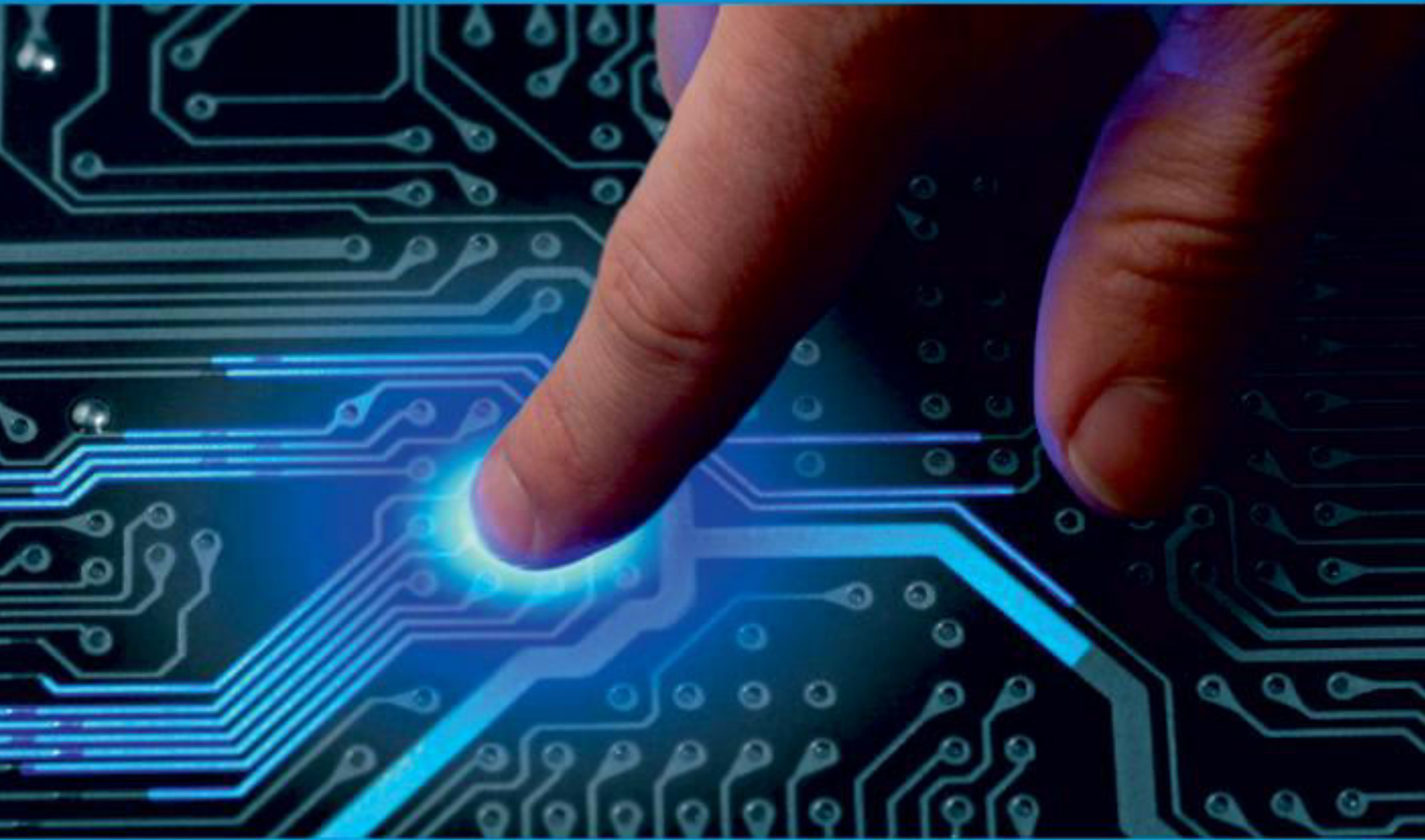
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 6, June 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906205 |

Water Quality Monitoring System using LSTM

Jonnadula Akash Mohan, Gopalam Vemanadh, Gunti Pavan Kumar

Under Graduate Students, Department of Electronics and Communications Engineering, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, AP, India

