# AUTOMATED WATER QUALITY MONITORING SYSTEM USING GSM SERVICE

Ramesh Bhaarath Vijay , Kapil Adhikesavalu

***Abstract:*** **-** This research paper proposes a design of Water Quality monitoring System Using GSM Service for the Aqua - Culture based Industries. This design, when implemented, helps in monitoring the water quality remotely, via GSM (by SMS). It is compulsory for an every officer from his industry to visit the ponds at a designated time and perform manual testing to measure the purity level of the water. But it is also known, that these kind of techniques will consume lot time and effort. This research project focuses on developing a prototype that can evaluate data collected through three bases: Oxygen dissolved in the water, Level of pH in water, Temperature level of the water. This design also has the capability to conduct the tests automatically with the help of a timer present in it. It also sends the degradation of water quality in the pond via SMS (Short Messaging Service).

***Keywords***- Water- Aquaculture-GSM Modem – Data processing System- SMS.

## 1. Introduction

The country's fresh water resources consist of 195210 kilometers of rivers and canals, 2.9 million hectares of Minor and major reservoirs, 2.4 million hectares of ponds and Lakes and about 0.8 million hectares of flood plain lakes and derelict water bodies. During the ten-year period of 1995-2004 inland capture production grew from 600,000 tons to 800,000 tones and at present contributes to 13% of the total fish production of the country.

Among the issues faced by the industry is the monitoring by conducting water quality tests for their ponds. Maintaining water quality is important in farming aquaculture organisms, as they are sensitive to water condition.

In the past, aqua farmers monitored quality of water by conducting colorimetric test. The test is conducted to measure ammonia level, pH level and dissolved oxygen (DO) level in the water.

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Furthermore, the process is very tedious to execute. To solve the problem, water quality monitoring system was introduced to farm.

The aim of the research project is to implement an automated remote water quality monitoring system via SMS as well as an alert system to inform concerned authorities about the degradation of water quality.

The objectives of this paper are to disclose why the three criteria namely: Dissolved Oxygen level, pH level and temperature level are used as the parameters to monitor water conditions, to describe the development process that will take place in implementing this system and lastly to explain the architecture of the remote automated water monitoring system.

## 2. Literature Review

### 2.1 Importance of Quality in water for aquaculture.

Water is a 'Universal Solvent' where various chemical dissolved in the water, as well as all physical attributes affecting them combines to form water quality. Good water quality level determined by all attributes present in the water at an appropriate level and often. Aquaculture water quality does not equal to environmental water quality. Criteria differ from species to species.

Physical, chemical, and biological properties are interrelated and it affects survival, growth and reproduction of aquaculture. Aquaculture also can have an adverse effect on the environment such as aquatic organism, consume oxygen Important water quality parameters to be considered are; temperature, salinity, pH, dissolved oxygen, ammonia, nitrite/nitrate, hardness, alkalinity, and turbidity.

### 2.2 Water Quality Parameter

P. Fowler, et al. in his study recommended that temperature, DO, and pH can be monitored directly on a continuous basis since they tend to change rapidly and have a significant adverse effect on the system if allowed to operate out-of- range.

Temperature refers to degree of hotness or coldness and it can be measured in degree Celsius. Temperature of water

needs to be monitored regularly as outside tolerable temperature range, disease and stress become more prevalent. Among effect of temperature changes are; photosynthetic activity, diffusion rate or gases, amount of oxygen that can be dissolved, and physiological process of the prawn and level of other parameters.

pH refers to the hydrogen ion concentration or how acidic or basic as water is pH is defines as log [H+]. pH value range form 0-14; pH = 7 is neutral, ph < 7 is acidic, pH > 7 is basic. Fig.1 explains the effects of pH on prawn.

