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Sensor Based Water Quality Monitoring System

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A THESIS

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To My Parents and Siblings……………

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ABSTRACT

According to Human Rights Watch, twenty million people in our country are still drinking water contaminated with arsenic. The World health Organization (WHO) has also stated this crisis as "the largest mass poisoning of a population in history". To reduce the water related diseases and prevent water population, we have to measure water parameters such as ph, turbidity, conductivity, temperature etc. Traditional methodology of water monitoring requires collecting data from various sources manually. Afterwards samples will be sending to laboratory for testing and analyzing. In order to save time consumption and decrease manual effort my testing equipments will be placed in any water source. As a result this model can detect pollution remotely and take necessary actions. The main goal of this paper to build a Sensor- based Water Quality Monitoring System. Arduino Mega 2560 act as a base station and data from sensor nodes will be send to it. For the academic purpose, this paper presents a small prototype of sensor networks consisting of temperature, water level, flow and ph. Then ph and temperature sensor values were sent cloud platform (ARTIK cloud) and displayed as a graphical representation on a local PC. Moreover GSM shield (SIM808) is connected to Arduino Mega which compares sensor values to threshold values and sends a text alert to the agent if the obtained value is above or below the threshold value. The results of this project are discussed in the result section of the paper. We tested three water samples from three different water sources (such as industrial water, tap water and swimming pool water). Three water samples collected from three different swimming pools.(Except one sample) Ph value found in rest of the samples were in normal range (temperature value between 26-27'C). Result section (in page 20) explains our project findings in details.

Chapter 1

INTRODUCTION

1.1 **MOTIVATION**

Environment around us consists of five key elements. These are soil, water, climate, natural vegetation and land forms. Among these water the most essential element for human to live. It is also important for the survival of other living habitants. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is must for public health. So it is highly imperative for us to maintain water quality balance. Otherwise it would severely damage the health of the humans and at the same time affect the ecological balance among other species.

In the 21st century providing pure drinking water is becoming a major challenge worldwide. International governing bodies such as United Nations (UN) and World Health Organization (WHO) also recognized human right to sufficient, continuous, safe, and acceptable, physically accessible, and affordable water for personal and domestic use. According to research of WHO 844 million people lack even a basic drinking –water service, including 159 million people who are dependent on surface water. Impure drinking can cause life threatening disease such diarrhea, cholera, dysentery, typhoid, and polio. The research alarmingly estimates that every year diarrhea alone is causing around death of five lakh people**.** Figure 1 illustrates how water crisis becoming an epidemic in twenty first century.

Now a day's Internet of things is a revolutionary technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. Internet of things integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. Though internet of things is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide and avalanche etc. Moreover it can be implemented in the field of water quality monitoring and controlling system. We can design a water quality monitoring system in smart city where there will be a network of devices connected to remote stations and the parameters from the water sources will be stored in a microcontroller via WSN. City dwellers can easily get notified about of the quality of the water via SMS or they can view it on webpage and also local authority can take necessary actions.