ABSTRACT: Quality Drinking water is important to the Health and Well-being of every Individual. This Paper proposes the development of a Raspberry-Pi based hardware platform for Drinking Water Quality Monitoring. The Selection of Water Quality parameters was made based on the Guidelines of the Central Pollution and Control Board (CPCB). A Graphical User Interface (GUI) was developed for providing an interactive Human Machine Interface to the User for Ease of operation. TDS Sensor and Temperature Sensor are used in measuring the Quality Parameters of Water. A Deep Learning Algorithm was used for GUI development, Data Acquisition and Data Analysis. Fuzzy Computing Techniques are employed for Decision-Making to categorize the Water Quality in different classes like consumable and non- consumable . The System has been tested for various water samples from different locations and the Water Quality is observed. Finally, the obtained results are compared with the Benchmark.

KEYWORDS: Water Quality Monitoring Using LSTM; Internet of Things; Remote Sensing.

I. INTRODUCTION

Over the past few decades, waters in and around Fiji have gradually succumbed to a fair degree of pollution. Chemical waste and oil spills are the major, primary forms of water pollution threatening Fiji's waterways. For example, an article published in the Fiji Times on 24 December, 2014 reported on raw sewage seeping into the Samabula River at a rate of 200 liters per second due to broken pipes [1]. Eliminating pollution altogether may seem like an unfathomable notion but limiting its effects when it does happen is certainly possible. The primary objective of this project is to devise a method to monitor seawater quality in an effort to aid in water pollution control in Fiji with the help of IoT and RS technology.

The Water Quality Monitoring System Using LSTM will measure the following water parameters for analysis; Potential Hydrogen (pH), Oxidation and Reduction Potential (ORP), Conductivity and Temperature using a RS technology. While monitoring these parameters, it is perceived that one should receive a stable set of results. Therefore a continuous series of anomalous measurements would indicate the potential introduction of a water pollutant and the user will be notified of this activity with the aid of IoT technology. False positives, such as anomalous readings over a short period of time, will be recorded but not treated as an alert. Hence, with the successful implementation of this monitoring approach, a water pollution early warning system can be achieved with a fully realized system utilizing multiple monitoring stations.

II. APPROACH

The first task and a very integral one was to determine which water parameters would provide a close indication for water pollution. Through extensive research [9-11] the parameters were chosen to be composed of pH, oxidation and reduction potential (ORP) and temperature. The reasoning behind these selections is discussed in section V – Water Parameters.

Independently these parameters provide very little information in terms of how polluted the seawater actually is. Therefore, analysis will consider collective parameter behavior in order to generate a valid output, which is either polluted or not unpolluted. To put this into perspective, a drop in pH of tap water alone is not a valid indication of pollution, this only indicates a formation of acids but it may still be consumable (e.g adding lemon juice to tap water).
The second step was the selection of locales that will provide useful data. The area in question should be susceptible to some chemical fluctuations by either marine life or human interference since performing data readings on clean, untouched waters would produce known results. Therefore, the locations were narrowed down to industrial areas,

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906205 |

marine jetties, sewer waste openings and city lines where human interference had a considerable impact. Given that security was a factor, the site was chosen as the USP jetty since the area is completely secure from theft and vandals.
The third obstacle was which form of data logging would produce an acceptable format. An FTP solution was developed initially on a local network, however without the intervention of local Internet Service Providers this seemed like the least convenient option. A cloud server has also been considered to act as an intuitive and a more permanent solution. Work is still in progress on this matter. Moving on, since the equipment has an SD storage option, data logging was ultimately done on the hardware itself in text format which can easily be read by practically any application.

The final step was to decide on an acceptable, proficient and accurate form of analysis. Seeing as the sea contains a vast number of unknowns which will imminently chemically alter the properties being measured. This will in turn present erroneous readings. As previously mentioned, changes in one measured parameter may be no indication of the sea water actually being in the presence of pollutants. The collective measured results had to be consistent over period of time to be treated as a possible threat. Moreover, to overcome this obstacle an intelligent analytical system had to be designed in the manner of a Neural Network model.