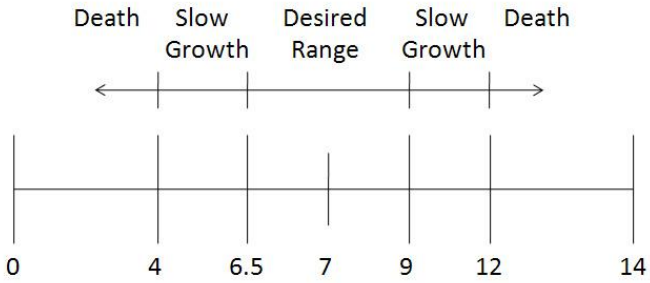


**Figure 1: Effect of pH to Prawn**

Dissolved oxygen describes the concentration of molecular oxygen in the water and it depends on the temperature of the water and the biological demand of the system. Dissolved oxygen is used in aerobic decomposition of organic matter, respiration of aquatic organism, and chemical oxidation of minerals. Because many organisms in the water use dissolved oxygen, it tends to change rapidly. Dissolved oxygen is supplied to water through several method direct diffusion of oxygen from the atmosphere, wind and wave action; and photosynthesis.

### 2.3 Automated Water Quality Monitoring System

Aquaculture is the farming of aquatic organism in natural or controlled marine or freshwater environments. Aquaculture history has started during 19$^{th}$ century in Tonle Sap Lake, Kampuchea and Indonesia. Farmers used cages made by bamboo and later the technique was improved by using steel tubes and floating drums to act as a cage. Since 20 years the, aquaculture industry is blooming rapidly and it is the most popular method in the fishery sector.

'Intelligent Aqua Farm System via SMS' is an example of remote monitoring and maintaining water quality system of aquaculture ponds. The system automatically monitors and records real-time data of two parameters; pH level and DO level, which are reported through Short Messaging Service.

### 2.4 Evaluating Water Quality Degradation

A study has been done by Faculty of Engineering, Akdeniz University to assess ground water pollution levels below agriculture field. The study was conducted by taking into consideration four inputs; nitrite, nitrate, orthophosphate, and seepage index value. Water quality index is then determined using evaluation method. Water quality index was originally designed to make an integrated assessment of water quality conditions to meet utilization goals. In the study, a fuzzy logic system was developed to assess the ground water pollution of Kumluca plain at previously selected nine sampling stations. The applied water pollution evaluation system involves the selection of water quality parameters and index values to form Water Pollution Index (WPI).

Other example of research project is a case study by Virgil University. The study was about the limitations of the current water quality index. The study indicated the need for more appropriate techniques to manage the importance of water quality variables, the interpretation of an acceptable range for each parameter, and the method used to integrate dissimilar parameters involved in the evaluation process is clearly recognized. Therefore, they propose inference to solve the problem. The study proposed dissolve oxygen and organic matters as inputs for the evaluation. Several sets of rules were defined to help them with the evaluation.

Meanwhile, a study conducted by et al used for model; Dissolved Oxygen predicting model, unilinear temperature model, BOD-DO multi linear model, and one dimension zoology model in evaluating and predicting water quality of ponds.

### 2.5 Relationship among the Water Quality Parameters

During the day, respiration of aquatic organism uses oxygen and produces carbon dioxide. The carbon dioxide is then used by aquatic plants through photosynthesis and it produces oxygen as it's by product. The cycle continues during the daytime. However, during night time, aquatic organisms keep using oxygen but the carbon dioxide produced dissolves in water as photosynthesis does not occurs during the night. As a result the concentration of oxygen in water reduces during the night.

Below table describe relation of dissolved oxygen, carbon dioxide and pH in ponds over 24 hours, as well as summarized tolerable range of water quality parameter for prawn farming.

Relative Concentration changes for dissolved oxygen, CO & pH

| Time | Change | | |
|---|---|---|---|
| | Dissolved Oxygen | Carbon dioxide | pH |
| Day time | Increase | Decrease | Increase |
| Night time | Decrease | Increase | Decrease |

Water Quality Parameter for Prawn Farming

| | | | |
|---|---|---|---|
| Temperature | 29-31°C | Hardness | <100ppm |
| pH | 6.5-8.5 | Turbidity | 30cm |
| Dissolved Oxygen | >5ppm | Ammonia | <1ppm |
| Alkalinity | 40ppm | | |

### 2.6 Data Telemetry

The remote sensing system is an important technology in today's world. Our society, for instance is pervaded by computer-controlled devices. Everything from Digital Clock to Hi-fi Robot can have one or often several microcomputer devices and can be controlled remotely. Remote monitoring system employs a technology called data telemetry. It allows remote measurement and reporting information of interest to the system designer or operator.

