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Water Monitoring and prediction analysis for Mosul City Using IoT

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***Abstract*—** Mosul is one of the cities of Iraq, which was attacked by fierce terrorist organizations called ISIS since 2014-2017 destroyed all the infrastructure of the city. After liberation the city from ISIS by the Iraqi forces had to return to normal life and repair all the destroyed topic of the city. The most important of these topics is for return drinking water and elimination of water pollution by testing and monitoring the water in real time with modern technology to use the best drinking water in addition to reach Mosul city as a smart city. In this paper, designed and implemented the proposed system by using internet of thing with low cost and instant results for the purpose of testing drinking water in real time for many important parameters of the water, such as Temperature, pH, TDS, Turbidity, and Conductivity,. Each parameter can be measured by the sensor. All these sensors connected to the Arduino UNO model can be used as a core controller and send the data to the internet through the Wi-Fi module (ESP 8266). Finally, the sensor data can be viewed on the internet using ThingSpeak API for the purpose of collecting information, analyzing and sending it for display on LCD or Mobile or Laptop. The results were compared with laboratory results in the "Right water project/Mosul". The proposed system was very powerful, short time to execute, very cheap, and highly efficient. The results for the proposed system is approximate to the Laboratory results by 98.6 %.

***Keywords*—**drinking water, water pollution, ThingSpeak, Arduino UNO, internet of thing.

I.INTRODUCTION

The problem of pollution in water is very increasing in Iraq in the last time. Many dams were built by neighboring countries on the Tigris river, led to reduce the water resources and

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increasing pollution in water. For this reason, the water needs to process more testing in the water projects to measure the water quality. All these projects test water manually on a daily basis by using many devices, more time consume and high effort to obtain the results. In the markets available more modern devices to measure water quality but it is very expensive. In this paper proposed the system to test the water instantly with low cost and very quickly by using the internet of things (IoT) and Arduino UNO. The IoT could turn out to be a standout amongst the most imperative techniques for growing greater utility-legitimate frameworks and for making the utilization of water assets more effectively. This paper will measure the value of Temperature, pH, TDS, Turbidity, and Conductivity of the water and finds whether the water is suitable for normal use. Each sensor needs to evaluate the coordinate by using GPS to measure the Latitude, Longitude, and Elevation.

II.LITERATURE SURVEY In 8102 designed and implement water monitoring in a project at municipal water tanks and drinking water reservoir. by using an Arduino for finding pH value and GSM module to send message technique. It used led display to have a continuous observation of water parameters in addition to get the user message of pH value of water. This project extends by sending the sensor data to the cloud to measure water quality [1]. In another paper, it studies water monitoring by using IoT in many parameters PH, water flow and soil moisture. It used ESP8266 Wi-Fi module based Smart Irrigation to send and receive information to the website through internet [2]. In another case, study to design and development control system water for monitoring to reduce the current water wastage problem by using rising technologies and IoT is one of them. For this reason many sensors used for sending data to the ESP8266 Wi-Fi module then to the cloud to collect and analysis the that used by the users to solve the problem related [3]. In other studies, IoT together with the Sensor water meters for the effectiveness, to measure the quality of water. It executing, the system for monitoring the water through different sensors turbidity, pH, temperature, conductivity. The controller accesses the information which is monitored by the use of sensors. The accessed data are controlled by the usage of Arduino controller. By using an IoT, the information is collected and the water

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pollution can be enquired, by a strict mechanism. This system states an alert to the public and concerned subdivision or unit about the water. The atmosphere can have adaptable good water[4]. In this paper designed and implemented the proposed system to monitor water quality by using IoT and Arduino UNO to test the drinking water used may sensors (PH, Temperature, pH, TDS, conductivity and Turbidity) of the water can be measured. To evaluate the results and gives more effective compared with the laboratory results of "Right water project/Mosul". All the results is collected and analyzed by ThingSpeak platform. The function for the ThingSpeak is implemented in MATLAB to display and read all the information about the results.