III. WATER PARAMETERS

A. **Temperature**

It is important to record temperature alongside the other parameters as this will be useful in behavioral analysis of the parameters being measured. Relating to temperature-relation theories, pH and conductivity have an undesirable effect with large temperature changes. In addition to this, extreme temperatures for pacific island climates is of understandable concern.

B. **pH**

The pH of a solution is the measure of the acidity or alkalinity of that solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. The majority of aquatic life prefers a pH level of 6.5 – 9.0. Anything outside of this optimum range is considered fatal to the marine ecosystem. Extreme pH values also increase solubility of elements and compounds making them toxic and therefore more likely to be absorbed by marine life. Furthermore, temperature has an inverse relationship with pH that is, as temperature increases pH levels decrease and vice versa.

D. **Conductivity**

Conductivity signifies the ionic strength of a solution. In other words it is the ability of a solution to conduct electricity with the typical unit for measurement being micro-Siemens per centimeter (uS/cm). As the dissolved ions increase in the water, conductivity increases. Therefore, the conductivity of tap water is perceptibly low at around 100 uS/cm. On the other hand, expected values for sea water are 55000-60000 uS/cm due to its high ionic content. Any further increase in the conductivity value may be indicative of polluted waters, such as sewer leaks or chemical wastes flooding into the water.
Moreover, conductivity is directly related to salinity that is conductivity improves with high salinity. Conductivity values outside of the optimum levels indicate a possible negative scenario. Dead Sea is a prime example of lethal concentrations of salt.
The temperature relation with conductivity is a proportional one. A general assumption of a temperature-conductivity relation is taken to be linear in nature with a deviation of 2%/°C.

IV. EXPERIMENTAL RESULTS

Four water samples from different water sources were tested to establish a reference on the parameters for each water type. The chosen water types were seawater, surface water, Tap water and polluted creek water.
The four water samples were tested simultaneously with four separate, identical systems at indoor ambient temperature. Readings were taken at 1 hour intervals for a total period of 12 hours. For security reasons the systems were not deployed in the specific areas of interest, instead water samples were collected and tested in a safe controlled environment. However, the tap water sample was changed every hour to see the consistency of Fiji tap water (supplied by Fiji Water Authority) readings.

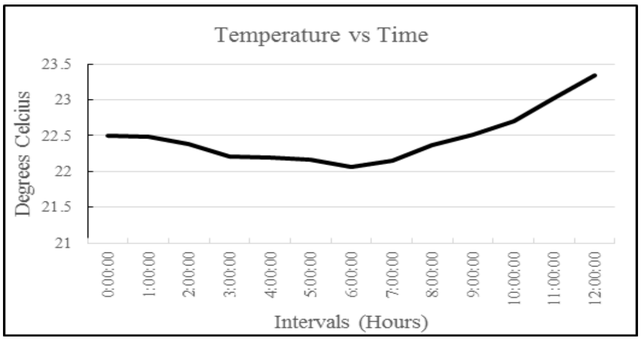
| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

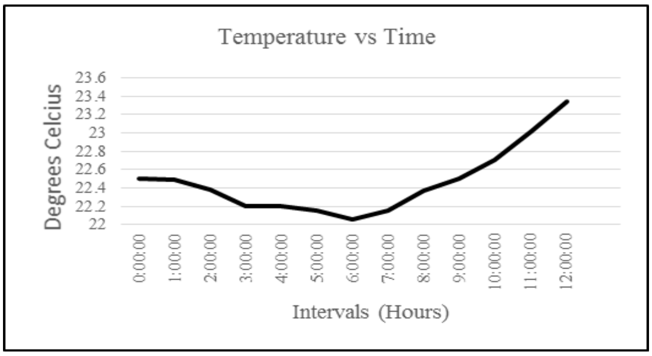
|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906205 |

