

## **LITERATURE SURVEY**

### **REAL TIME SYSTEMS WATER QUALITY MONITORING AND CONTROL SYSTEMS**

TEAM LEADER: B.AJAY

TEAM MEMBER 1: S.ARUN PRAKASH

TEAM MEMBER 2: S.DHINAKAR

TEAM MEMBER 3: R.JAYASURYA

#### **PAPER 1:**

##### **TITLE 1: River Water Quality Robot Embedded with Real-Time Monitoring System: Design and Implementation**

**AUTHOR:** Mohd Amirul Aizad M. Shahrani;Safaa Najah Saud Al-Humairi;Nurul Shahira Mohammad Puad;Muhammad Asyraf Zulkipli.

**DESCRIPTION:** New sensor capabilities and implementations are being developed by wireless communication. For environmental applications, recent developments in sensor networking are essential. The Things Internet (IOT) allows links between different devices to share and collect data. In addition to automation, IOT expands its capabilities by using Industry 4.0 to resolve environmental concerns. Since water is one of the fundamental requirements of human survival and life underwater, some mechanism is necessary to occasionally control water quality. This paper proposed an autonomous robot occupied with real-time multi sensory (pH, temperature, voltage and garbage level) for better water quality. The data were recorded using sensors and transmitted via Wi-Fi to a designed MIT inventor mobile application and stored in the cloud to monitor the water quality. The river water robot is also attached to a self-power generator using a solar cell and wind turbines. Based on the obtained results, it was found that the pH of the tested river water in the range of 2-4.6, which considered to be highly acidic. In conclusion, the designed robot had shown significant functionality in the real-time receiving and transmitted data with no human interfering required.

**Published in:** 2021 IEEE 12th Control and System Graduate Research Colloquium (ICSGRC)

## **PAPER 2:**

**TITLE: Floating Robot Control System for Monitoring Water Quality Levels in Citarum River**

**AUTHOR:** Reza Putra Pratama; Angga Rusdinar; Ig. Prasetya Dwi Wibawa

**DESCRIPTION :** Water is the primary need of every living thing, with the availability of water for living things, it is very helpful for daily needs. Especially river water in Indonesia has been heavily polluted, the pollution can come from industrial, household, agricultural and fishery waste. Therefore, the purpose of this research was to make a robotic solution to monitor river water quality regularly and can be monitored in real-time. The results obtained from this test were spherical robots and for fuzzy logic controller systems use 5 membership functions for yaw parameters with a sensor reading angle limit value  $[-90^\circ, 90^\circ]$ . For the pitch parameter, there were 3 membership functions with the limitation of sensor reading angle value  $[-32^\circ, 32^\circ]$ . There is a moving average as a filter to process the reading value of the gyroscope with a sample value of 10 times the reading because the response was following the actual reading and minimal noise. Dispatched of robot control commands can be sent and received in real-time. Haversine Formula calculation results had an accuracy of 92.67076% compared to the calculation of the distance from google maps.

**Published in :** 2019 IEEE International Conference on Internet of Things and Intelligence System (IoTaIS)

## **PAPER 3:**

**TITLE: Design of IoT-Based River Water Monitoring Robot Data Transmission Model Using Low Power Wide Area Network (LPWAN) Communication Technology**

**AUTHOR:** Rahayu Dwi Lestari; Angga Rusdinar; Muhammad Ary Murti; Gilang Tawaqal; Dongho Lee

### **DESCRIPTION:**

River water monitoring system was one of the efforts as a contribution to control the pollution and/or damage of the Citarum watershed in Indonesia based on Presidential Decree Number 15 of 2018. Monitoring

of Citarum River water quality is essential because it is to know its condition. Despite that, regular monitoring requires water samples to be taken to the laboratory to be tested. Therefore it was not real-time and wasteful of energy. In this paper, a design of IoT-based river water quality monitoring-system using LPWAN communication technology will be proposed so that monitoring points on the Citarum watershed can be monitored in real-time and the results of monitoring data will be stored in the server for data logging. A test about communication range was performed with four nodes and one gateway with LoRa transceiver paired with Arduino boards, as LPWAN communication method, to be able to exchange information in terms of hardware and implement network mesh topologies to widen monitoring points in terms of software. It is shown from the test result that the communication range for the transmission between node to node or node to gateway reaches a maximum of 500 m close on the surface of the water.

