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*6th International Conference on Electrical
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September 18 – 20, 2019
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Bandung - Indonesia

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PROCEEDINGS

6th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI) 2019

September 18 – 20, 2019, Bandung – Indonesia

Editors:
Irawan
Hendri Irawan
Munawar A Riyadi
Mochammad Facta

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6th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI) 2019

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Foreword from General Chair EECSI 2019

In the name of Allah, Most Gracious, Most Merciful.

Welcome to the sixth International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2019) in Bandung, Indonesia.

The 6th EECSI 2019 provides platform for researchers, academicians, professionals, and students from various engineering fields and with cross-disciplinary working or interested in the field of Electrical Engineering, Computer Science, and Informatics to share and to show their works and findings to the world.

I would like to express my hearty gratitude to all participants for coming, sharing and presenting your experiences in this vast conference. Only high-quality selected papers are accepted to be presented in this event, so we are also thankful to all the international reviewers and steering committee for their valuable work. I would like to give a compliment to all partners in publications and sponsorships for their valuable supports.

Organizing such an prestigious conference was incredibly challenging and would have been impossible without our outstanding committee, so I would like to extend my sincere appreciation to all committees and volunteers from Universitas Budi Luhur as a host and all colleagues from Universitas Gadjah Mada, Universitas Diponegoro, Universitas Sriwijaya, Universitas Ahmad Dahlan, Universitas Islam Sultan Agung, Universitas Muhammadiyah Malang, Universiti Teknologi Malaysia and IAES Indonesia Section for providing me with much needed support, advice, and assistance on all aspects of the conference. A special thanks for IEEE Indonesia Section for the technical co-sponsorship during the conference. We do hope that this event will encourage the collaboration among us now and in the future.

We wish you all find opportunity to get rewarding technical program, intellectual inspiration, renew friendships and forge innovation, and that everyone enjoys the trip to Bandung.

Dr. Mohammad Syafrullah
General Chair EECSI 2019

Foreword from IAES Indonesia Section

Bismillahirrohmannirrahim,
Assalamualaykum warohmatullahi wabarakatuh and Good Day, Ladies and Gentlemen,

We would like to welcome our colleagues to attend the 6th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI 2019) in Bandung on 18-20 September 2019.

I hope this event will become a great event for researchers, engineers and professionals to strengthen ties and partnerships and their findings and development to the world in the field of electrical, computer, and informatics.

Institute Advanced Engineering and Science (IAES) collaborating with Universitas Budi Luhur, Universitas Diponegoro, Universitas Ahmad Dahlan, Universitas Gajah Mada, Universitas Islam Sultan Agung, Universitas Sriwijaya, Universitas Muhammadiyah Malang, and Universiti Teknologi Malaysia as several tops universities have successfully organized the conference six times since year 2014. This achievement is due to valuable contributions also from our colleagues from Universitas Budi Luhur. I would like to put my sincere gratitude and appreciation for all partners, friends, organizing committee, reviewers, keynote speakers, and participants who have made this event as a key stage to show great progress to the world as today.

I would also like to extend my gratitude to Rector of Universitas Budi Luhur, academia and supporting staffs from Universitas Budi Luhur who become a main host and IEEE Indonesia section as a technical co-sponsor for EECSI 2019.

We wish you a happy conference and success in Bandung.

Thank you.

Assoc. Prof. Mochammad Facta, Ph.D
IAES – Indonesia Chapter

Foreword from Rector Universitas Budi Luhur

Distinguished Guests and Participants, Excellencies,
Ladies and Gentlemen

On behalf of the EECSI 2019 conference organizers, I would like to express my gratitude to all of you, who have come together here from various countries, for your cooperation which has enabled us to conduct a highly fruitful conference.

In this year's EECSI Conference which main theme was "Bridge Toward Industrial Revolution 4.0 and Its Applications on Electrical, Electronics, Computer Science and Informatics for Humanity", I expected that every participant to make contribution to this related field and promote mutual understanding among the participants through this event.

