of ZigBee application layer and the network layer. ZigBee is a new kind of low complexity, low power consumption, low data rate and low cost wireless network technology. It's mainly used for close wireless connections. According to the standard IEEE 802.15.4, it can hold 64000 sensor nodes communicated with each other. The sensor node only needs tens of micro-ampere current to ensure network connection. Through radio waves, data will be transferred from one node to another one. So their transmission efficiency is very high. [6].

There are mainly three types of network topology for a ZigBee Network [2]. It is respectively shown as in following figures.

In the three figures, F, R, C represents respectively the node of the full function device, reduced function device and network coordinator. [2].

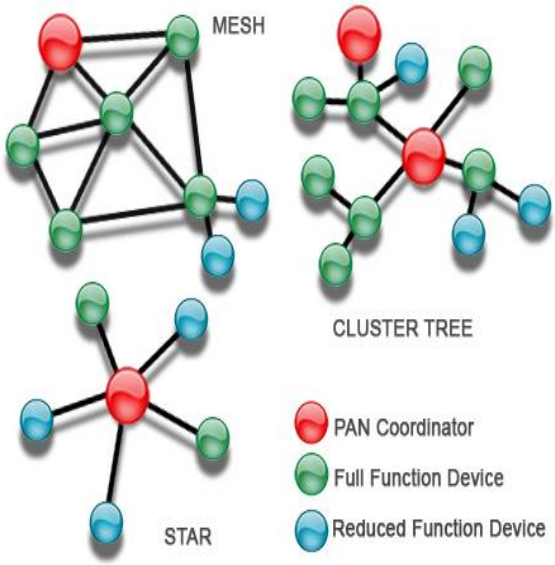

Fig VI: Zigbee Network Topology.

6. CONCLUSION

In this paper a comparative study has been performed which is aimed to understand the quality of the water to make it drinkable and thus presented the different system architectures in which the physical, chemical and microbial contamination can be detected and identified in water. The study shown here has a Positive meaning to strengthen the environmental protection and to improve environmental performance throughout the community.

Based on the above comparative study numerous difficulties can be solved such as intermediate-range transmission of water quality monitoring system and can realize real-time remote monitoring on the water quality and remote data sharing.

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