Water Quality Monitoring Sensed Parameters Using IoTs

Ni Ni San
Technological University (Kyaukse)
maninisahlaing@gmail.com

Lae Yin Mon
Technological University (Maubin)
laeyinmon.lym@gmail.com

Win Yu Cho
Technological University (Kyaukse)
winyuchogyic@gmail.com

Abstract

Water is an essential need for survival. Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of drinking water the quality needs to be monitored in real time. This paper describes a design and development of a low-cost system for real-time monitoring of the water quality in IoT (Internet of things). In this system, several sensors are used to measure physical and chemical parameters of water. Several parameters such as pH and temperature can be measured. The measure from the sensors can be processed by the core controller. As a main controller, the Arduino model can be used. Finally, users can be viewed sensor data using Wi-Fi system. In this paper, the author is taking four water samples from Technological University (Kyaukse) and around Kyaukse city to measure the quality of water. The monitoring result of water sample can be seen in Thingspeak cloud server. By using Thingspeak cloud server, analysis data can be exported with excel file.

Keywords: PH Sensor, Temperature Sensor, LCD, Arduino UNO, Wi-Fi Module, I2C Module.

1. Introduction

Water is limited and essential resource, agricultural and all the creatures existing on the earth including human being. Everyday water is used for many purposes such as drinking, cooking. The collection of information at set locations and at regular intervals in order to provide data which may be used to define current conditions can be defined as water quality monitoring. The water quality parameters PH measure the concentration of hydrogen ions. Its shows the water is acidic or alkaline. Pure water has PH7 values; less than PH7 has acidic; more than PH7 has alkaline. The range of PH is 0 to 14. For drinking purpose, it may be 6.5 to 8.5. If the normal range of PH not included, it causes the irritation if eyes, skin and mucous membranes in drinking water. For questions on paper guidelines, please contact the editorial board as indicated on the website. Information about final paper submission can be available on the website. Block diagram of home automation system can be described as shown in Figure 1.

Figure 1. Block diagram of the system

The whole design of this system is mainly based on IoT which is newly introduced concept in the world of development. There is basically consists of two parts, the first part is software and the second part are hardware. The second part sensors which help to measure the real time values, another one is Arduino ATmega328 converts the analog value to digital value and LCD shows the displays output from sensors. The Wi-Fi module gives the connections between hardware and software. In software, C language is used. Thingspeak application is installed to see the output when the system gets started direct current given to Arduino and Wi-Fi gets on. The parameters of water were tested and the result is given to the LCD display. The application was provided with hotspot gives the exact value as on LCD display on kit. Thus, like this when the kit is located on any specific water body and Wi-Fi is provided that can observe its real time value on android phone at any time.

2. Hardware Architecture

Firstly, it starts the program and initialization the system of the water quality monitoring system. Then, check the overall system such as temperature: DS18B20 and SKU: SEN0161: PH sensor. The temperature sensor is used to know how the water temperature is cold or hot. PH sensor is used to know the water PH level for the input water. These applications are shown the PH, temperature data. This flowchart is start from top to button and the program start with defining of the pins that will use. In the test
condition, if the sample water is base pH sample water, the LCD will show the correct base pH value. If the sample water value is not base pH, the test sample water will check next pH value. In the next situation, if the sample water may be pure pH value, the LCD will show the pure pH value in the LCD screen. Either if the sample water is not pure pH value, the condition will check next pH value. When the sample water is reached the acid PH value and the check value of acid is correct and the LCD will show the correct acid PH value. The checking process of PH value repeated again and again. After testing all the PH sample value and the test value is correct the system end. In the test situation step, the temperature sensor tests the real time value of water [5]. And then, the test value can be seen on the LCD screen. This step is repeated again and again. When user get the real time situation of water temperature value, this flowchart is completely end. And then, Wi-Fi service starts and connects to the internet. It waits the command form the server. The user also connects to the internet and desired button. When the user presses the button, the command behind the button operates and upload to the server. From the server, the string with respect to the command was send to the ESP. The ESP read the string and operates the functions [3].