It is good for Budi Luhur University to learn about the excellent research done from different country regarding the conference topic. We also learned new ideas from each other, which we could adopt to further improve our work in this important area. I would like to pay my deep respect to all the participants for your positive participation.

We greatly appreciate the support we have from the EECSI conference organizing committee, to the Program Chairs, to the Program Committee for their extremely hard work for the details of important aspects of the conference programs and social activities. They have made this a very pleasant experience.

Finally, on behalf of the Conference Committee, I would like to express my appreciation to all the participants for taking time out of your busy duties to attend the event and to all your organizations for sending excellent participants to the event.

Assoc. Prof. Dr. Ir. Wendi Usino, M.Sc, MM
Rector Universitas Budi Luhur

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Time Slot	Room 1	Room 2	Room 3	Room 4
	for Facial Emotion Recognition - **Kartika Candra Kirana**		**Siswanto**	
14.30-14.45	Emotion and Attention of Neuromarketing Using Wavelet and Recurrent Neural Networks - **Muhammad Fauzan Ar Rasyid**	Technologies, methods, and approaches on detection system of plant pests and diseases - **Devie Rosa Anamisa**	Lightweight Method for Detecting Fake Authentication Attack on Wi-Fi - **Muhammad Yusuf Setiadji**	Fish Eggs Calculation Models Using Morphological Operation - **Syaipul Ramdhan**
14.45-15.00	An SoC-Based System for Real-time Contactless Measurement of Human Vital Signs and Soft Biometrics - **Aminuddin Rizal**	Prediction Of Students Academic Success Using Case Based Reasoning - **Abdul Rahman**	Enhancing IPSec Performance in Mobile IPv6 Using Elliptic Curve Cryptography - **Supriyanto Praptodiyono**	A Third Order based Additional Regularization in Intrinsic Space of the Manifold - **Rakesh Kumar Yadav**
15.00-15.15	Coffe Break			
15.15-15.30	Optical Studies of Er-doped Yttrium Aluminium Garnet Phosphor Materials - **Nurhakimah Norhashim**	Case Based Reasoning Adaptive E-Learning System Based On Visual-Auditory-Kinesthetic Learning Styles - **Abdul Rahman**	Applying MAC Address-Based Access Control for Securing Admin's Login Page - **Bintang Maulana Prasetya Pagar Alam**	Speaker and Speech Recognition Using Hierarchy Support Vector Machine and Backpropagation - **Asti Fath Fadlilah**
15.30-15.45	Low-Power And High Performance Of An Optimized FinFET Based 8T SRAM Cell Design - **Nurul Ezaila Alias**	Securing IoT Network using Lightweight Multi-Fog (LMF) Blockchain Model - **Muhammad Yanuar Ary Saputro**	Optimizing Design of Core-clad Width for Single Mode Fiber with Zero Dispersion Shift - **Toto Saktioto**	Privacy Control in Social Networks by Trust Aware Link Prediction - **Syam Dhannuri**
15.45-16.00	Fuzzy Logic Based Incubator Temp and Humid Level Controller Prototype - **Kuat Supriyadi**	An Android-based Hoax Detection for Social Media - **Supardi**	Design-of-Experiment Based Systematic Tuning of Square Open Loop Resonator - **Teguh Prakoso**	The Feasibility Of Credit Using C4.5 Algorithm Based On Particle Swarm Optimization Prediction - **Siswanto**
16.00-16.15	River Water Pollution Monitoring using Multiple Sensor System of WSNs (Case: Siak River, Indonesia) - <mark>**Evizal Abdul Kadir**</mark>	Forecasting Indonesia Composite Index Using the Optimization of Fuzzy Backpropagation Neural Network - **Anwar Rifai**	Optimization Info Rate Using APSK Modulation Scheme for Delivery ABIS over Satellite Communications - **Hillman Akhyar Damanik**	Smart Performance Measurement Tool in Measuring The Readiness of Lean Higher Education Institution - **Okfalisa Okfalisa**
16.15-16.30	Controlled Position Navigation of Single Degree Magnetic Levitation - **Dhiraj Basnet**	Fractals Study and Its Application - **Setyawan Widyarto**	Performance Analysis of SM-MISO with Q-CSIT in Wireless Sensor Network - **Subuh Pramono**	Obtaining Reference's Topic Congruity in Indonesian Publications using Machine Learning Approach - **Sam F Chaerul Haviana**

