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Design Cloud Computing System for Data Collect of Water Quality and Level of Rivers

Bashar M. Ahmed[*,], Ali Hayder Abdul Kareem[*,***]**
Laith A. Abdul-Rahaim[*] and Anwer Sabah Mekki[****]

[*]Electrical Engineering Department, College of Engineering, University of Babylon, Hilla, Babil, Iraq
[**]Electronic and Communications Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, Iraq
[***]Ministry of Education, Directorate of Education in Karbala, Department of School Building, Karbala, Iraq [****]Department of Medical Devices Techniques Engineering, Al-Turath University, Iraq

E-mail: bashar.mudhafar.1@ced.nahrainuniv.edu.iq, ali_hayder@karbala.edu.iq, drlaithanzy@uobabylon.edu.iq, anwer.sabah@turath.edu.iq

Abstract. - Cloud computing service provides an important and effective element, as it has become a radical change in the field of data analysis, as it provides a powerful and flexible platform at the same time for storing, processing, as well as analyzing huge amounts of data in various fields, especially with the development taking place in the automation of devices and an inspiring source in analyzing or controlling it. Or even collect data from it for deeper insights, and make decisions based on that data more quickly, especially with the development taking place in the field of technology. Cloud computing was used to design a program to collect data, analyze it, and retain the information provided through it, and this works on the principle of the Internet of Things. This information can be published through a website that enables the data to be displayed on the interface of the program, and this information can also be updated and viewed via the website and from a distance through the website. In addition, users registered within the program can access this information. The goal of this proposed project is to ensure data updating and transfer of information to any device connected to the Internet that has access to it and can be displayed within seconds.

The goal of this proposed project is to ensure data updating and transfer of information to any device connected to the Internet that has access to it and can be displayed within seconds. This data is in the form of tables, graphical analysis, and images, and cloud computing is used to upload and update this data, and it is linked Raspberry pi via WIFI at the receiving site, which in turn is connected to a group of sensors that send the required information. A small simulation model was created that collects data for the purpose of analyzing it and taking action on it by monitoring the flow of water in the river level, as it represents basic information for water resources after analyzing the data uploaded about water levels and quality, which represent one of the basic tools in river resource management, which plays a major role in Determine the quality of fresh water that changes over time, and identify water level problems that are continuously measured and controlled. . The high water level of river flow and the potential risks of not controlling the amount of excess water is another major reason to design and implement a river water monitoring system through cloud computing by constantly studying uploaded data and displaying the water levels and quality of rivers with information data sensed through submerged sensors, In this model, ultrasonic sensors and turbidity sensors were used

to measure this collected data, thus maintaining river resources within the permissible level and being able to take measures to return the data to the natural state of low river levels, as well as measure the quality of rivers dynamically during the day when Water carries a certain percentage of impurities that can be accurately sensed by a sensitive turbidity sensor.

The sensor system technology connects to the cloud database and uploads this information directly through a secure connection that can be accessed directly from anywhere and at any time, and the communication between this group of sensors using the cloud service, while the graphical user interface represents the information collected from the sensors.

1. Introduction

Cloud computing was used to design a program to collect data, analyze it, and retain the information provided through it, and this works on the principle of the Internet of Things.This information can be published through a website that enables the data to be displayed on the interface of the program, and this information can also be updated and viewed via the website and from a distance through the website. In addition, users registered within the program can access this information. The rivers are a wide natural waterway on the earth, in which freshwater resulting from rain or water flowing from springs or from water bodies like lakes or any water supply.Geographically, the river starts from the source to downstream of the earth.Where the downstream may be sea,ocean or lake,Therefore,it required to preservation of this resource and good monitoring and controlling on it for any changes that might entail radical reforms.Most of peoples do not imagine the blessing of diapering the sources of river's water and constantly monitoring its movement and its quality every day.Some cases of water wasted due to uncontrol or not monitored periodically,especially in winter.