A. IoT IoT systems permit users to attain deeper automation, analysis, and integration inside a system. They improve the reach of those areas and their accuracy. IoT utilizes existing and rising technology for sensing, networking, and artificial intelligence. IoT exploits recent advances in software system, falling hardware costs, and fashionable attitudes towards technology[5]. Its new and advanced components bring major changes within the delivery of merchandise, goods, and services; and also the social, economic, and political impact of these changes. the foremost necessary options of IoT embrace computing, property, sensors, active engagement, and tiny device. the benefits of IoT span across each space of lifestyle and business[4]. Here may be a list of a number of the benefits that IoT must offer:

- Improved Customer Engagement.
- Technology Optimization.
- Reduced Waste.
- Enhanced Data Collection.

Though IoT delivers an impressive set of benefits, it also presents a significant set of challenges. Here is a list of some its major issues:

- Security.
- Privacy.
- Complexity.
- Flexibility.
- Compliance.

B. ThingSpeak ThingSpeak is a free web service that lets you collect and store sensor data in the cloud and develop IoT applications. The ThingSpeak web service provides apps that let you analyze and

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visualize your data in MATLAB, and then act on the data. Sensor data can be sent to ThingSpeak from Arduino, Raspberry Pi, BeagleBone Black, and other hardware. It requires a user account and a channel. A channel is where you send data and where ThingSpeak stores data. Channels store all the data that a ThingSpeak application collects. Each channel includes eight fields (field 1- field 8) that can hold any type of data, plus three fields (Latitude, Longitude, and Elevation) for location data and one for status data (show status). Once you collect data in a channel, you can use ThingSpeak Apps to analyze and visualize it. The Latitude and Longitude are specify the position of channel in decimal degrees, but the Elevation specify the elevation position of the channel in meters. Each field custom to store type of sensor like temperature, PH,….etc.

PARAMETER OF WATER.

A. Temperature. The sensor of temperature used for mensuration the temperature of water. This can be shown in Fig. 1. Once the correct measuring is required, continually|. Always take into account the temperature. the rise in temperature of water will increase the ionization rate. as an example pH and conductivity changes with the change in Temperature. pH concentration is temperature dependent, once the temperature goes up, the speed of ionization will increase and the other way around. Temperature plays a significant role once mensuration water quality[5].

B. pH. The pH is that the live of the acidity or pH scale of that solution. The pH concentration may be an ordered series whose vary is from 0-14 with a neutral purpose being 7. Values higher than 7 indicate a basic or alkalescent solution and values below 7 would indicate an acidic solution. the bulk of aquatic life prefers a pH level of 6.0 – 9.0. something outside of this optimum vary is taken into account fatal to the marine system. Extreme pH values additionally increase the solubility of parts and compounds creating them hepatotoxic and so additional probably to be absorbed by marine life. what is more, the temperature has Associate in an inverse relationship with pH that's, as the temperature will increase pH levels decrease and the other way around[6].

C. Electric Conductivity(EC). Conductivity signifies the ionic strength of a solution. In alternative words, it's the flexibility of a solution to conduct

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electricity with the everyday unit for mensuration being micro-Siemens per centimeter (uS/cm). because the dissolved ions increase within the water, conduction will increase. Therefore, the conduction of water is noticeably low at around 100 uS/cm. On the opposite hand, expected values for sea water square measure 55000-60000 uS/cm thanks to its high ionic content. any longer increase within the conduction worth is also indicative of impure waters, like sewer leaks or chemical wastes flooding into the water. Moreover, conduction is directly associated with salinity that's conduction improves with high salinity. conduction values outside of the optimum levels indicate a potentially negative situation. The Dead Sea may be a prime example of deadly concentrations of salt. The temperature relation with conduction may be a proportional one. A general assumption of a temperatureconductivity relation is taken to be linear in nature with a deviation of 2% °C[7].

