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WIRELESS POWERED COMMUNICATION NETWORK IN IOT ENABLED WATER DISTRIBUTION SYSTEM

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EXTENDED ABSTRACT

INTRODUCTION

Water distribution system (WDS) is a very important research area that affects the economic growth of our country and requires a great amount of energy for monitoring and management. Many routing protocols has been developed to conserve energy and extend the battery life. In spite of considering the energy conservation, it results in performance degradations. So there is a need to ensure the water quality and wastage in real time by integrating new technologies such as wireless powered communication network (WPCN), Energy harvesting (EH) and AI methods to reduce such issues. In WPCN, the wireless devices first harvest energy from the RF source signals and then manage this energy for its processing. The research in the area of WPCN is leading more ways in energy harvesting and management due to charging over air when compared to the conventional battery charging system. Therefore, its free from battery replacement issues which results in low operational cost and increase in performance. Another advantage of WPCN is its stable and controlled power supply under different requirements and physical conditions. All these advantage makes WPCN a better choice in wireless energy transfer [2]. To extend WPCN into IoT, the designing of resource allocation schemes, interference management etc is considered carefully [1][3].

This research paper focusses on optimizing the energy used in the WPCN with multiple energy sources and multiple sensors in order to achieve zero power state where the the amount of energy produced and consumed reaches to a constant value. The problem of unfair information transmission and EH in a dynamic environment is planned to solve by implementing an energy management scheme where important decisions are taken using artificial intelligence methods.

METHODS

The representation of system model is as in figure 1 which consists of multiple RF energy sources and multiple sensors where different water quality data will be collected and transmitted to the base station from the pipeline. The model consists of three group of sensors which will be collecting different types of water quality parameters. The energy will be harvested and transmitted to the sensors by considering the issues such as EH fairness, doubly near far problem etc using the controller. Every process will be controlled and monitored by the controller where the energy management scheme using AI methods will be implemented. The energy and data transfer will be based on TDMA using a dynamic allocation scheme. A mathematical model is derived from to achieve zero power energy in the system.

RESULTS AND DISCUSSION

This paper makes a novel contribution to achieve energy optimization using WPCN for real time monitoring in water distribution system. The paper also extends WPCN by considering all the design considerations such as resource deployment, energy allocation, self-interference etc. The simulation is deployed in a 20 by 20 m environment by referring to a previous model [3] and the channel model position is calculated by subtracting the path loss along with the distance of the sensor node from the energy node from a constant value which dependshhbb on the assigned deploying environment space. In this model one of the node is chosen as a base node for data transmission based on the equal distance from the networks to the energy node. The table1 provides the assumptions that are used for simulation.

Parameter	**Value**
Transmission energy for RF nodes	3000 mA
RF frequency	915MHz
Medium Access control	802.15.4

Table1. Assumptions considered for simulation

There are a few parameters that should be considered when setting up the model. One of them is the energy consumption of the sensor nodes which varies depending on the type and manufacturer of the sensors, energy consumption of the energy harvesting nodes, setting the distance for the transmission and finally, the selection of frequency for transmission. The energy consumption of the nodes vary based on the amount of data to be sent, transmission distance etc. In this experiment, plug and sense by libelium has been used which consumes the power as in table 1.

State	**Power Consumption**
On	17mA
Sleep	30µA
Hibernate	7µA

Table2. Energy consumption of Libelium plug and sense

In this model three different groups of sensors are used to collect data. The first group is used to detect the water quality ions and the second to find the physical parameters such as temperature, pressure and third group to calculate pH, DO and turbidity. These values which are sent to the remote station will provide a clear picture about the quality of water in real time to the clients based on the energy produced by the energy sources and managing the energy using the algorithms implemented in the controller.

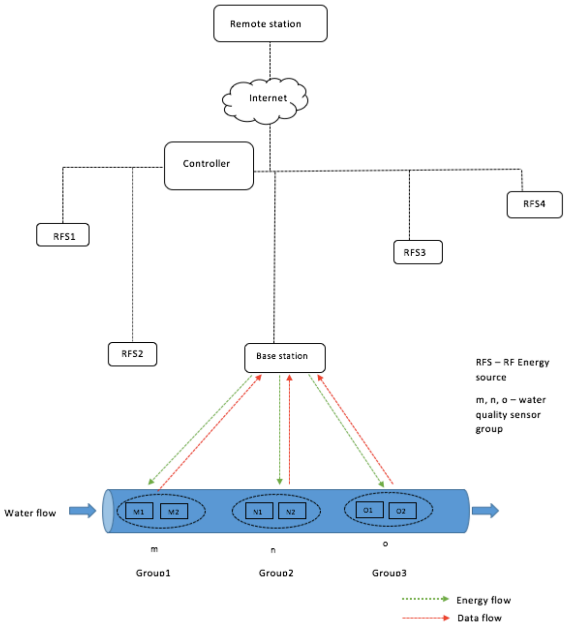

Figure 1. The System Model

The result of this model depends on how the energy is managed to achieve zero power by considering the fairness issues of the energy source and data transmission. The selection of the energy source is based on clustering by calculating the distance of the sensors from the energy source and every operation including the energy consumption will be monitored and controlled by the controller to achieve the desired result.

CONCLUSIONS

The water quality has always been a serious issue and intelligent monitoring of the water is a powerful process that combines computing, engineering and environmental factors for ensuring the water quality and thereby protecting the water ecosystem. The upcoming WPCN technology with IoT helps to build an energy efficient and self-sustainable system that helps to reduce the energy scarcity issue without performance degradations.

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