**Published in:** 2019 IEEE International Conference on Internet of Things and Intelligence System (IoTaIS)

#### **PAPER 4:**

**TITLE:** Evaluation and Analysis of Goodness of Fit for Water Quality Parameters Using Linear Regression Through the Internet-of-Things-Based Water Quality Monitoring System

**AUTHOR:** Harish H. Kenchannavar; Prasad M. Pujar; Raviraj M. Kulkarni; Umakant P. Kulkarni

#### **DESCRIPTION:**

Freshwater is the planet's most important natural resource and is prone to pollution, making it necessary for real-time monitoring. The Internet-of-Things (IoT)-enabled water quality monitoring (WQM) system enabled real-time monitoring of freshwater resources. The WQM uses physicochemical parameters, such as temperature, pH, dissolved oxygen, electrical conductivity, biochemical oxygen demand, nitrate, and total dissolved solids to control the water quality. The advent of IoT had proven its effectiveness in capturing, studying, and continuously transmitting environmental data in real time. Mineral-rich watersheds experienced the exploitation of available resources in and around rivers, leading to urgent real-time monitoring of river water. The operation pollutes the water by mixing different types of toxic waste, namely, urban,

industrial, and agricultural, making it unusable for human activities. In India, the traditional method of taking samples from the site, bringing them to the laboratory, and performing the analysis of the samples was in practice, it took a day or two to get results and it does not happen in real time, causing water-borne diseases among inhabitants of watersheds. This article attempted to assess the water quality of the Ghataprabha river. Water samples were taken from the river via the WQM system from identified sampling points and subjected to linear regression analysis to estimate the relationships and goodness of fit between the parameters. Once the parameter relationship was known, a one-way ANOVA was applied to the water samples and the water quality is analyzed using the ANOVA hypothesis. Additionally, the river data set can be used to train the WQM system.

**Published in:** IEEE Internet of Things Journal

## **PAPER 5:**

### **TITLE:**

**Design and modelling of cable suspended sonde for water quality monitoring**

**AUTHOR:** Gayathri Surendran; Ganesha Udupa; G. J. Nair

### **DESCRIPTION:**

Quality of water bodies was measured for environmental monitoring, irrigation and potable water. The depth of water bodies like river, lake, well and pond, varies between 3m to 10m. In the recommended system, water qualities, namely, pH, turbidity and temperature are logged automatically from a floating platform and the data is transmitted to the shore for further analysis. The sensor box was suspended by a cable from the floating platform and an automatic winch mechanism is used for lowering the box for vertical profiling. Two Arduino microcontrollers are used for data collection, wireless transmission and winch control. Mathematical modelling of displacement of the sensor box due to flow is done using fluid dynamic equations. Depth of the sensor box was obtained from the ultrasound sensors. Communication from the sensor box to the platform is done through serial interface and the data is transmitted from the platform to the shore via bidirectional WiFi. The system is capable of measuring, logging and profiling water quality at different locations and providing it in near real time for assessing environmental impact.

**Published in:** 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT)

**PAPER 6:**

**TITLE :River Water Quality Monitoring and Simulation Based on Web GIS**

**AUTHOR:** Niu Maojing

**DESCRIPTION:**

With the progress of industry, river pollution is becoming more and more serious. Web GIS technology was used to monitor and simulate the river water quality, achieved the goal of controlling water environment condition in real time and dynamically. Moreover, Web GIS has the advantages of map visualization and network transmission, which could be used to complete the task of water quality monitoring and simulation on different sites, improving work efficiency remarkably.

**Published in:** 2016 Sixth International Conference on Instrumentation & Measurement, Computer, Communication and Control (IMCCC).