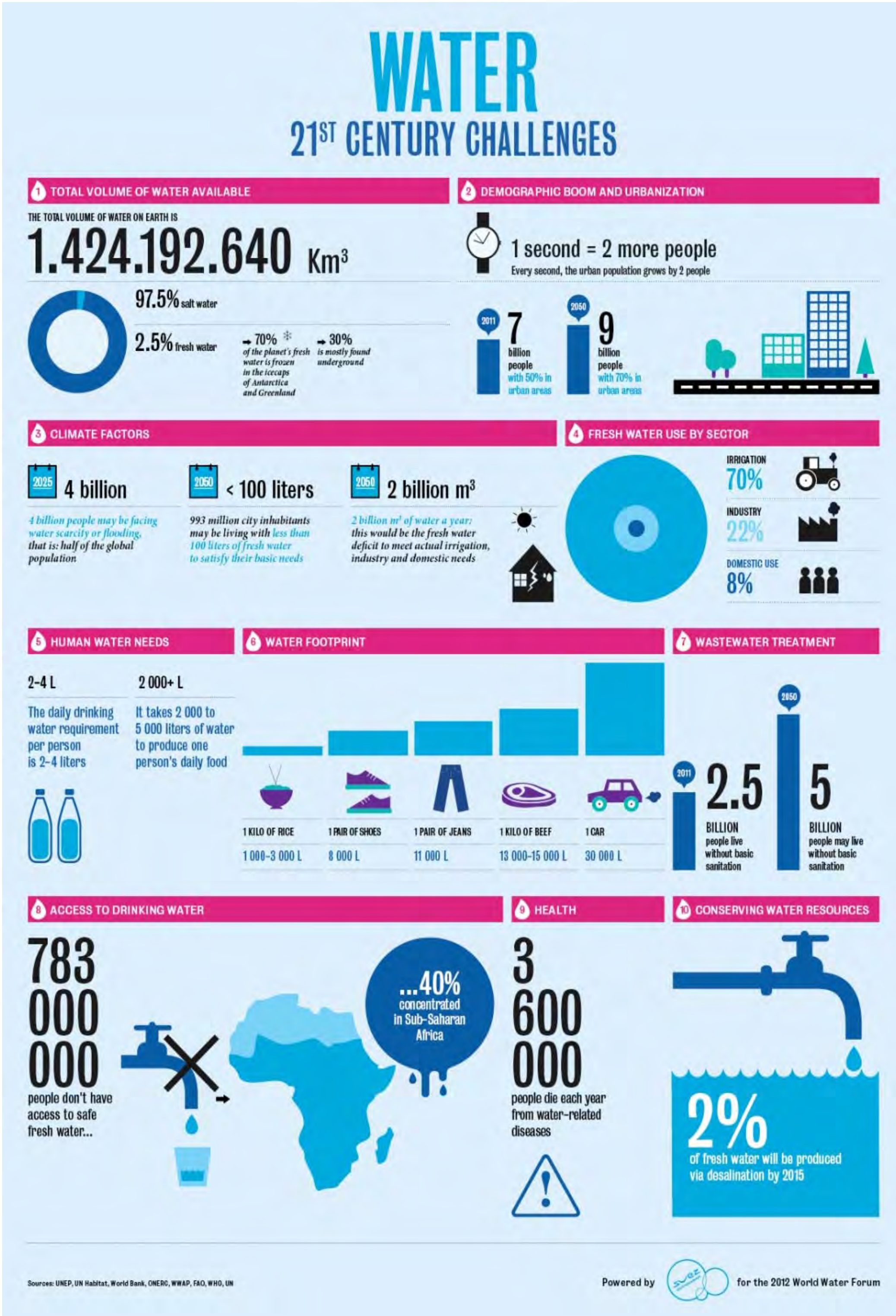

Figure 1: Water 21st Century Challenge (courtesy of World Water Forum).

In the context of Bangladesh rural area is mostly expose to water pollution. As we can see from **Figure: 2** among all the pollutions in Dhaka city, water pollution is the most contiguous. My motivation for doing this project is to design a prototype which will be feasible and cost effective for poor people. This way I can contribute to my countries development and enrich my knowledge in the field of internet of things. There is no better incentive than saving a children's life and ensure him or her healthier life.