![Flowchart of the System](image_url)

**Figure 2. Overall Flowchart of the System**

In the circuit show in figure composed of five components. They are pH sensor, temperature sensor, Arduino UNO, ESP8266 Wi-Fi module and I2C module. In this system, the Arduino UNO based on ATmega328P is used as the core controller. As show in circuit, the ground pin and supply pin of DS18B20 temperature sensor is connect to the Arduino UNO pin of ground and supply pin. The data pin of temperature sensor pin connected to the digital pin2 of the core controller. Between the supply pin and the data pin a 4.7kΩ resistor is connected. The data pin of temperature sensor pin can connect any digital pin of the microcontroller. In the pH sensor, it consists of pH probe and the BNC module. In the BNC connector, it consists of pins such as supply pin (VCC), temperature pin (T0), analog pH pin(P0) and two ground pins (GND). In the circuit, the supply pin and ground pin of BNC connector is connected with Arduino UNO supply and ground pin with each other. To know the output of the pH value, the BNC connector of analog PH pin is connected to the analog pin (A0) of the Arduino. To see the result of the PH value, user connects the microcontroller with I2C LCD bus. In the I2C LCD bus, the serial clock (SCL) and serial data (SDA) pin are connected together with the A4 and A5 pin of microcontroller. The ESP8266 NodeMCU Wi-Fi module of Transmit pin (TX) and receive pin (RX) pin are connected serial communication with Arduino UNO transmit and receive pin. C program is used as the programming language. The hardware parts have the sensors which help to measure the real time values and the microcontroller converts the analog value to the digital value. And the output of these values is displayed on the LCD. The ESP8266 gives the connection between the hardware and software. The whole design of this system used only 5V to get the power. By just directing connected to the microcontroller with this module, user can start loading up the data into the ThingSpeak server.

![Overall Circuit Diagram of the System](image_url)

**Figure 3. Overall Circuit Diagram of the System**

3. Software Development

In this paper, components are tested step by step such as pH sensor, temperature sensor, I2C, LCD and Node MCU by using with Arduino.

3.1. Flowchart of PH Sensor

Upon the execution of the program, it first checks if Bluetooth is already enabled on the phone. If Bluetooth is enabled, the device and service discovery process will run. The software will check if there are already predefined devices stored in the phone’s memory. If they do exist, they will be listed down for the user to select one. The program then checks to see if the selected device is in range. It will then verify if the device is a Bluetooth transceiver (Arduino board). Now if there are no devices stored in memory, the program will search for Bluetooth-enabled devices within the area. Once discovered, these devices will be displayed on the screen and also stored in memory. Otherwise, it
will be given its saved name and will prompt the user to enter the pairing password for the Arduino board. Upon entering the correct password, the program stores all connected controller modules’ names inside the phones’ memory, then only the Main Menu user interface will be displayed. As shown in Figure 4, a list of home appliances is a combination of one or more lights, doors, fans which have been preset to a certain status or state. These states are either ON or OFF. When the certain instruction has been chosen, the software will send data to the Arduino BT transceiver, which in turn will send the data to the controller modules. The List of Home Appliances option in the Main Menu will display the entire controller modules saved in memory. Lastly, Exit will let the user end the program.

3.3. Implementation of ThingSpeak

At first open Thingspeak link and click on the ‘get started now’ button on the center of the page and redirected to the sign-up page (the figure 6 page is reached when the ‘sign up’ button on the extreme right click). Fill out the required details and click on the ’create account button’.

Figure 6. Sign Up the Thingspeak

Now a page can be seen with a confirmation that the account was successfully created. The confirmation message disappears after a few seconds and the final page should looks as in Figure 7.

Figure 7. Confirmation Page of the ThingSpeak

Go ahead and click on ‘New Channel’. The next page can be seen on the Figure 8.

Figure 8. Naming the Project of Channel Page and Assigning Channel Name

User can change name to fit user need and user can add a description corresponding to the channel. The user can add any other useful description into the metadata field. Once user has edited the fields, click on ‘Save Channel’ button. User should now see a page like the below in which the ‘Private View’ tab in defaulted.
The private view shows a chart corresponding to each of the channel fields that the user has added. Now the user clicks on the 'Public View' tab. This should look exactly similar to what the user sees in the 'Private View' tab since the use's channel is public. In this case the user's channel is not public ('make public' check box not checked in the 'channel setting' tab), the public view tab shows a message that 'This channel is not public'.

Now click on the 'API keys' tab. User should see a screen similar to the below. The Write API key is used for sending the data to the channel and the read API key(s) is used to read the channel data. When user creates a channel, by default, a write API key is generated. User generates read API keys by clicking the "Generate New API key" button under this tab. User can also add a note corresponding to each of the read API keys.