The most wide spread, wide area, wireless, digital network is the GSM network. GSM is a digital cellular network, originally intended for voice telephony. SMS (Short messaging service) is an application that can be utilized from GSM network. Message sent, which is in text form, from the sending mobile is stored in a central short message centre (SMC) which will then be forwarded to the destination mobile.

## 3. Research Project Development

Figure 2 depicts the development flow of the research project. Development of the research project starts with preliminary research to obtain adequate information regarding the problem was identified and agreed, design phase takes place.

After that, development of the research project starts by configuring hardware to be used, followed by developing the software required. After both hardware and software are completed, the system is then tested. The development of the research project follows the figure above where at each phases; evaluation will be done to determine whether the design/system developed fulfills the requirement.

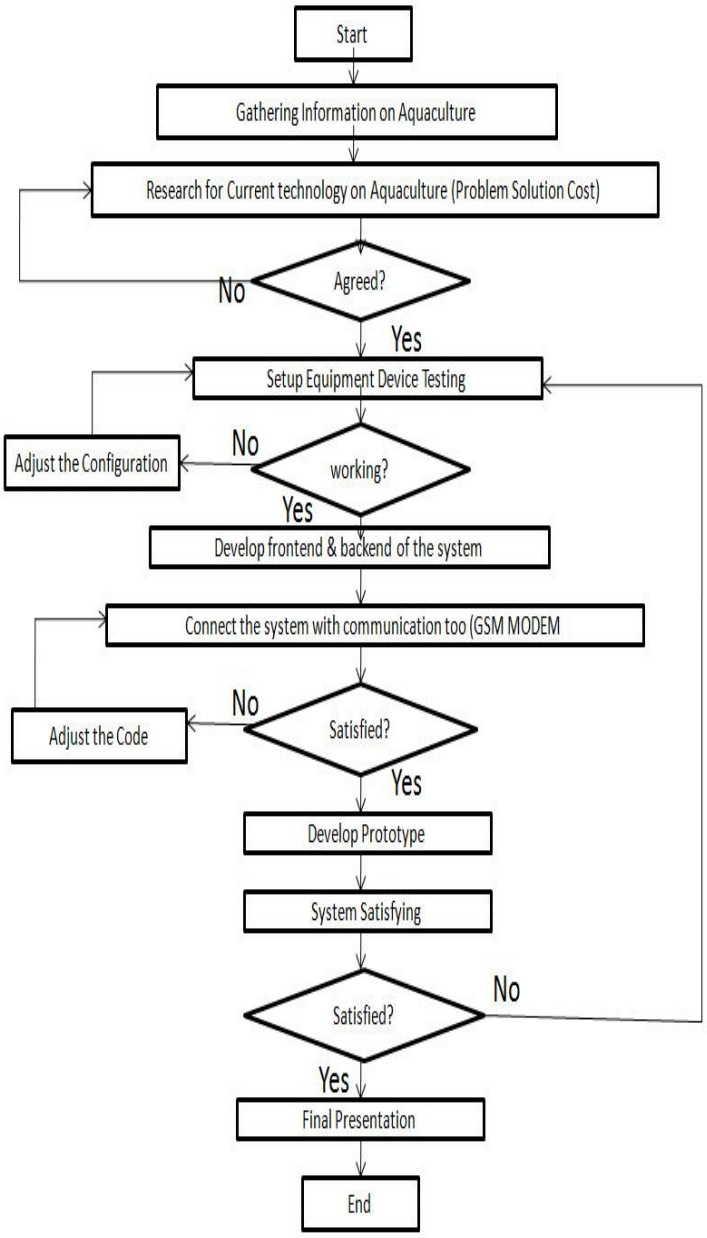


**Figure 2**
Flowchart Diagram for Development of Research project

## 4. System Architecture

The system architecture, which represents skeleton of the research project, consists of four components; data acquisition System, data telemetry, data processing and output and is depicted in Figure 3.