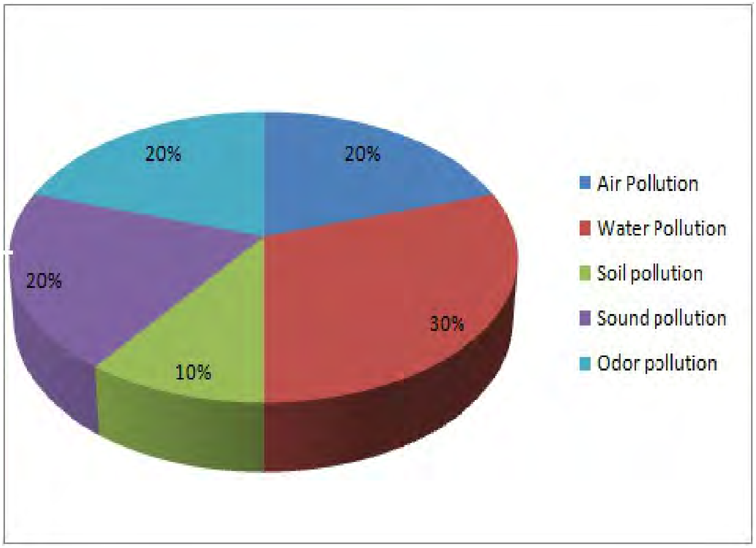

Figure 2: Statistical representation of pollution in Dhaka city (Courtesy of pollutionindhakacity.weebly.com).

The main aim of this project is to develop a real time internet of things based small scale, cost effective prototype with the help of available sensors.

1.2 Objective

The population of our world is growing rapidly and percentages of drinkable water sources are dropping down very fast. As a result of that meeting the need of ever growing people, major water sources like rivers, ponds, seas, canals etc are being filled up and large industrial in fractures are made. According to World Health Organization (WHO) by 2025, half of the world's population will be living in water-stressed areas. For the developing country like Bangladesh, where people cannot afford high cost water purifier this system can provide affordable solution to water crisis.

1.3 Thesis Outline This paper is summarized as below:

i) The first section gives overview of internet of things, a brief introduction of water population and previous work done in this field.

ii) The next section describes system architecture, hardware implementation and software part.

iii) Last section describes results of this experiment, further work scope in this field, conclusion and references.

Chapter 1

LITERETURE REVIEW

Water quality monitoring has gained more interest among researchers in this twenty first century. Numerous works are either done or ongoing in this topic focusing various aspects of it. The main theme of all the projects was to develop an efficient, cost effective, real time water quality monitoring system which will integrate wireless sensor network and internet of things. A brief digest of previous works in this field is given bellow.

Nasser, Ali, Karim and Belhaouari (2013) [52] proposed paper institute and developed a self-configurable, reusable and energy efficient WSN- based water quality monitoring system. Existing frameworks though have the applicability in water monitoring system, cannot be reused in other monitoring applications because of its static nature. Moreover this dynamic framework also improves the network life time, monitor the water quality real time, and store the information in a portal.

B O'Flyrm, R Martinez, J.Cleary, C.Slater, F.Regan, D.Diamond and H. Murphy (2007)[8] developed a multisensory system measuring water parameters such as temperature, dissolved oxygen, conductivity, ph, turbidity, phosphate and water level for water quality monitoring. The market demand for novel, miniaturized, intelligent monitoring systems for freshwater catchments, transitional and coastal waters is high very across worldwide. Moreover they also work on building custom sensors and integration of Tyndall based integrated sensor network.

Yue and Ying [7] presented novel system architecture of distributed sensor nodes and a base station which collects real –time sample from different field sites. They used wireless sensor network for collecting data and solar power panel for power supply. Low CO2 emission, low power consumption and flexibility are few notice worthy pros of this system.

Barabde and Danve (2015) [20] paper presented three layers of system architecture of water quality monitoring system. Those three are nodes for data monitorization, a base station and a remote station. They connected all the layers with wireless communication protocol and data being send to the base station from data monitoring nodes via microcontroller. Collected data was displayed on a local host PC. Matlab was used to create a GUI (graphical User Interface) for data visualization and water parameters such as ph, turbidity, conductivity were displayed. If the compared value exceeds standard value a SMS will be sent to the client.

Kamble, Kakade, Mahajan and Bhosale worked on arduino based mechanized water quality monitoring system.

Wang, Ma and Yang (2011) [19] focus on theoretic issues such as routing algorithm, network lifetime, and so on and apply wireless network into online zigbee and GPRS based water monitoring system. Data transmission was done by zigbee protocol and data collected by GPRS shield. MySQL was employed in the database side.