River Water Pollution Monitoring using Multiple Sensor System of WSNs (Case: Siak River, Indonesia)

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Abstract — **The river is a natural phenomenon that commonly available in the tropical region because of rain intensity. Many peoples and community like to live along the riverside for a few decades ago. The river used by the community for transportation and daily activities uses river water. In this research objective to design and develop a new system with multiple sensors system to monitor river water pollution because most of the people use it. Wireless Sensor Networks (WSNs) used in this design and development because of advantages WSNs system, multiple sensor nodes installed for detection of water pollution such as water temperature, pH, electrical conductivity (EC) and dissolved oxygen (DO). The system designed to be able to monitor river water pollution parameters and send the information to the data center (backend system). Arduino microcontroller used to process and filtering the data before sending to the backend system, only valid and valuable information to collect and keep in the database. Results show system be able to detect polluted water with indicating parameters and shows in a graph. Based on analysis can be concluded that polluted water indicator mostly from residence waste and industry. Furthermore, WSNs sensors will deploy in some area then compare the results each other.**

Keywords—Multiple sensor, WSNs, River water, Pollution, Monitoring

I. INTRODUCTION

Indonesia located in southeast Asia with the tropical region as normal many rivers scattered in many area or province, some river is long in a few miles to over than a hundred miles. The traditional community in a suburban and rural area using river water for daily activities such as washing, shower and even for cooking. Economic growth and development effected to local city authority for invited investor and company operating in the area as to increase job for the community. Riau province is located in central of Sumatera Island in Indonesia, this province has 5 rives and the long, as well as the deepest, is Siak rivers. Along the Siak rivers, companies are operating and the big company is pulp and paper beside many small companies. Sometimes the companies emit the pollution to the river then makes river contaminate with pollution or chemical spills. Polluted river water very dangerous to the community when they use it for daily activities as mention in early. Contaminate river water may come from various of caused such as industries waster, chemical spill, community and residence waster and because of disaster river water flooding, volcano, etc. This research aims to do a monitoring system with 3 basics water sensor which temperature, pH, and electrical conductivity. All the data set and collect in the system.

The traditional method to measure water quality have been done by several techniques as discussed in [1-4]. The method can collect information to the water quality than test in the laboratory including biological, chemical contents and physical of the water. Normally very hard to differentiate and do the measure along the river but some sample to the point can be done. Real-time water quality monitoring system using WSNs are popular in recent year because of the advantages of technology to collect data and information through the sensor node. The requirement for continuous data monitoring for water quality in a real-time system to establish the trend and predict to determine behavior from the history as discussed in [5-9].

A biological sensing system for detection water quality is a method to detect bacteria using a computer vision system in analysis, the water pollutant with chemical contamination be able to analysis as discussed in [10-12]. The use of multi-sensor for the water pollutant detection system for the basic parameter with the limit to a few parameters, the use of localhost for data collection has limited access to monitoring system as elaborated [13-16]. Image processing contributed to the remote sensor in analyzing and monitoring with long-distance of water quality. In the previous research, the maximum distance is 10 meters used image analysis [17, 18]. In the deep-water or river, the use of the robotic system for water quality detection system has the advantages. Another scenario is in the ocean with the aid of mobile communication assist in the detection of water quality but the cost may concern. Some research has been done using this method for water quality detection but ineffective for the fixed system and case of the area as discussed in [19-22].

In this research propose a new method to detect water quality by analysis the samples, the analysis can be done either water quality or polluted water. Multiple sensors propose to achieve a better analysis of data by compare value of detection in each sensor. The basic parameter propose are temperature, pH, electrical conductivity and salinity. The research gain in this method for knowledge and contribute new technique for water pollution monitoring system by collect data including a new design of sensors. A new technique of communication system between sensor nodes to WSNs as a gateway through WSNs sink for smooth data transmission and sharing is one of intention in this research. This case of research at one of the long and deep rivers in Riau Province, Indonesia which is Siak River. With the local or remote data monitoring center, a complete monitoring interface implemented to carry out historical data queries and network state display as well as data analysis status.

