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The development of water quality monitoring system using internet of things

Sharifah Nurulhuda Tuan Mohd Yasin [1*)], Mohd Fauzi Mohd Yunus[1], Nur Bahiyah Abdul Wahab[2]
[1]Politeknik Sultan Mizan Zainal Abidin
[2]Institut Pendidikan Guru Kampus, Temenggong Ibrahim

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ABSTRACT

Biological diversity or biodiversity is an important element in the river water management system. The interaction between the various organisms in the river makes it a very complex ecological system. Therefore, water safety issues are a very important issue. Consumer complaints and reports made by the relevant government departments indicate that consumers are dissatisfied with the quality of water supplied. Hence, a concept in which equipment, machines, sensors and devices are connected to the Internet and there is data collection and transfer through the network developed to follow the river water quality index. Integration of the elements of sustainability and IR4.0 through the Internet of Thing by adopting electronic and Internet applications of Thing has a very positive impact to refresh the approach to lesions in Malaysia. The project aims to develop a wireless water quality monitoring system that aids in continuous measurements of water conditions based on pH and turbidity measurements. The developed system was successfully detecting both the pH and turbidity values. Water analysis and monitoring is a very important aspect of water conservation and protection. Water is a vital resource that runs more quickly overtime. To ensure continued supply of safe, clean drinking water, together as community to protect and to this vital resource.

Corresponding Author:

Sharifah Nurulhuda Tuan Mohd Yasin,
Politeknik Sultan Mizan Zainal Abidin
Email: shnurulhuda@gmail.com

Introduction

Biological diversity or biodiversity is an important element in the river water management system. The interaction between the various organisms in the river makes it a very complex ecological system (Muhammad , Vaduz , Saima, 2003). Since the existence of human settlements in this world, the problem of river pollution has arisen (Kasan, 2006). The approach should be taken in improving the quality of river water management system including application of conservation and river water conservation (Manuel, Alberto, Carolina, Nora, 2002). Hence, a more systematic diagnostic system should be introduced to maintain the water quality index from pollution worse than human activity

The classification of water quality is using the Water Quality Index (WQI). WQI performance is a minimum indicator of water quality measurement through the determination of physical-chemical surface water parameters (Nithyanandam, Huan, & Thy, 2015). The water quality index is always used to classify the water quality level. Performance is a minimum indicator of water quality measurement through the determination of physical-chemical surface water parameters. Measurement obtained is then compared to the Malaysian water quality standards.

There are hundreds of thousands of water samples every year. Water samples are usually collected over a long period of time then the sample analysis at the lab. Additionally, there are some chemical and biological processes such as potentially oxidation reductions (redox) that require measurement on site to ensure accuracy and other aspects are considered discussed in the study (Rao, 2013). Therefore, online water quality monitoring system has the potential to be presented with continuous data is highly demanded. The main objective of this study is to develop IoT water quality monitoring systems that assist in the continuous measurement of water conditions. IoT environmental monitoring app usually uses sensors to assist in protection environment by monitoring water quality.

The diversity of research on the water quality monitoring system discussed by Wang, Wang (2009) and Jiang & All (2009). According to Wang, Wang (2009), IoT devices typically in this application usually include large geographical areas and also mobile. The IoT diversification leads to wireless sensing that will revolutionize the river area. The developed system allows for remote monitoring and real-time monitoring of water quality parameters and allowing current status observations and water quality history. Jiang & All (2009) perform a water monitoring system that includes pH analysis, conductivity, dissolved oxygen and temperature levels will be implemented. Alarm sounds will be triggered if there is water pollution or water quality changes. The parameters are measured with landing sensors and data transmitted to base stations via GPRS.

Literature Review

The worrying state of the environment has affected the quality of rivers, seas and ponds. The shameless act of disposing trash into the sea has impacted their quality negatively deeply. Smokes from factories rose and soon form acidic rain that will pour on the land and water (Samsudin, Salim, Osman, Sulaiman, & Sabri, 2018). It's absolutely no wonder the quality of the sea are plummeting.

Furthermore, families occasionally frequent the space beside waterfalls. There is no guarantee that the water is clean and harmless. People are sometimes seen consuming the water no matter intentionally or not. Small children especially, are prone to sickness from the polluted water. Acquiring information from locals is one of the ways to go, except there is no telling how truthful they are.