Yazhini and Maruthi (2017) proposed model showed us how internet of things platform can be used for water management. Remote Sensing techniques and Internet of things can be applicable for wider spectrum of research domain for monitoring, collecting and analyzing data.

Rao, Marshal, Gubbi, Palaniswami, Sinnott and Pettirogrove [51] in their research, a low cost wireless sensor network for sensing physical and chemical parameters is proposed. This system observes the behaviors of aquatic animals due to water population using data analysis.

Zhenan, kai and Bo (2013) developed an intelligent system combining remote sensing technology and control applications. In this system they monitored and controlled river and lake water quality. They overcome the technical challenges such as sensor selection and control over wireless network by adopting appropriate algorithm for system design.

Wadekar, Vakare and Prajapati [10] in their paper, design a system to limit the usage of water. They set up this system in residential societies and continuously monitor the level of water tank. Home owner will install an android application in his smart phone for getting regular information of water level. The data will be stored on the cloud and if he or she is connected to Wi-Fi then he or she will have access to data. There will be a motor submerge into the tank and according to the level of water and requirement it can be switched on or off.

N.Vijay Kumer, R Ramya [2013] [40] developed a system for real time monitoring of the water quality parameters. In their research they measure the water parameter such as turbidity, conductivity, temperature, ph and dissolved oxygen. Instead of arduino they used the raspberry pi b+ model as core controller and send the sensor data on cloud platform.

Rajurkar C, Prabaharan and Mutulakshmi in their project monitor the usage of water in a flat system. In the flat system pipelines generally diverted into different blocks. In their study they consider one particular block and place a flow sensor at each pipe which gives the usage of water at one block ideally. This way they minimize the wastage of water and prevent the domino effect cycle arises as wastage of water. The residence will have a mobile application installed in their phone and they will get real time reporting of water used. The data will be send to cloud platform and it will be used as a statistical data for use of water at every seasons that is winter, summer and monsoon.

Brinda D and Jain P.C. [50] in their paper designed a wireless sensor network using zigbee module. This module transfers the sensor data wirelessly to the microcontroller. Then a GSM module sends that data to the pc or smart phone. Additionally they used proximity sensors to alert the regulatory body by sending a SMS via GSM module in case someone tries to pollute the water body.

Cloete, Malekain and Nair [43] in their paper they designed and developed a water quality monitoring system which measures the physicochemical parameters of water such as flow, temperature, ph, conductivity, and the oxidation reduction potential. They detect the contamination of water by measuring the parameters and then send notification to the user. Sensors are connected to a microcontroller- based measuring node which processes and analyzes the data. In their paper, they used a zigbee transmitter and receiver module for communication between the measuring and notification nodes.

In our project, we work on developing an automated arduino based water quality monitoring system. We proposed a model where sensors are connected to arduino. Thus sensor values are sent to a core micro controller and displayed on a LCD. Arduino is also interface with GSM module in order to send text notification to user.

Chapter 3

Water Monitoring System: Model and Implementation

3.1 Proposed Model

We proposed a water quality monitoring system based on internet of things. Water properties can be **physical** (temperature and turbidity), **chemical** (ph and dissolved oxygen) and **biological** (algae and phytoplankton). In the proposed system, physical and chemical properties of water in different water sources such as drinking water, swimming pool water, water bodies inside Dhaka city and industrial waste water are investigated. In this research, we monitor physical and chemical parameters of the aforementioned water sources by using an internet of things based sensor network. This section composed of two different parts. In first part, a brief overview of the whole system is presented. In the second part, system design will be discussed descriptively. The second part includes both hardware implementation and software.

System architecture: In this project a prototype of water monitoring system is presented. You will get overview of system prototype bellow (**Figure.3**). A microcontroller is used as a sensor node which stores real time data and sends the data to the cloud storage via Wi-Fi. There is also a GSM shield connected to microcontroller which sends the text notification to mobile device. Http protocol transfer the data to cloud and a webpage running on a local host server displays the result.