II. MULTIPLE SENSOR SYSTEM OF WSNs

The proposed design multiple sensor systems for water quality monitoring using WSNs based on a case study at Siak river in Riau Province Indonesia. The river is very long with more than 200 km along to the end at the seaside, most of community and rural resident lives on the riverside and doing daily activities use river water. According to a preliminary survey on the river and study on geographic on the river then come out with the design of the sensing system for detection of the river. Figure 1 shows a type of geographic of Siak river located in Riau Province, Indonesia. The river compact with the residence of community in some of the area then highly polluted into river water from the housing waste as well as unhealthy community residence. Furthermore, in the raining season become worst because some of the area flooding and all of the rubbish and waste go into the river through the canal.

Fig. 1.   A scene of Siak river in Riau Province Indonesia

Based on the early survey the actual condition of the river and water is highly polluted water with various contamination because the river is not only for the residents live along the riverside but more than that is for transportation, many vessel, and wooden ship through the river with carrying various material including people which high-speed boat. Furthermore, many companies operating along the river as well because of easy transportation and water supply, some of the company spilled the chemical waste and material to the river. Figure 2 shows an actual condition of the river with polluted water indicated with black color on the end of the canal. Based on the early survey and visual observation then multi-sensors is required for detection water contamination and analysis to determine of chemical contained in the river. River water collected as a sample to analysis and results shows many materials contaminated in the water then to decide the sensor need to install to the system for detection such as temperature, DO, pH and electrical conductivity.

Fig. 2.   Water polluted by chemical of industry operating along river

Multiple sensors system design into four parameters for detection of river water pollutant index, the detection results of all sensor analyzed and determine the polluted water contain. Table 1 shows the complete expected measurement indicator and range of the results in the unit as well as the accuracy. Figure 3 shows a complete block diagram of WSNs system for water detection.

TABLE 1. MULTIPLE SENSOR DESIGN SPECIFICATION

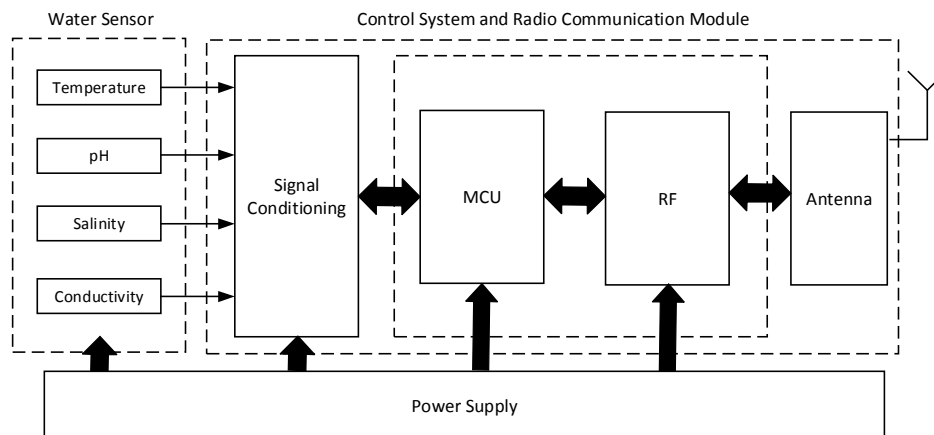| Parameter	Range	Accuracy	Method
pH	0 to 14	± 0.1	Glass Electrode
Temperature	0 to 16 ^{o} C	± 0.5 ^{o} C	Thermistor
DO	0 to 20 mg/L	± 0.5 mg/L	Polarography
Electrical Conductivity	0 to 50	± 0.5	Conductivity Measurement

Fig. 3.   Block diagram of WSNs multiple sensors system.