Therefore, rivers monitoring system [1-4] are to preserve and control these natural resources. Cloud server enables to collect the data without human intervention. In other words, the data are collected, analyzed and monitored remotely from anywhere in the world under a security-protected environment over internet, that will create interaction between the physical hardware (sensors) and cloud computing server and provide the requirements. Cloud server [5,6] is the most promising technology where sensors are connected with each other over the internet where the sensing data are sorted individually from connected objects. A quality and water level sensor [8,9] will monitor by using turbidity and ultrasonic sensor which connected with a Raspberry Pi. And information that is sensed is send directly to Raspberry Pi device, which in turn sends it to the cloud server [10-13]. The purpose is to find the quality in which we need and not exceed the permissible upper limit of flood risk. This prototype that proposed a system which depend on Raspberry Pi [14] parameters in which deals as an open-source hardware, where turbidity and ultrasonic sensors are present the Low power and inexpensive performance. Raspberry Pi has built-in local area network and wireless local area network which can be used to get access to the internet [15-18] in which the collected data store on the cloud server to be access from everywhere and anytime in the world, in which the data directly used and send the collected results to make the desire reports.

The data classified to three different categories, first one is a graph of the latest data information; another one is quality meter of turbidity data; last reading, maximum reading the average data table are the last one for data of one of the rivers out of the rest(six rivers)which can be later used by main control system environment.

Organization of the paper is will be displayed in sequence below. Section 2describes the related work of the research. Section 3describes the model and block diagram of the system that proposed for monitoring the rivers. Section 4describes the hardware components of the system,cloud database server and the graphical user interface that used. Section 5is the conclusion.

2. Related work

In 2015, Vijayakumar and Ramya [19] Presented a system that is designed and development base on low-cost monitoring system in real time data according to the collected data for water quality based on internet of things (IOT). Different sensors are connected together to measuring different parameters such as physical water parameter and chemical water parameter. These parameters are temperature, conductivity, PH, dissolved oxygen and turbidity that measured for the water sample. Raspberry Pi b+ used with these different sensors which measured different parameters even though the Raspberry Pi make controlling on these sensors where the internet of things is used also that present low cost, reliable and an efficient capable for delivering and analysing the data, also on the end of view, sending and displaying the data on the cloud server via WiFi (wireless fidelity) to the mobile.

In 2017, Gunde et al. [20] proposed a system that used for large campus, the proposed system for management the distribution of the water which is based on internet of think (IOT). This system developed for multi-level of the water where the water pump automatically starts and then stops. The results reveal that the collected data that obtained are helped to predict the next values of using the water as a period of time. For a while the water pump takes an action as a step of the water. Another features that by using web application which is developed to get an interaction between the water pump and the end user which help the last to indicate the next value that present in the future.

In 2018, Lee et al. [21] Integrated internet of think (IoT) technology at the home in a simple open source [21] computer device This creates an interactive environment by reducing work on humans, which takes much time and effort from him, which is an integrated, independent system or automation system. Raspberry Pi used in the proposed system with different sensors connected with creates an interactive environment by reducing work on humans, which takes much time and effort from him, which is an integrated, independent system or automation system. Raspberry Pi used in the proposed system with different sensors connected.

In 2019, Kapoor and Barbhuiya [22] proposed a smart system that based on cloud storage functionality by using Raspberry Pi for collect the data of the weather where the Raspberry Pi device used for processed these data and send it to the cloud server to store it. The sensors indicate any abnormal situation and directly connected with Raspberry pi device which is also base with the internet of think (IOT). The proposed system represents as data information. Raspberry Pi used with these different sensors which measured different parameters even though the Raspberry Pi make controlling on these sensors where the internet of things is used also that present low cost, reliable and an efficient capable for delivering and analysing the data. The using of Raspberry Pi board is more attractive due its impact size and much more reliable and simple installation device.