When test the temperature of water, the thermometer is immersed in the water. The result of the water temperature is shown by degree Fahrenheit (F). According to the figure, the result of the water temperature is 30 degree Celsius.

PH sensor is connected with BNC connector to pH sensor module. To connect with Arduino, it will need an analog (A0), power (5V) and GND. PH sensor module consists of pH sensor module and a signal conditioning board which give output which is proportional to the PH value. It can be interface to any microcontroller.

Again, the pH sensor module with Arduino

Again, the pH probe is immersed in the acid solution; the value of PH will change because it is the acid solution. These results will see on the serial monitor as shown in Figure 13.

Again, the PH sensor is tests with salt solution which has nearly PH9. The LCD will display the message of PH9 as show in Figure 14.

When the pure water is monitoring and watched in the Thinspeak server, the result show that water quality reached in PH value of nearly7. And the monitoring result is shown in figure monitoring result of pure water.
Figure 16. Monitoring Result of Pure Water
By adding the impure water to the pure, the PH value is lower than the pure water and monitoring result can be seen as shown in figure monitoring result of pure water and impure water.

Figure 17. Monitoring Result of Pure Water with Impure Water
When collecting pure water from Technological University (Kyaukse) pure water machine, and test with PH sensor, the monitoring value of PH and temperature can be seen as shown in Figure 17.

Figure 18. Monitoring Result of Sample Water from Technological University (Kyaukse) Artesian Wall
Taking water sample from Ye-Zu drainage and testing these sample water with pH sensor, the monitoring value of PH and temperature can be seen as shown in Figure 18.
The experiment results for comparison of different pH Solutions are illustrated in the Table 1.

Table 1. Comparison of Different pH Solutions

<table>
<thead>
<tr>
<th>No</th>
<th>Types of solutions</th>
<th>Measured Value</th>
<th>WHO standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>pH4.0 solution</td>
<td>8.36</td>
<td>5.5-6.5</td>
</tr>
<tr>
<td>2</td>
<td>pH9.18 solution</td>
<td>9.18</td>
<td>8-14</td>
</tr>
<tr>
<td>3</td>
<td>pure water</td>
<td>7.01</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>4</td>
<td>lime juice</td>
<td>3.74</td>
<td>0.5-6.5</td>
</tr>
<tr>
<td>5</td>
<td>salt solution</td>
<td>8.18</td>
<td>8-14</td>
</tr>
<tr>
<td>6</td>
<td>TUK(SE) water purification machine</td>
<td>6.9</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>7</td>
<td>TUK(SE) Artesian Well</td>
<td>6.5</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>8</td>
<td>Ye-Zu Cannel</td>
<td>7.23</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>9</td>
<td>Min-Ye Cannel</td>
<td>7.22</td>
<td>6.5-8.5</td>
</tr>
</tbody>
</table>

5. Conclusion and Discussions

Monitoring of pH and temperature of water makes use of water detection sensor with unique advantage and existing GSM network. The system can be monitor water quality automatically, and it is low cost and does not require people to watch on duty. So, the water quality testing is likely to be more commercial, convenient and faster. The system has good flexibility. By replacing the related sensors and changing the corresponding software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. The embedded devices are keeping in the environment for monitoring enables self-protection. This need to deploy the sensor devices are implemented the environment for collecting the data and analysis. By deploying sensor devices in the environment, user can bring the environment into real life i.e. it can be interacted with other objects through the network. Then, the collected data and analysis results will get to the end user through the Wi-Fi.

It is discussed that the contribution of the system details the owner contributions for the provision of waterway, water quality treatment drainage facilities. The water quality resources are used as the basis for the water analysis which is essentials for water quality monitoring and aquaculture industry. It is suggested that the result obtained in the design is the appropriate selection for the water level sensors. These types of temperature and PH sensors will be used. The water quality monitoring system can be used in the real field, water monitoring efficiently at a low-cost. It is also known that water analysis can prevent inevitable water environment occurrences, decision-making, proper planning, and management of the aquaculture industry. This system could potentially be improved if these parameters are added to the monitoring system.

Acknowledgment

The author wishes to express her thanks to Prof. Dr. Khin Htike Htike Lwin, Rector, Technological University (Kyaukse), for her encouragement and kind permission to submit this dissertation. The author particularly wishes to acknowledge all the teachers from the Department of Electronic Engineering, Technological University (Kyaukse), for their support, encouragement and invaluable guidance in the preparation of this paper.

References

[6] https://www.en.m.wikipedia.org/wiki/Wi-Fi