III. SYSTEM DESIGN FOR POLLUTED WATER DETECTION

The design of multiple sensing systems for polluted water used four parameters of the sensor as mention in early, every sensor contributed the data to collect and do the analyses in the system. To detect common polluted water in time then sensing system must deploy on the river at any time. Solar system is required for supply the power to the system because remote location with no electricity available. In this case a set of solar panel system with backup battery is provided base on the capacity of sensing system that have been tested. In the monitoring of polluted river water system, there are several external factor need to consideration such as environmental, whether, temperature, etc. Based on early testing some of parameter is increasing abnormal with exponential curve, this is because of some of sensing contact to the obstacle with contribute high polluted chemical but only in short time.

Design of multiple sensor use several model of sensing and one of it is used temperature sensor which contributed of thermistor product with non-linear parameter between temperature and internal resistance. The range of temperature sensor is from 0 C to 40 C. The scale of temperature is selected based on early measurement and average temperature of Siak river water as well environmental in Pekanbaru city in Riau Province. In common use the thermistor us valid for high temperature which is more than 300 C, thus low range of temperature is better in detection in avoid counteracting the nonlinearity. The resistance of sensor be able to scaled using general formula as invented in Steinhart-Hart thermistor third order approximation can be write as in equation 1 [2]:

$$\frac{1}{T} = A + B \cdot \ln(R) + C \cdot (\ln(R))^3 \tag{1}$$

Where T is the temperature of water detected in kelvin and R is the measured resistance in Ohm. While A, B, and C are standard constants fabricate from the manufacturer. When the sensor powered then induce a voltage across the thermistor at the fed point and go into an operational amplifier (op-map) to gain and adjust the offset signal. Value of voltage out from the sensor is in analog then must convert to digital to match with WSNs system which used Arduino microcontroller. The value of thermistor internal resistance is depending on manufacturer, in common the resistance for room temperature for example 25 C with 20k ohm then the characteristics can write as in equation 2:

$$R_T = | R_0 \cdot e^{\beta \cdot \left(\frac{1}{T} - \frac{1}{T_0}\right)} \tag{2}$$

Where RT is the resistance of the thermistor at T and the temperature is in Kelvin. While the value of T0 is 298.15 K (or 25 C) and the value of beta based on manufacturer datasheet and specification. Equation 3 used to calculate the temperature based on manufacturer datasheet as a comparison to the actual value detected in testing. The results of temperature based on the analysis used formula as equation 3 are required for the calibration of the temperature detected by the sensor.

$$T = \frac{\beta}{\ln\left(\frac{R}{r_\infty}\right)} \tag{3}$$

Where:

$$r_\infty = R_0 \cdot e^{-\beta/T_0} \tag{4}$$

A. Multiple Sensor System

The design of multiple sensors system has been done in a prototype as well as tested in the laboratory scale. Sensor for detection of river water pollutant as specification shows in table 1 is fabricated to connect to the microcontroller. Figure 4 shows the fabricated system and tested with a mini scale, results show the system able to read all the parameters of water contain then shows in the LCD display. Next step is to test the prototype after improving the casing according to the field at the riverside.
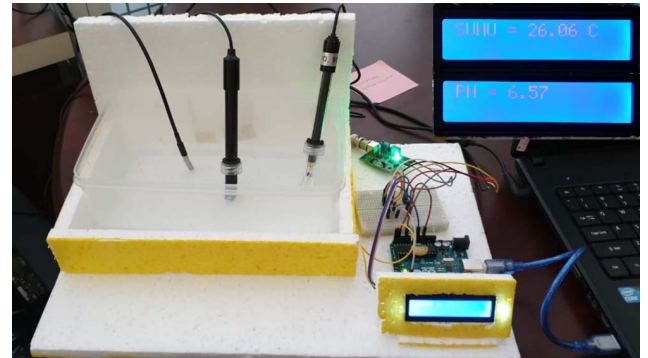

Fig. 4. Prototype of multiple sensors for detection water pollutant.