In 2019, Rahman et al. [23] proposed an intelligent patient monitoring system that automatically screens the patient's health condition through various sensors. The data is then processed using a Raspberry Pi and useful information is saved to the IoT cloud. The result

provided a constant health monitoring facility for the patients who are in the ICU or bedridden at home remotely from any place. Sensor and digital thermometer are the two sensors that have been used to allow real-time monitoring of sensor signal and temperature of the patient.
In 2022, Venkatesh S Kumar et al. [24] studied an IOT- based digital display using a raspberry pi which has been proposed to ensure the updating of data and the output displaced in any internet connected devices so it can post through a website and the data can be viewed on a digital notice board. From a distance, notice can update the through the website and additionally, registered users receive notifications on their android phone. Notice board is a typical instrument that is used to display important data. The data is usually in the format of texts and images and PC is used for storing and send information with Raspberry pi that linked via WIFI at the receiving position.
In 2023, K Vijay et al. [25] proposed an intelligent Raspberry Pi to access all people data from any devices that connected to the system based on cloud-based for channels of communication between the Raspberry Pi and the device are possible. The result provided VNC (Virtual Network Computing) cloud to connect with Raspberry Pi remotely and use the device that's attached to the Pi from anywhere in the world. When it comes to keeping tabs on and managing your gadgets, remote control systems are invaluable. When it comes to remote accessing graphical displays and sharing Android applications, VNC system by far of most popular tool that designed for remote desktop access via mobile VNC.

3. Proposed system architecture

In this section the data collects, stores it and analyses in cloud server in real time. Ultrasonic sensor is used to collect the water level of multiple rivers data by using ultrasound through calculating the speed of sound (in which 340 m/s in the air) and dividing it into two, and through the going and coming (Triger and echo) time, we can get the water level of the rivers during this period. Another scenario by using turbidity sensor that immersed to collect the quality of the water through attaching the flow water of each river.
The aggregated data is uploaded as separated data, each one of them represent a data collect which are analyzed automatically and separately. Figure 1 shows architecture diagram of the proposed system.

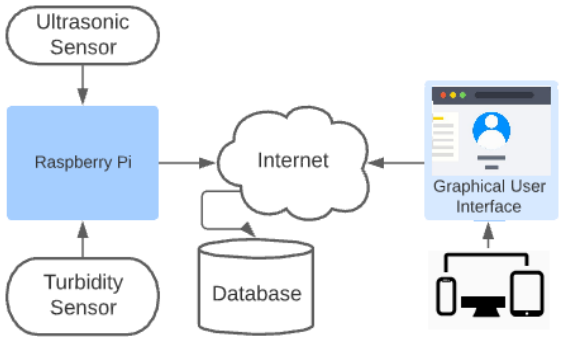

Figure 1. Architecture diagram of the proposed system.

The connections hardware of the proposed system made as the desire requirement for the river situation. In the meantime, two different sensors is connected to the Raspberry Pi which represents the link between the cloud server and the information of the river to be collected, one of them being the ultrasonic sensor for water level and another one is turbidity sensor for

check the quality of river's water Figure 2. shows the Raspberry Pi device and hardware proposed architecture:

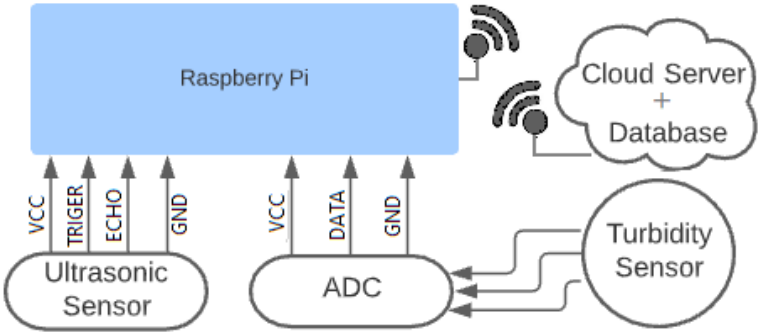

Figure 2. System device hardware.

The Raspberry pi represents the link through which it can be linked the turbidity sensor with VCC, GND and Data signal port. The GND port of the turbidity sensor connected directly with the GND pin of Raspberry Pi interface board, meanwhile the power pin VCC of the turbidity sensor connected with 5V power pin of Raspberry Pi interface board and more also the output signal pin data of the turbidity sensor connected with the General-Purpose Input/Output (GPIO) 2 pin of interface board for the Raspberry Pi device. Similarly, ultrasonic sensor has also GND pin port which is connected directly to the Raspberry Pi through GND pin port of interface board, meanwhile the power port VCC of ultrasonic sensor connected with the 5V pin of interface board for Raspberry Pi, on the other hand ultrasonic sensor has Triger and Echo ports which connected to the GPIO 23 and GPIO 24 pins respectively, of the interface board for Raspberry Pi.