Lastly, the sheer inconvenience that would incur on people to go check themselves is something to avoid. This will not only waste people's time but also their energy (Wang, Wang, 2009). Even though there exist pages or websites that cite the pH levels, but they are not in real-time. Most of them provide data from minutes or hours ago. The traditional method of collecting the water samples and checking said samples yourselves works but it is an inconvenience.

Production of tools that can measure where the stage of health (water quality index) in chemistry. This tool is manufactured by reading to evaluate the function of recording quality level through special sensors in IoT (Manuel, Alberto, Carolina, Nora, 2002). While reading the data obtained can prevail for the purposes of analysis, record, display and be warn JPS about the health status of the river ' the surgery ' in chemistry. The platform apply as cloud database simplifies the storage process and the process of data analysis as well as it also has the characteristics of high security. While mobile applications (apps) in turn serves as a dashboard to display general.

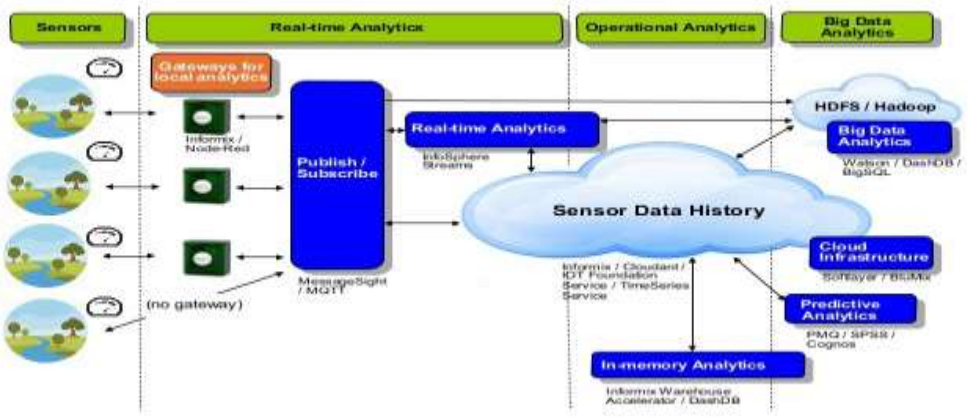

Figure 1 . Data flow IoT

Problem Statement

The most frequent water quality issue is due to the high content of iron (iron(III) oxide) and magnesium content in raw water of treated water. Water quality disorders occur as a result of changes in the color of the water that turns yellow to a dark brown color. The color change is due to action chemical reactions that are used in the water treatment process at the Treatment Plant (Kasan, 2006). This water treatment diagnostic and auditing process still uses manual methods, where water will be measured and the quality index will be clinically measured inside the laboratory. Besides, low pH levels cause fish killed by stressing animals system and causing physical damage, which in turn makes them more vulnerable to disease.

Water is the most important source of survival for all beings on earth. Therefore, water safety issues are a very important issue. Consumer complaints and reports made by the relevant government departments indicate that consumers are dissatisfied with the quality of water supplied (Nithyanandam, Huan, & Thy, 2015). Hence, a concept in which equipment, machines, sensors and devices are connected to the Internet and there is data collection and transfer through the network developed to follow the river water quality index. Integration of the elements of sustainability and IR4.0 through the Internet of Thing by adopting electronic and Internet applications of Thing has a very positive impact to refresh the approach to lesions in Malaysia.

The production of tools that can measure the level of health (water quality 8 index) chemically (Samsudin et al., 2018). This tool is produced by reading recording function to evaluate the quality level through the special sensor of Internet of Thing. And the data obtained can be used for analysis, recording, display and it is a warning to the JPS about the health status of the river that is chemically dissolved. The information used such as the cloud database greatly facilitates the process of storage and process of data analysis while it also has high security features. While mobile apps serves as a general display dashboard.

Figure 2 . Concept IoT

Method

Agile development model is also a type of Incremental model. Software is developed in incremental, rapid cycles (Cockburn, Alistair, & Highsmith., 2001). This results in small incremental releases with each release building on previous functionality. Each release is thoroughly tested to ensure software quality is maintained. It is used for time critical applications. Extreme Programming (XP) is currently one of the most well known agile development life cycle model. Agile methodology is explained in more detail under the Agile Tester topics. In this chapter, the Agile Methodology Model fits the project. Repeated processes ensure that every problem is detected and resolved quickly and efficiently. The advantage of using this method is continuous communication from the user, so any improvements can be made from their suggestions or complaints.