The testing has been done in the laboratory for a long time to check the performance of the system. Results show the reading in the various parameter of detection of polluted water gives accurate results to the calibration with the manual or conventional system. The used of multiple systems for detection is good because gives a various indicator of polluted water to analyze than the final result for determining of polluted water more accurate. Furthermore, introducing an intelligent system on microcontroller programming assist the accuracy of the decision on the results.

B. WSNs Sensing Commnication

Communication to the backend system is one of the requirement to pull data to the server and monitoring system. In actual condition sensor system located on the site which at the riverside and several sensors connected each other for data sharing and a system used as a gateway for communication to the backend system. Based on the survey the distance of site location more than 30 km to the backend system. Figure 5 shows a design of communication to the backend system, every sensor node represented water pollutant sensing system have their own sink node for collecting data and keep in the localhost before sending to the backend system. The proposed multiple sensing for water pollutant apply in 4G as a network for communicating from sink node to backend which is database or data center for faster transfer of data a well as real-time monitoring, currently most of the area covered by 4G network and ready to apply.
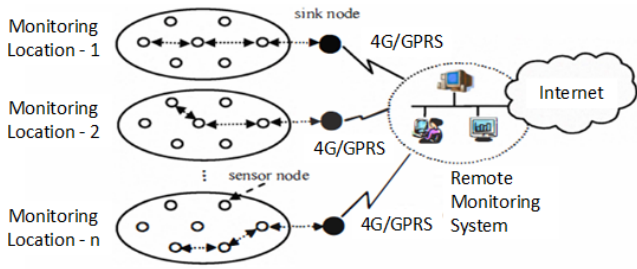
Fig. 5.   Multiple sensor communication to backend system

The system design with real-time monitoring system thus detected data from the sensors mush be transfer immediately with low delay. Figure 6 shows a block diagram applied in this system for communication to the backend. While 4G technology used then river water pollution data collected in an interval of time to minimize dumb and useless data that can be waste in local memory.
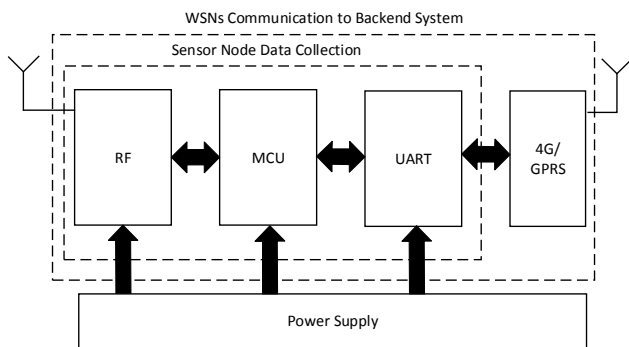

Fig. 6.   Block diagram of sink node to communicate to sensor node

The design of multiple sensors system consists of four parameters which common indicator in polluted water but the sensor node for WSNs be able to serve sensing system up to 50 nodes or location in 10 of a gateway. The distance of sensing system node from a location to others according to site survey effectively not more than 500 meters because the longer distance between sensing system then the results is low accuracy because the river water flow is very high especially in raining season. The system supplied with independence power system from the solar panel because of some location very far away from the electrical utility.

IV.   SIMULATION RESULTS AND DISCUSSION

The results system based on in house testing which in the laboratory for several sensors such as temperature, water pH and electrical conductivity and do calibration to the manual (conventional) system which manually measured to the tested water. The preliminary testing is very important to make sure the reading of the sensing system is accurate to the actual condition. To do a comparison and some of the results from the sensors compare to other datasheet and literature in reference [2]. The results of this testing of temperature achieve reading in the sensing and comparison to the thermometer as shown in Figure 7 shows the temperature measurement by thermometer compare to a temperature sensor in the sensing system. The average deviation between the sensing temperature to the manual thermometer is very minimum which 0.071 ℃ to 1 ℃ in maximum.
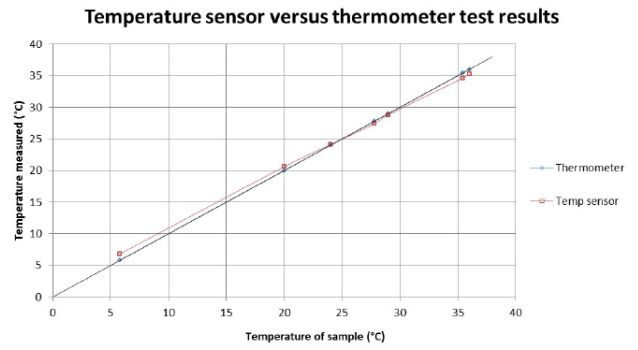

