Remote Water Quality Monitoring Station

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Abstract --- **The system presented in this paper was designed to monitor contamination in surface water, specifically the Speed or Eramosa River, in Guelph, Ontario. The design is mobile and self-powered so that it may be deployed quickly and for long durations in remote areas. The system consists of four major parts: a solar panel power supply, a data logger, a radio communications module for relaying information to the treatment plant, and sensors for detecting water contamination.**

Index Terms -- **Data storage, remote monitoring, solar panel, water quality, wireless communication**

I. Introduction

Our design team was approached to design a system to monitor water quality in areas where surface water was being used as a drinking water source. The monitoring station was required to be portable and self contained so that it could be easily transported to locations as needed. Our team worked to create a layout that was durable and low maintenance, while keeping the overall cost of the project as low as possible. It was assumed that the station will only operate in ice free conditions as no water can be drawn from a frozen river. Also it was assumed that the station would operate in weather typical to Southern Ontario and thus have ample sunlight available for Solar Power Generation. While stations currently exist to monitor water quality in lakes and rivers they are typically bulky and not highly mobile. [1] Our design aimed to maximize mobility by removing any extraneous design elements and only monitor key water quality parameters. Research was conducted in to existing water quality monitoring stations and basic system layout was developed breaking the system into four components. These components were evaluated independently while ensuring compatibility.

II. Conceptual Design and Methodology

A. Overall Design

Our design consists of four main components; power generation, communication unit, data processing and storage, and water quality sensors. All these components will be mounted internally on a floating buoy. The water quality sensor will protrude from the base of the buoy into the water to be monitored. The design structure is shown in figure 1.

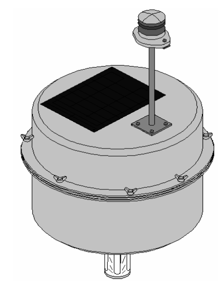

Figure 1: Model of completed station

B. Major Components

Power for the system will be generated using solar panels that will be used in conjunction with rechargeable batteries. Solar panels will operate during the day on sunny days and the batteries will run during the night and cloudy days. For communication purposes, a radio transmission unit will be used to transmit the stored data to a water treatment plant. A data storage device will be implemented to allow a level of fault tolerance, and standalone operation. The device will communicate directly with the main processor only. The system sensor package will consist of a probe capable of standalone operation.

III. Detailed Design

A. Solar Panel and Batteries

The power source of the system is designed to operate on a level of 12 volts and will allow a power output of 10 watts. A dual layer power generation scheme is used, which consists of a Solar-Battery system. The first layer is a solar panel array, which will be the primary source, given the high generation potential. The second layer is a re-charge capable battery array. This allows the system to operate in periods of darkness or heavy cloud cover. During solar operation, batteries will be recharged and system will be powered directly from the solar panels. During periods of darkness, batteries will power the system, and logic will prevent current leakage through to the solar panels. The electrical schematic for the power system is shown in figure 2. The power system was simulated using weather information taken from NASA Surface Meteorology and Solar Energy (see http://eosweb.larc.nasa.gov/sse/). Data obtained from the simulation revealed that the design can operate for an indefinite period of time based on normal weather conditions.

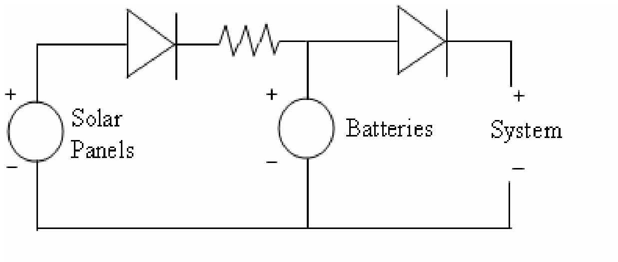

Figure 2: Logic used to regulate the power discharge from the battery.

B. Communications

There are three common ways of communicating wireless information, satellite, cable modem, or radio. Radio was chosen since out of the three it offered the best combination of simplicity, cost, and range as shown in [1]. The communication unit is a RF modem, with a range of up to 20 miles. It will use an RS-232 interface to communicate with the processor. A second RF modem at the plant will interface with a PC or microcomputer on receiving side. The modem will be set to 900 MHz to optimize the range.

C. Storage Device

The storage device is based on a flash memory scheme. A series of 8mb flash chips are arrayed in an address expansion mode provide the storage unit. Chip Selection is controlled by a series of decoders, given an input address. The addressing and data transfer is controlled by a microprocessor, which also provides the interface.

D. Water Quality Sensor

The probe will be powered from the solar panel and will communicate using an RS-232 interface. It will include 4 sensor attachments that will monitor pH temperature, dissolved oxygen and turbidity simultaneously taking readings on 10 second intervals.

IV. Discussion

Our station is a design to send a warning when one of the parameters monitored exceeds values shown in Table 1.

Table 1: Alarm Values

Parameter	**Alarm**
pH	<6.5 or >8.5
Temperature	>27° C
Turbidity	10 NTU
Dissolved Oxygen	<3mg/l

The values chosen were based on Ontario standards for drinking water [3] and knowledge of water treatment capabilities. Thus the value of turbidity is higher then that for drinking water as filtration methods are employed on raw water from surface sources. The dissolved oxygen level was chosen based on the required oxygen levels of large aquatic organisms such as fish. pH values are based on drinking water standards as pH is not usually altered during treatment. Temperature is based on the highest normal temperature of a Southern Ontario river in summer. Turbidity and temperature will change depending on location and season and may need to be altered accordingly.

V. Conclusion

Rapid water contamination is a very real possibility and concern when utilizing surface water for drinking purposes. While monitoring is preformed on drinking water to ensure safety, upstream monitoring will greatly improve the chances of detecting a problem before it can reach the distribution system. There is a vast amount of room for improvement in the field of remote water quality monitoring, Future designs in the field should make use of up and coming technologies including real time bacterial monitors and more efficient solar panels.

Acknowledgement

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References

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