A. **Reference for tap water**

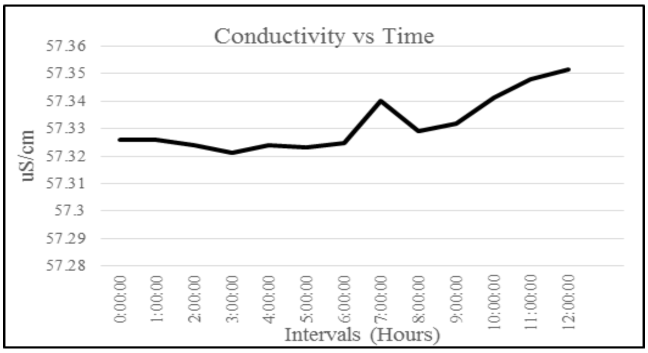
Fig. 4-7 shown the trends of the acquired data and are consistent with the globally accepted values for pH, conductivity and ORP. The temperature effect on pH and conductivity is clearly observed.

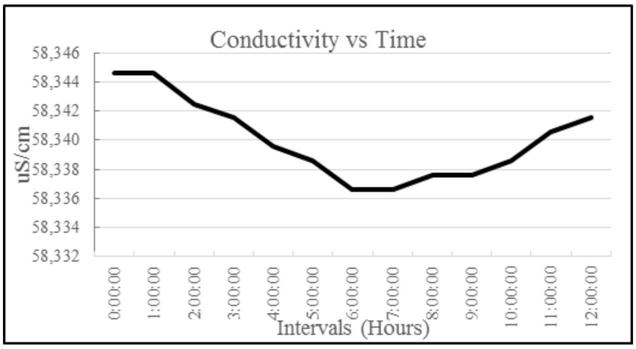




GRAPH OF TREND FOR SEA WATERGRAPH OF THE SOLUTIONS AMBIENT TEMPERATURE

CONDUCTIVITY FOR TAP WATER

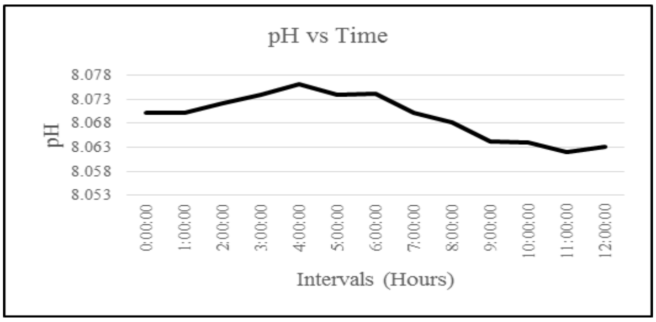


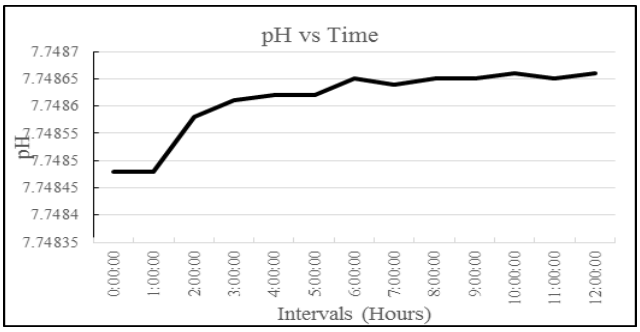


CONDUCTIVITY TREND SEA WATER

PH TREND FOR TAP WATER PH TREND FOR SEA WATER

In addition, Temperature- Conductivity relation can be seen to be linearly proportional.





B. **Reference on sea water**

A sample of fresh seawater, collected from the shores of Sigatoka, was tested to provide a reference on healthy sea water with little to no contamination.

The results shown in indicate values that are near to the researched data for acceptable sea water parameters that can sustain aquaculture .

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906205 |

C. **Reference on surface water**

A sample of water was taken from Rewa River (Suva, Fiji) to provide a reference on surface water. The results obtained fromRewa River were also consistent with the researched data available on acceptable surface water parameters.