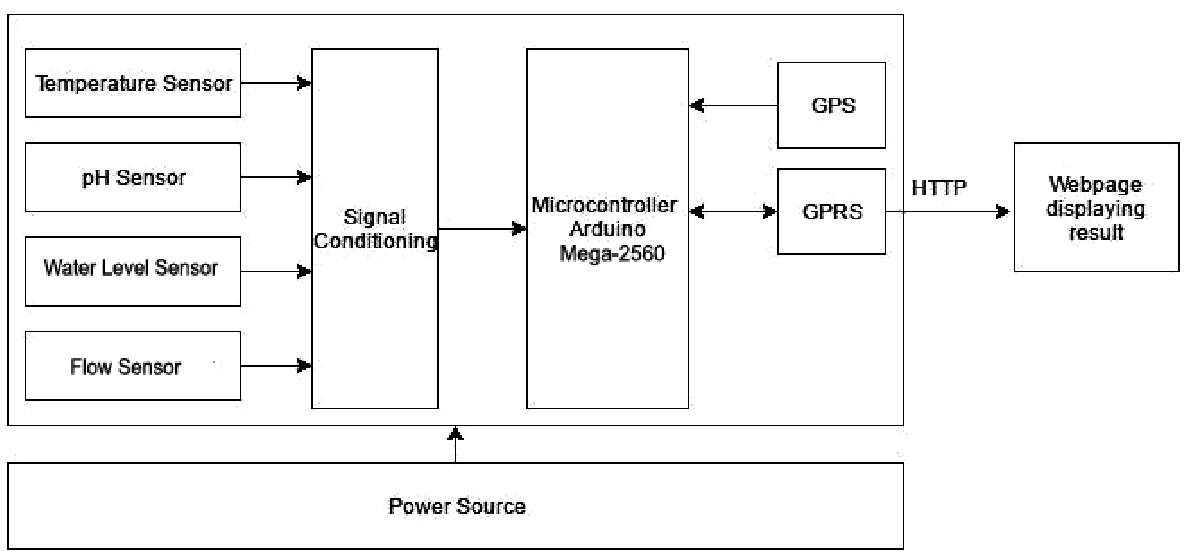

Figure 3: Overview of the system architecture (courtesy of author: Hao Chan, "Water Quality Monitoring System," published on hackster.io).