D. Total dissolved solids(TDS) TDS refers to any minerals, salts, metals dissolved in water. It comprise in organic salts and a few little amounts of organic matter that are dissolved in water. TDS detector that is compatible with IoT Device, plug and play, simple to use. The TDS probe is waterproof, it is often immersed in water for while activity. This detector are often utilized in water quality application, like domestic water, tank farming. With this detector, you'll simply a TDS detector to replicate the cleanliness of water to shield your health[7].

E. Turbidity Turbidity is that the live of variety of particles within the water. we have a tendency to used muddiness Sensor for mensuration the muddiness. muddiness is measured in Nephelometric muddiness Units (NTU). it's taken because the optical property of water Associate in nursing is an expression of the quantity of the sunshine that's scattered by the suspended particles within the water once a light-weight is shined through the water sample. because the intensity of scattered light-weight is inflated, the muddiness will increase. During the amount of low flow, several rivers ar a transparent inexperienced color, and muddiness is low, typically but ten NTU. throughout rain, floods, water flows quick and mixes with the various particles, that makes the muddiness of water high. muddiness is that the live of variety of particles within the water. we have a tendency to used muddiness Sensor for mensuration the

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III. PROPOSED SYSTEM

The proposed system is used for monitoring water by using many sensors for each parameter of water connecting to the Arduino UNO as a controller to read all the data from the sensors process to send the information to the ThingSpeak by Wi-Fi module (ESP 8266). ThingSpeak collects the data and analysis by MATLAB for sending data to the user for displaying (LCD, Mobile, and PC). The block diagram for the proposed system as shown in Fig. 1. The steps of the proposed system used in this paper is shown in Fig.2.. At the start needs to enter the Thing speak site to Create new channel by giving the name (ID) and put the felid 1-5 by the parameters of water (pH, TDS , Turbidity, EC, and Temperature). By using GPS measure the Latitude, Longitude, and Elevation for the position of the channel (the place of sensors). After complete all the information, the ThingSpeak site gives the API key to read and write.

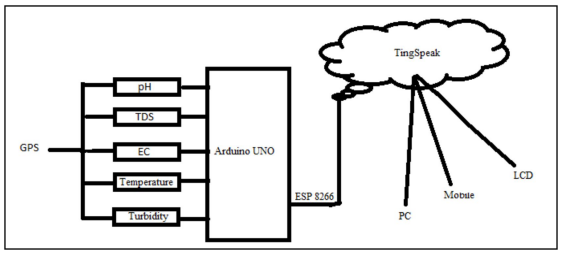

Fig.1 The proposed system.

The channel ID and the API key is very important values to put in the MATLAB function. In this state, ThinkSpeak is ready to receive the data from Wi-Fi module, for this reason initialized all the sensors, all the sensors send the data to the Arduino for processing the data and sending to the internet through the Wi-Fi module (ESP 8266) to the ThinkSpeak. The ThinkSpeak collect, store and analyze the data to send the results through the internet to the display devices after run the code of MATLAB ,the program starts reading the

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API key and channel ID then send the data as a graphical plot.

IV. RESULTS

For the purpose of presenting the laboratory results and the results obtained from the proposed system, it is necessary to know the Iraqi determinants of river maintenance from pollution no. 25 on 1967 issued by the Ministry of Environment, which is adopted by the "Right water project/Mosul". This determinants as shown in Table 1.

TABLE I. THE IRAQI DETERMINANTS OF RIVER MAINTENANCE FROM POLLUTION `

NO.	Type Of Test	Symbol	determinants
1	Temperature	C^0	Less than 35
2	power of hydrogen	pH	6-9
3	Electric Conductivity	EC	400 uS/cm
4	Turbidity	Turb	(10-18) NTU
5	Total dissolved solids	TDS	1500 mg/L