Figure 3. Shows the ultrasonic sensor (HC-SR04) send sense data directly to the GPIO port of Raspberry pi where the sense data is also directly sent to the cloud via local network that connected with the internet to processed and analyses. Ultrasonic sensor working with 5v voltage that can be supplied by the Raspberry Pi, while the high output from the sensor will also be 5v which could effected on the GPIO port of the interface board for Raspberry Pi; For this reason voltage divider circuit is used with half feedback to prevent any damage in the interface board for Raspberry Pi by reduce the voltage which get from the sensor to the Raspberry Pi within the operating range (below 3.3v), also 40KHz of frequency is used (twice the frequency that the human ear can hear). Water level calculated from the distance between the ultrasonic sensor and the surface area of the river where the ultrasonic pulses travel along this distance then reflected back to the sensor according the equations below

$$\text{Speed} = \text{waterlevel} / \text{time} \quad \ldots\ldots (1)$$

$$340\ \text{m/s} = 2 * \text{waterlevel} / \text{time} \quad \ldots\ldots (2)$$

$$\text{waterlevel} = 170 * \text{time} \quad \ldots\ldots (3)$$

On the other hand, turbidity sensor measured the quality of the water from detects the scattering light due to the particles that are suspended in the river light that scattered by particles suspended in water. This measurement of the suspended amount of particles that is found in the river which can be used to monitor the quality of the water in NTU (Nephelometric Turbidity Unit), the sensor generates an output voltage proportional to the turbidity which changes with the total amount of suspended solids in water that flows in the river.

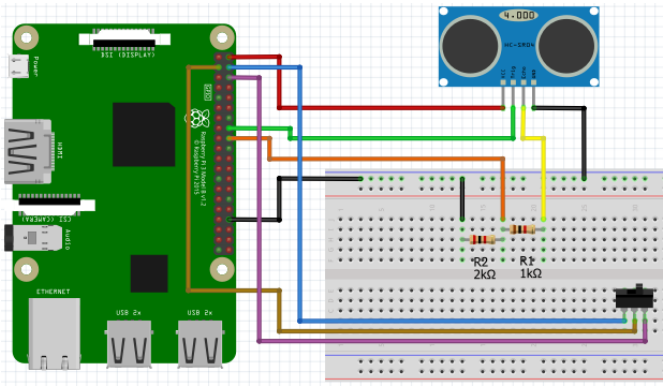

Figure 3. Ultrasonic and turbidity sensors.

The collected data gets checked and sends directly to the database via the internet. Data are collected for both sensors to plot it as a graph and quality meter, as well as collected in the form of information organized in a table.

The Raspberry Pi containing 2.4GHz and 5GHz wireless LAN that connected to the database (firebase which Google's platform) by using Python language which is simple, dynamic and reliable language with vast variety of libraries. Database use a JavaScript Object Notation (JSON) format to communicate with Python file to stores the collect data structures, JSON file is a standard data interchange format. This format is primarily used to transmit any data between the web application and the cloud server.

Cloud database can be described as a collection of informational content, that can be categorize as a private, public or hybrid cloud computing infrastructure platform. Meanwhile this porposed system use public cloud that operates on the own business on-premises servers. Google creating a Firebase as a platform for web and mobile applications which has the ability to transfer and display data in real-time form that is limited band for free small business while it will be pay as you go for blaze plan. See Figure 4.

Figure 4. Google Firebase platform.

4. Experimental hardware setup

As explained previously, Figure 5 shows the turbidity sensor connections with the Raspberry Pi and immersed inside the water. Turbidity sensor has an analogue signal output, so analogue to digital converter (ADC) is used to gives digital input to Raspberry Pi. Turbidity sensor measured the quality of the water for the river from detects the scattering light due the particles are suspended in the river. This measurement is the amount of suspended matter in water which

can be used to display the quality of the water that flows in the river, the sensor generates an output voltage proportional to the turbidity which changes with the total amount of suspended solids in water that flows in the river.