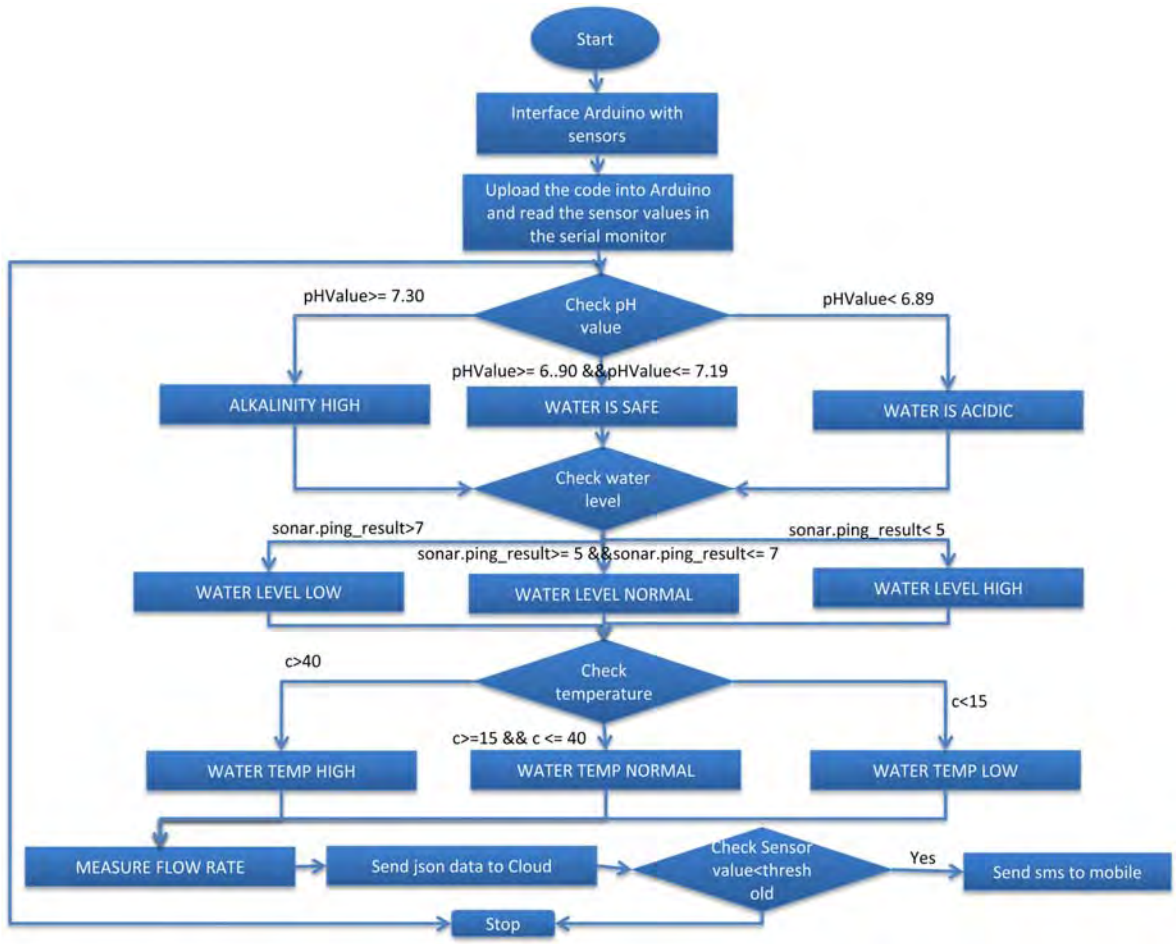

Figure 4: Flow chart of data acquisition process.

3.2 System Design:

Sensor Node: Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on a computer, used to write and upload computer code to the physical board. There are different models of arduino board available in market place. We have chosen mega 2580 over other models (such as UNO) because it provides sufficient digital/analog pin for multi sensor connection. It is microcontroller board based on the ATmega2560. It requires 5v power supply and has a clock speed of 16 MHZ. We can connect it with computer through universal serial bus (usb) port and can store up to 256 KB of data. It has 54 digital I/O pins and 16 analog input pins. Four sensors are connected to four digital/analog pin of arduino. **Figure 5** (in the next page) gives us an illustration of arduino mega.