Fig. 7.   The results of temperature sensing compare to thermometer

In the polluted water, electrical conductivity index is one of the indicators have to do a measurement to achieve complete water pollutant, based on the design with sensor occupied 2-electrode. Low error on results based on testing for the electrical conductivity is expected to get high accuracy in the determination of polluted water. Normally error rate for this measurement is not more than 15%, similar to other indicators of polluted water. In figure 8 shows the results of signal conditioning testing compare to the simulated conductivity.
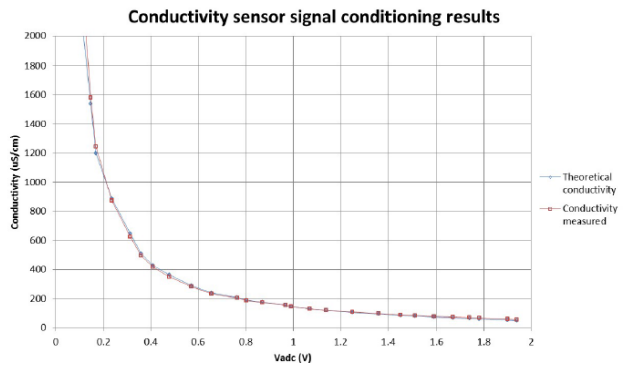

Fig. 8.   Electrical conductivity testing results for sensor node

Another common indicator to measure water quality is water pH, this indicator is very important to determine polluted water. Sensing system for detection of water pH designed integrated to others sensor and measurement results analyze into the same microcontroller. Refer to the table, the specification of pH within the range from 0 to 14 with 0.1 accuracies. Figure 9 shows the results of measurement water pH theoretical analysis.
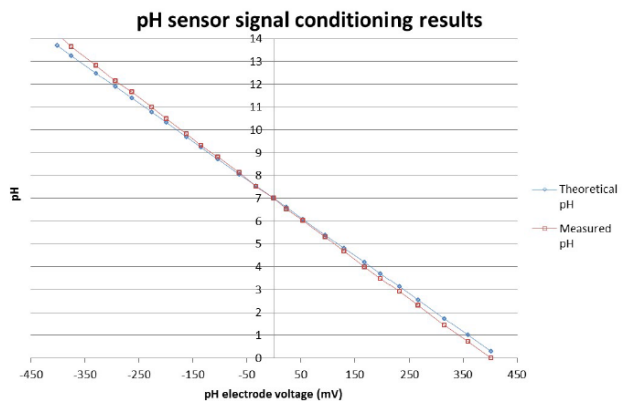

Fig. 9.   Water pH test results versus theoritical analysis

According to the initial testing in the laboratory, all the sensor for good function and be able to detect water parameters as indicate then display the value to output in an LCD. Further action is required to install and to do testing at the actual site as the proposed system. The results expected to achieve high accuracy based on actual contain polluted water.

V. CONCLUSION

Proposed design of polluted water using multiple sensors have a design, fabricated and tested in mini scale which is laboratory as well as initial testing on the site. Results show good agreement between measured compared to analysis and manual (conventional) measurement. Four main indicators in sensing system such as water pH, temperature, DO and electrical conductivity is measured to determine and gives the decision on the quality of river water either polluted or not. The proposed system applied intelligent system as well in programming the microcontroller to achieve high accuracy in the final decision based on detected value. Further action to get a sensing system beneficially to the community then, a water level and flow are required to include into an integrated sensing system then warning for flooding can be implemented. In final, to make sensing system is smart then intelligent algorithm should apply into microcontroller programming because of various type of material and chemical flow into the water.

ACKNOWLEDGMENT

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