Figure 5. Connection of turbidity sensor to Raspberry Pi.

The connection of the ultrasonic sensor shown in the Figure 6. It is digital sensor which senses the level of the water that must be fixed at the top of the river to detect the river water level chich sense any variation in water level. Ultrasonic sensor working with 5v voltage that can be supplied by the Raspberry Pi, while the high output from the sensor will also be 5v which may effective on the GPIO pin on the interface board of the Raspberry Pi (where Raspberry Pi can read or write the data); So that voltage divider is used to prevent the high voltage from the sensor to the Raspberry Pi by reduce it within the range and the frequency that used around 40KHz (twice the frequency that the human ear can hear). Water level calculated from the distance between the ultrasonic sensor and the surface area of the water where the ultrasonic pulses travel along this distance (Triger signal) then reflected back to the sensor (Echo signal).

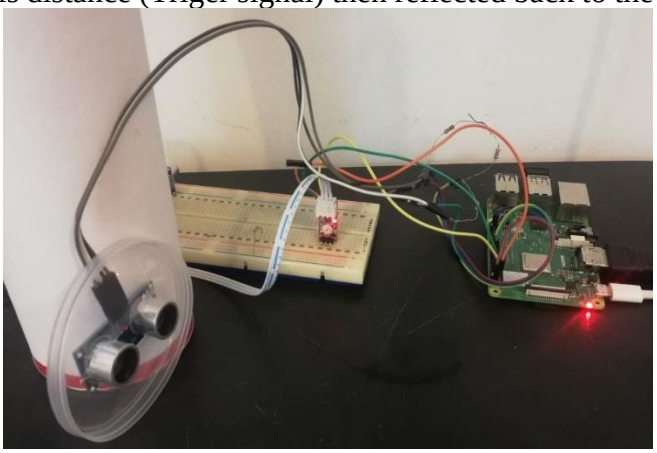

Figure 6. Connection of Ultrasonic sensor to Raspberry Pi.

The connection of two sensors (Turbidity and Ultrasonic) are shown in the Figure 7 below. All the sensors in this scenario are indicate the quality and measure the water level of the river. ADC is used to gives digital input signal to Raspberry Pi from turbidity sensor.

Figure 7. Connection of turbidity and Ultrasonic sensor to Raspberry Pi.

Figure 8. shows the data reading is displayed in the terminal (Command Prompt) of the Raspberry Pi monitor. It is shown the data measuring continuously in real-time for water level and water quality. Also, it is sending these data to cloud real-time database (firebase) that can be monitored as Figure 9.

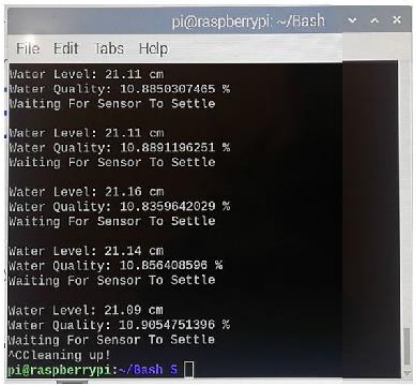

Figure 8. Output results (quality and level of water) of the two sensors.

Figure 9. Database collect results of the two sensors (quality and level of water).

The website built in html and JavaScript language that displays in Figure 10 with six drawings that represent six different data rivers of graph with real-time result of water level, quality meter of the water and table for last, maximum and average reading result. The website represents the information reading from the sensors which is stored in the database.

Figure 10. Website data results for six rivers.

5. Conclusion

Nowadays, the care of water sources became easier with the cloud database through which it is possible to easily monitor these rivers periodically and from anywhere without restricting them to one place. to be continuously analyzed and purified in order to make it as clean water to continuously analyze and monitor it to preserve water. This paper focus on analysing the quality and level of river water. Water level determined by considering the distance of surface of the river and ultra-sonic senor through knowing the real depth of the river, that is, by subtracting the distance between the ultra-sonic senor and the surface of the river from the distance between the ultra-sonic and the river bed. The proposed system sends the data to cloud database by Raspberry Pi parameters for stored and analyse it based on the collected data. The data values display through website that can open from any authorized web access device.

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