Conductivity for the water samples differed significantly because of the different salinity concentrations for different water types. The highest conductivity being 58000 uS/cm for sea water and the lowest being that of tap water with conductivity value of 58 uS/cm. ORP for sea water and river water were similar with results being in the low 100-200mV range. ORP for tap water was observed to be 350 mV which is fine considering that the acceptable range is from 300-650mV.

The data obtained for polluted water has some interesting values for ORP and conductivity. A very low ORP value was observed, averaging at -2mV which is an indication of overpowering reductants. This is an expected value considering the background of Nabukalou Creek having waste lines connected to the creek. The conductivity value was in the 40000 range indicating that water samples likely contained traces of pollution. A summary is also presented in table format

SOURCE	TEMPERATURE	PH	CONDUCTIVITY
REWA RIVER	20-30°C	7.7-8.2PH	70-80uS/cm
CENTRAL TAP WATER	20-30°C	7.7-8.1PH	55-70uS/cm
SIGATOKA	20-30°C	7.7-7.9PH	50-60 mS/cm
NABUKULAU CREEK	20-30°C	7.7-7.9PH	42-45 mS/cm

V. CONCLUSION

This research demonstrates a smart water quality monitoring system. Four different water sources were tested within a period of 12 hours at hourly intervals to validate the system measurement accuracy. The results obtained matched with the expected results obtained through research. The temperature relation with pH and conductivity were also observed for all the water samples. GSM technology has been successfully implemented to send alarm based on reference parameter to the ultimate user for immediate action to ensure water quality. Additionally, the parameter references obtained from all the different water sources will be used to build classifiers which will be used to perform automated water analysis in the form of Neural Network Analysis.

In a nutshell, the system has proved its worth by delivering accurate and consistent data throughout the testing period and with the added feature of incorporating IoT platforms for real time water monitoring, this should be an excellent contender in real time water monitoring solutions.

ACKNOWLEDGMENT

The research team would like to thank the VASIREDDY VENKATADRI INSTITUTE OF TECNOLOGY for funding this research project.

REFERENCES

[1] Madigibuli, A., “Sewere Spill”, Retrieved from Fiji Times Online: http://www.fijitimes.com/story.aspx?id=289915, Accessed on: November 4, 2015.

[2] Libelium., “Water Quality Monitoring in Europe’s Largest Fluvial Aquarium”, Retrieved from Libelium: http://www.libelium.com/water-quality-monitoring-europe-largest-fluvial-aquarium-zaragoza/, Accessed on: November 4, 2015.

[3] “Sea Water Monitoring For Chemical Parameters”, Retrieved from Gujarat State Project Management Unit: http://www.geciczmp.com/Sea-water-monitoring-for-chemical-parameters.aspx, Accessed on: November 4, 2015.

[4] Vakacola, M., “ Biannual Sea Water Monitoring Program”, Retrieved from Mamanuca Environment Society: http://mesfiji.org/biannual-sea-water-monitoring-program, Accessed on: November 4, 2015.

[5] Postscapes, “Retrieved from History of the Internet of Things”, Retrived from Online: http://postscapes.com/internet-of-things-history, Accessed on: November 4, 2015.

[6] K. A. Mamun, Sharma, A., A. S. M. Hoque, T. Szecsi, “Remote Patient Physical Condition Monitoring Service Module for iWARD Hospital Robots”, Asia-Pacific World Congress on Computer Science and Engineering, 2014.

[7] Atzori, Luigi, Antonio Iera, and GiacomoMorabito. "The internet of things: A survey." Computer networks 54, no. 15, 2787-2805, 2010.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906205 |

[8] "Preventive Solutions", Retrieved from http://www.preventicesolutions.com, Accessed on: November 4, 2015.
[9] Luke Mosley, S. S., "Water Quality Monitoring in the Pacific Island Countries", Report, University of the South Pacific, 2005.
[10] 3riversquest.org., "Sampling Parameters and Descriptions", Online: 3riversquest.org, Accessed on: November 4, 2015.
[11] Ministry of health, Fiji Island, Fiji National Drinking Water Quality Standards, 2005.