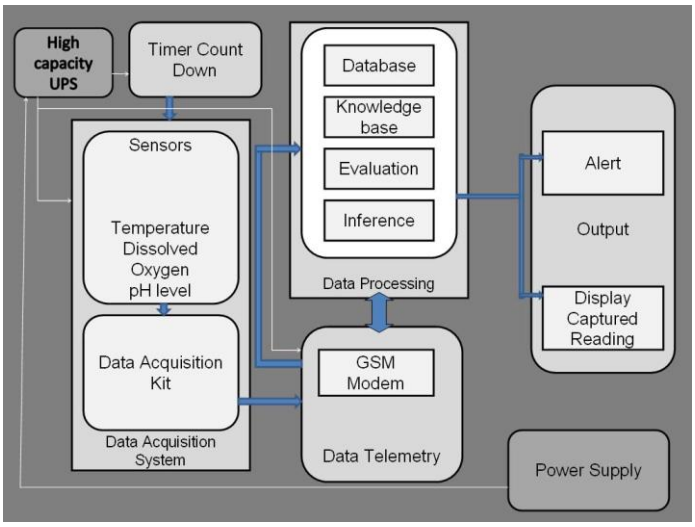


**Figure 3: Block Diagram**

### 4.1 Power supply and UPS

This block helps the monitoring system to be in activation mode 24×7. In case of any power failure, the UPS which can withstand for long hours can help in continuing the activation of the monitoring system.

### 4.2 Timer Count down

This equipment controls the device regularly. It has a timer in it. When the count is done the test is done and the acquired information is transmitted. The tests can be performed regularly without any manual help. They are programmed that the test can be performed once in a day and send the details. Also the staff in-charge can also program the timing for the tests to be conducted.

### 4.3 Data Acquisition System

Data Acquisition system is consists of two components; sensors and data acquisition kit. Sensors are needed to pick particular reading from the pond and the reading would be gathered by data acquisition kit. Data acquisition kit is responsible to convert analog signal received and converts it into digital signal. The kit is also responsible to prepare message for data telemetry purposes.

### 4.4 Data Telemetry

Data telemetry consists of GSM modem. The modem is connected to the data acquisition kit. The modem will receive prepared messages by the kit and send the message to data processing component.

### 4.5 Data Processing

Data processing component would be the heart of the system. The component consists of four sub-component; data-base, knowledge base, inference, and evaluation. The first sub-component stores the message received from data acquisition kit through short message service. Knowledge base, meanwhile, stores data related to water quality level for inference purpose. Real time data received would be fed into the inference to determine water quality of the pond. Evaluation will be done using the inference result. This sub-system enables proactive measure in the monitoring system. Monitored data would not have to be in intolerable range before it could trigger the system.

### 4.6 Output

Result of the water quality evaluation would be used by this component. Two type of output would be produced; first, the data received and the output of the evaluation would be displayed on central computer screen, second, alert message would be sent to farmers upon detecting degradation of the water quality.

### 4.7 Data flow Diagram

Data flow diagram (DFD) is a tool that depicts the flow of data through as system and the work or processing performed by the system. Figure 4 shows the data flow diagram for the project.