The main objective of this phase is to design the new application which is connected with a sensor to pH level in water plants. Design is the process to design the user interfaces for this application. After the requirements have been determined, the necessary specifications for the hardware, software and data resources that will satisfy the requirements can be determined. All decisions made from planning and system analysis is converted into computer application. This is to ensure the efficiency and effectiveness of the application. Below are the explanations for the phases: 1) User interface design, Interface design of pH

Level in water plants for this administration was develop to make it user-friendly and easier to use since the user have been used manually to checked by the staff; 2) Database and design model, pH Level in water plants is identified to use Oracle for the database. Entity Relationship Diagram (ERD) is drawn to shows the flow of the system.

With input from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is referred to as Unit Testing.There are some issues which come up in the client environment. To fix those issue patches are released. Also to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

Figure 3 . Agile Model of SDLC

Results and Discussions

Water quality monitoring system development

Phase 1: Analysis of Development Needs Criteria for the Internet of Thing River Basin Auditing

This study will be divided into two stages,that is simulation and experimental studies on the actual field of water plants as prototype. The water quality will be measured according to the chemical test. Specifications based on parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), ammonia nitrogen (AN), suspended solids (SS), pH, nitrate and phosphate the level of water health that is streamed to the plant based on the Water Quality Index (WQI). It aims to facilitate the subsequent water treatment process. Health indicators of water resources will be displayed automatically on the display board through three colors, red, green and yellow near the plant being tested as immediate information to the monitor. This monitoring process is important to ensure the safety and quality of water supplied for public and industrial use.

Table 1. Monitoring Process

Testing Step	**Model Approach (Simulation)**	**Monitoring Approach (Experimental)**
Location	System extent (specific boundaries, models)	Monitoring on site
Time	Simulated period	Sampling in terms of time and frequency
Guidance	Input (based on baseline and scenario)	Measurement of system input or water attributes
Application	Variable Process Model type Model design Equipment - model equation, parameter Functional test Testing / Verification Error / uncertainty Scenario run Reports	Method of Monitoring Monitoring Design Equipment - Functional Test Calibration Error / uncertainty Field run test Reports

Phase 2: Design and Simulation of the Internet of Thing River Basin Auditing

Step 1: Hardware Implementation

Hardware devices involve micro-controller, pH and turbidity sensor and Wi-Fi modules. Generally, micro-controllers process data taken by pH sensors and turbidity, then sends data to the database using a Wi-Fi module as a bridge.

Microprocessor

The WeMos D1 is a ESP8266 WiFi based board that uses the Arduino layout with a operating voltage of 3.3V.

Figure 4. WeMos D1

PH sensors and turbidity

The electrode is composed of a PH glass electrode and a silver chloride silver reference electrode, and is a measuring component of the PH meter for measuring the pH value of the aqueous solution.

Figure 5. Ph sensor

Wi-Fi module

ESP8266 Serial Wi-Fi Wireless ESP-01 Adapter Module 3.3V 5V Compatible for Arduino

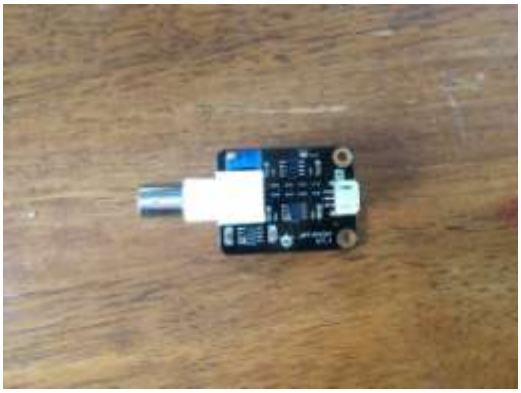

Figure 6.. Wifi module : Ph Meter v1.1

Step 2 : Software implementation
Essentially, hardware has been programmed using Arduino IDE. This software can be used with any Arduino board such as WeMos. Open Source Arduino (IDE) software makes it easy to write code and upload it to a board. It runs on Windows. The data collected are then archived in an online database losant. It is an open source software that facilitates researchers to record sensor data and convert it into useful content. Platform Dot.tech can be used to transmit data to the cloud from any device that allows the internet by configuring actions and reminders based on real-time data and releasing data values via visual tools.