**PAPER 7:**

**TITLE: Predictive power management for a solar-powered off-grid surface water quality monitoring system**

**AUTHOR:** Raja Rehan Khalid; Angelika Meyer; Josef Meiers; Horst P. Beck; Georg Frey

**DESCRIPTION:**

The paper investigates the mobile real time measuring station incorporating renewable energies to monitor the surface water quality. This type of measuring stations are designed to establish the Water Framework Directive (WFD) perceived by European Commission. The core goal in the discussed work was to attain self-reliance by the mobile monitoring station, by maximized the use of renewable source energy and limit the utilization of energy produced by conventional ways. To attain such goal, further enhancement was achieved in such system by realizing Power Management System (PMS) incorporating predictive controls, to overcome the fluctuating behaviour for automated data collection for surface water quality and power failure in renewable energy system. To include the prediction within the measuring station PMS, Support Vector

Machines (SVM) as a machine learning method was considered. The paper also presents architecture for predictive power management system for real time measuring station as a case study model.

**Published in:** 2016 IEEE 11th Conference on Industrial Electronics and Applications (ICIEA)

## **PAPER 8:**

**TITLE: Real Time Wireless Monitoring and Control of Water Systems Using Zigbee 802.15.4**

**AUTHOR:** Saima Maqbool; Nidhi Chandra

### **DESCRIPTION:**

In this paper we have shown how to monitor the water level of water systems such as water tanks, rivers, ground water table, and bore wells remotely. It had also shown that how to control the working of pump automatically and remotely. It can also be used to remotely monitor the flood areas wirelessly and information can be sent to mobile wirelessly. This project is designed to monitor the water level with the help of water level sensors, Zigbee 802.15.4, 74HC14 inverter and GSM technology. Furthermore, it can monitor the quality of water with the help of water quality sensors such as turbidity sensor and dissolved oxygen sensor. In this monitoring system, sensors monitor the water level, dissolved oxygen, turbidity, temperature and pH level of the water at some predefined sensing interval. This approach would help in reducing the water overflow and home power consumption.

**Published in:** 2013 5th International Conference and Computational Intelligence and Communication Networks

## **PAPER 9:**

**TITLE: Development and Application of Mobile Water Level Monitoring Based on Multi-sensor Integration**

**AUTHOR:** Hongmei Zhang; Weiliang Tao; Ming Cao

### **DESCRIPTION:**

According to the current status of water level monitoring of inland river, this paper presented and designed a multi-sensor integrated dynamic

system for mobile water level measurement, which was based on CORS(continuous operational reference system) GPS(global positioning system), GPRS(general packet radio service), PDA(personal digital assistant) technology as well as a post processing platform. The system design, signal quality control and data processing are researched in detail. This system had been used for an actual experiment. The results show that this system has high stability, reliability and flexibility. It was a very-well supplement for the present water level monitoring based on water-level stations.

**Published in:** 2010 International Conference on Electrical and Control Engineering

#### **PAPER 10:**

**TITLE:** A demonstration of wireless sensing for long term monitoring of water quality

**AUTHOR:** Fiona Regan; Antoin Lawlor; Brendan O Flynn; J. Torres; R Martinez-Catala; C. O'Mathuna; John Wallace

#### **DESCRIPTION:**

At a time when technological advances are providing new sensor capabilities, novel network capabilities, long-range communications technologies and data interpreting and delivery formats via the World Wide Web, we never before had such opportunities to sense and analyse the environment around us. However, the challenges exist. While measurement and detection of environmental pollutants can be successful under laboratory-controlled conditions, continuous in-situ monitoring remains one of the most challenging aspects of environmental sensing. This paper describes the development and test of a multi-sensor heterogeneous real-time water monitoring system. A multi-sensor system was deployed in the River Lee, County Cork, Ireland to monitor water quality parameters such as pH, temperature, conductivity, turbidity and dissolved oxygen. The R. Lee comprises of a tidal water system that provides an interesting test site to monitor. The multi-sensor system set-up is described and results of the sensor deployment and the various challenges are discussed.

**Published in:** 2009 IEEE 34th Conference on Local Computer Networks