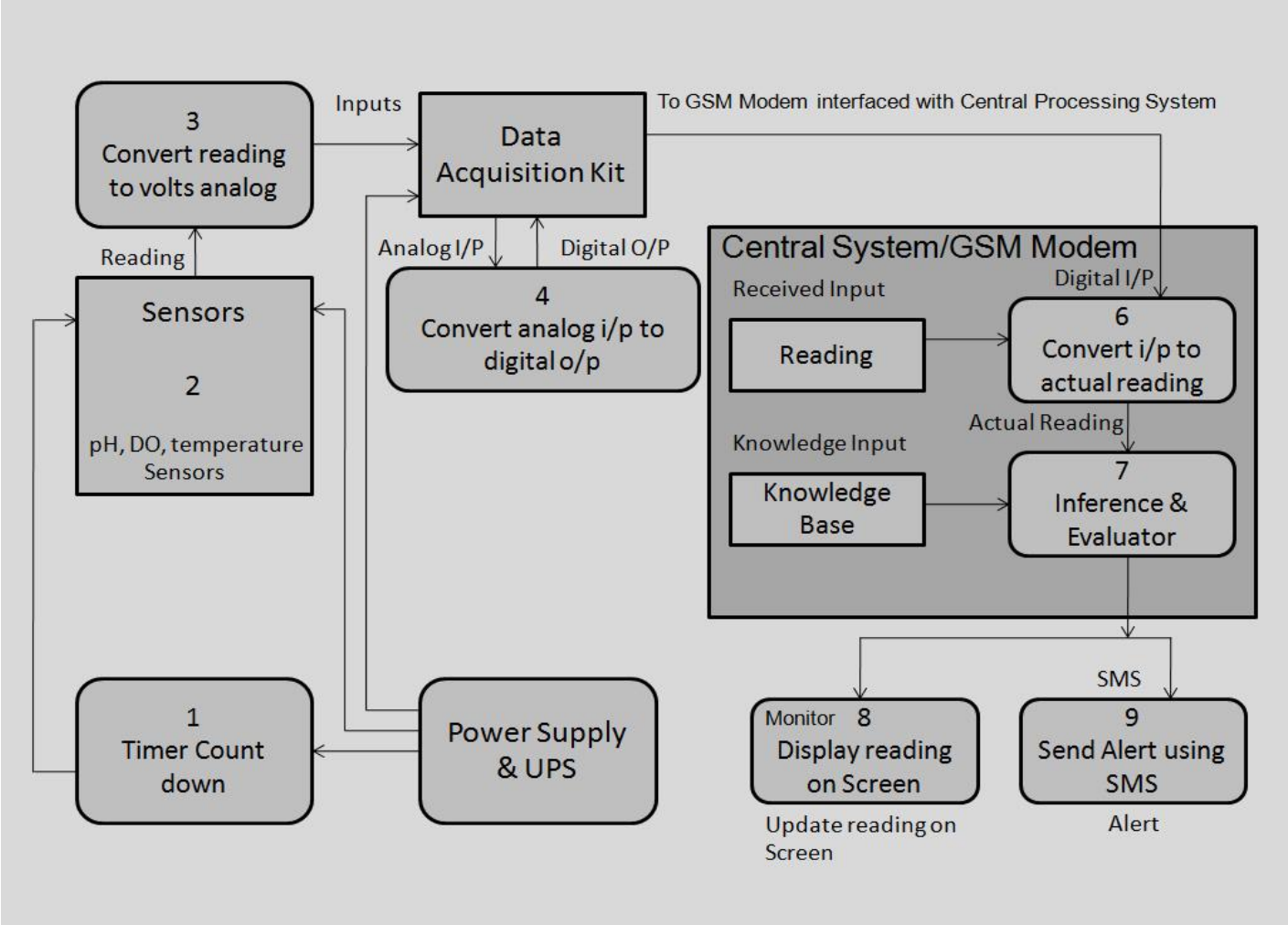


**Figure 4: Data Flow Diagram**

The system gets activated from the timer. Then it is triggered with input readings by sensors placed in water. The reading will be converted to its corresponding voltage value by the sensors. Then the inputs will be sent to data acquisition kit; where the analog reading received will be converted into digital signal. The output will be sent to central system or the data processing part using GSM Modem connected to the data acquisition kit

As the input received is in the voltage form, the input need to be converted to its actual value and this will be done by the data processing system built using visual basic.

Inference and Evaluation will be done by the data processing. Output of the evaluation will be compared to knowledge base. Two outputs will be produced by the system; evaluation result will be sent through short message service upon detecting any degradation of the water quality.

## 5. Conclusion

This research paper proposes system architecture for proactive automated water quality monitoring system. It is believed that by having such system, tedious, and cost-consuming jobs of manual monitoring can be eliminated. The architecture proposed is consists of four components; data acquisition, data telemetry, data processing and output.

Three parameters will monitored and used to evaluate the water quality namely; temperature, pH, and dissolved oxygen. Further work includes developing the prototype of the system and testing the system in actual aqua farm for more accurate results.

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