In the end, data is displayed on a website created by open software, w3layouts.com is one of the most popular HTML5 web host builders. PH sensors and turbidity sensors are connected to Arduino. Arduino will process data and send it to the database via the Wi-Fi module. Users will be able to receive updated data that allows classification of water quality levels based on Department of Environment Malaysia measurements. PH and turbidity data have been recorded in offline and online measurement. Further data continues to be collected through online measurement in the Internet of Thing platform.

Figure. 6. Online measurement of pH and turbidity levels

Phase 3: Preparing the testing and evaluation of the Internet of Thing River Basin Auditing
To solve the problem of reading and data collection, this research aims to plan and implement the Internet of Thing to control data and reading water quality pH. The system to be designed can communicate with a variety of smart objects using Wi-Fi or 4G standards. As a result, all data / reading can exchange information through the system designed. The main contribution of this device / research to the designed Internet of Thing system allows communication between different smart devices, including smartphones, microcontrollers, and sensors. The system provides solutions to determine the water quality level to find out the degree of acidity and help the determination of pH using Internet of Thing technology.

Applications to be built for the purpose of monitoring and getting accurate readings developed are to use a server that can implement the Internet of Think. This application protects the implementation of Cloud and Big Data by providing the APIs in assisting with the data collection process and making it informative. API is a way or solution for objects to interact with the web. This API allows HTTP and HTTPS. To obtain a value or variable from the server then the variable ID is required and the user account token provided by the server.

Conclusions

The river is part of life and is also a very important source. Awareness in the safeguard and the cleanliness of the river should be enhanced among the community at large. Development of tools that can measure the level of index river water this can increase knowledge and awareness in maintaining river and life (Samsudin et al., 2018). This tool is manufactured by reading a function record river through special

sensor in IoT. While reading the data obtained can prevail for the purposes of analysis, record, display and be warned the man to the status of the river. The platform apply as cloud database simplifies the process of storage and data analysis process disampin it also has characteristics of high security (Nithyanandam, Huan, & Thy, 2015). While web page and apps turn function for general display. In an era of Industry 4.0 and Big Data, production of this instrument plays a very important role to enhance knowledge and awareness at a glance into the river. With the availability of sensors that can collect water and health index data combined with IoT Arduino then process data become much easier and efficient.

IOT is a technology that has become popular to describe the phenomenon of relationship device with life. Small sensor and computer chip placed on a variety of devices that allow them to communicate through the internet or other network computer system (Nithyanandam, Huan, & Thy, 2015). Because IoT move farther into their daily lives, it creates interesting opportunities to pick research. In industry, the IoT could do the automation in the industrial process (Junior, 2016). IOT may also be used for purposes of monitoring river water flow. IOT is a system where device that interconnected can change data over the Internet without requiring interaction human-to-human or human-to-computer. IOT is installed with the device detector to get further reading record the reading data. Reading can give value reading provides an overview of the level of the water. The level of acidity of water also affects the analysis process or decision at the reading. The liquid has a pH is too high or too low can cause damage to the environment.

Emphasis on the Government's efforts to improve community awareness about environmental sustainability through conservation programs in Malaysia is gaining the attention of all walks of life (Samsudin et al., 2018). Environmental conservation programmes is in line with the requirements of *Agenda 21* which require the involvement of the community as a whole and here the role to increase community awareness requires an initiative interesting, simple, fun and a more recent (up to date) in order to stimulate the interest of the community. Therefore, the assimilation of the industrial revolution 4.0 (iR 4.0) in the interest of the community to carry out conservation programs is the best step to enhance sustainable living practices. Integration of elements of sustainability and iR 4.0 through IOT by making use of electronic applications and IOT is expected to become a major force in the main community in Malaysia and a very positive impact for refreshing approach to life in a sustainable manner in Malaysia. But the impact on the community is to overcome the issue of awareness and environmental sustainability; Ekonomi is saving energy use and increase productivity through automation and the country as a Hub for development of IoT.

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