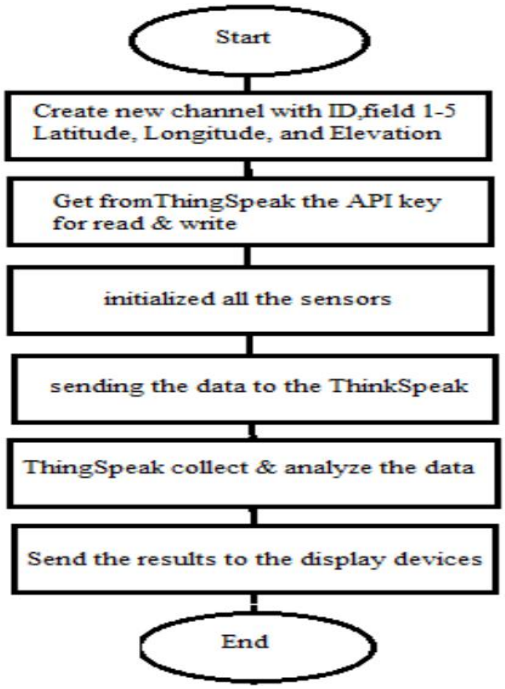

Fig.2 The steps of the proposed system.

The laboratory results for the five parameters as shown in Table II

TABLE II. THE LABORATORY RESULTS.

Date	C^0	pH	EC	Turb	TDS
15/9/2018	>30	8.1	390	12.5	294
16/9/2018	>30	8.0	330	14	302
17/9/2018	>30	7.9	364	6.5	299
18/9/2018	>30	7.7	400	3.6	238
19/9/2018	>30	7.9	385	8.0	263
20/9/2018	>30	7.7	390	5.0	246
21/9/2018	>30	7.6	402	8.6	265
22/9/2018	>30	7.6	395	6.2	241
23/9/2018	>30	7.7	405	7.0	299
24/9/2018	>30	7.8	402	2.6	240
25/92018	>30	7.6	381	9.5	226

The results of the proposed system as shown in Table III. The results of the proposed system is very efficient and approximately to the laboratory results by 97.6% .for this reason the proposed system is very useful in the practical life instead of manually test for the laboratory station. The graphical results obtained by the Thinkspeak observe by sign in the ThinkSpeak site by user name and password to display the graphical results. The graphical results as shown in Figures3-6. The temperature parameter is not used in this paper because the temperature in September is less than 30 C^0 , but if increase the temperature more

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than 30 C^0 then this parameter is very effected to the other parameters

TABLE III THE PROPOSED RESULTS

Date	C^0	pH	EC	Turb	TDS
15/9/2018	>30	7.91	381.1	12.2	288.5
16/9/2018	>30	7.808	322.1	13.73	298.7
17/9/2018	>30	7.701	355.3	6.344	291.9
18/9/2018	>30	7.51	391,1	3.55	232.97
19/9/2018	>30	7.702	375.76	7.89	256.86
20/9/2018	>30	7.52	380.65	4.88	243.1
21/9/2018	>30	7.42	392.65	8.394	258.64
22/9/2018	>30	7.42	385.54	6.1	235.5
23/9/2018	>30	7.52	395.4	6.95	291.9
24/9/2018	>30	7.62	392.361	2.543	234.34
25/92018	>30	7.41	372.1	9.28	220.67

Fig. 3 The graphical results for pH

Fig. 4 The graphical results for TDS

Fig. 5 The graphical results for Turb

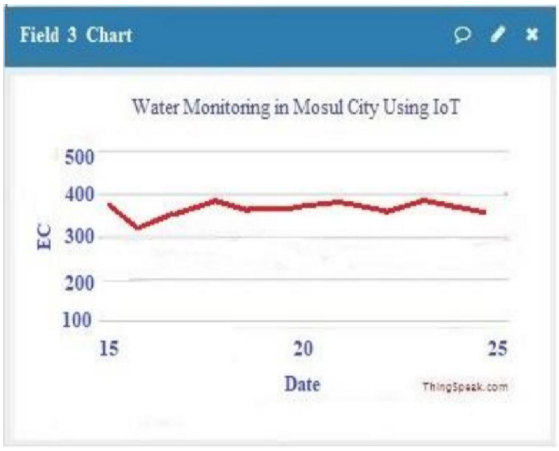

Fig.6 The graphical results for EC

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