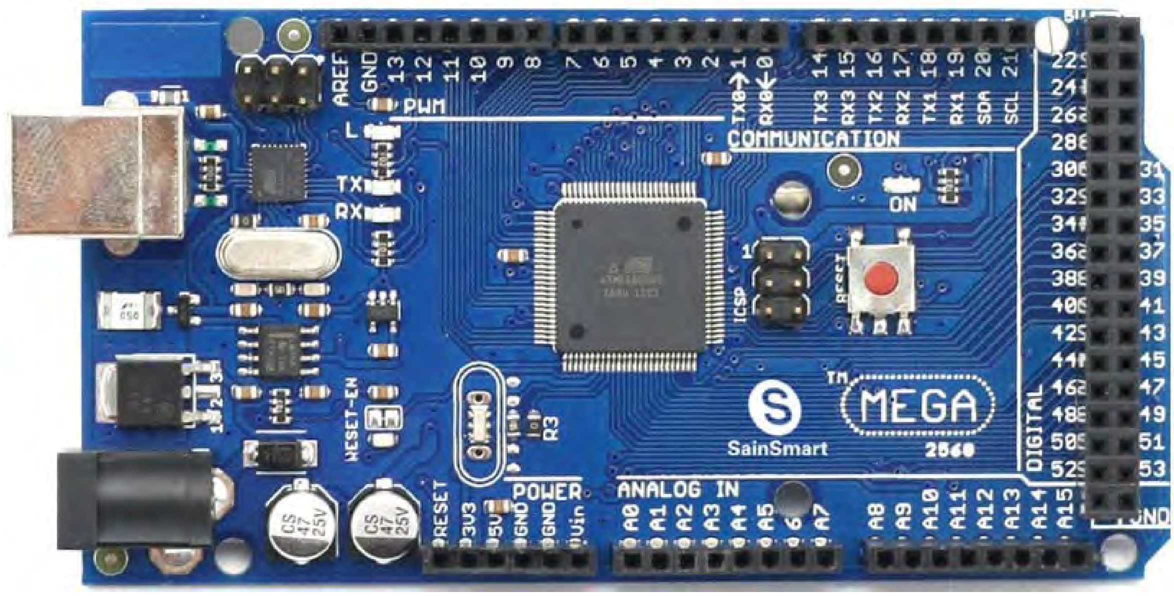

Figure 5: Arduino Mega 2560 (courtesy of Amazon. in).

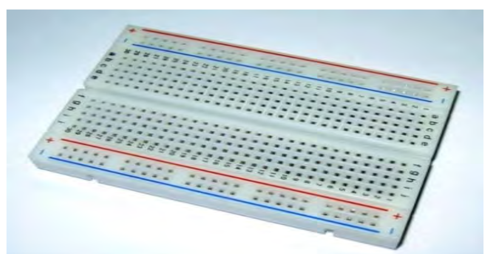

Figure 6: Breadboard.

Hardware Components: The list components for this project are giving bellow.

1. Arduino Mega Board 2560.

2. 16 × 2 liquid crystal display.

3. Analog ph sensor (E-201 PH).

5. A GSM shield (SIM 808).

6. An ultrasonic sensor (HC-SR04).

7. Temperature sensor (ds18b20).

8. Flow sensor (YF-S201).

9. 3 LEDS of different colors (Red, Yellow and Green).

10. A buzzer.

11. Breadboard.

12. AC100-240V to DC 12V 2A Power adapter.

13. Male to female or female to female jumper wire.

LED: In our project we used three different color of LED. Red, green and yellow is used for sensor value high, normal and low respectively for each sensors (expect flow sensor). LEDs have cathode and anode pole which indicates either negative or positive.

Figure 7: 3MM size LED of three different Colors (RED, Green and Yellow).

Liquid Crystal Display: A 16 × 2 liquid crystal display is interface with arduino mega to display the sensor values on screen. There are two rows and it can display 16 characters per row. So it will have (16 × 2 =32) 32 characters in total and each character will be made of 5*8 pixel dots.

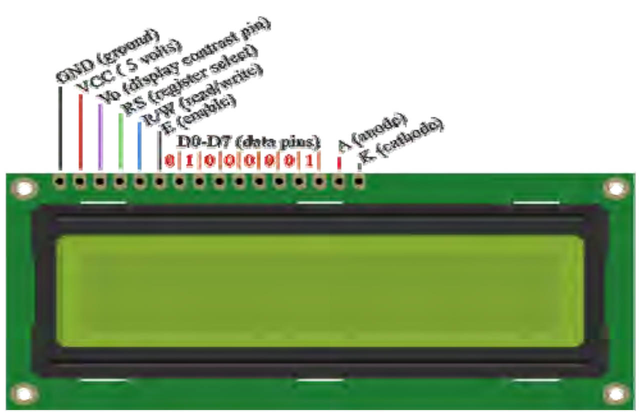

Figure 8: (16 × 2) LCD display (courtesy of howtomechatronics.com).

Buzzer: The definition of buzzer is it is an audio signaling device and can be of three types. These three types are mechanical, electromechanical, or piezoelectric. We have used a piezoelectric buzzer in my project. If we apply AC voltage at few kilohertz it will deform. We can deform it back and forth at the same speed as the AC signal and it produces an audible sound. We can apply same process in reserve. Though the buzzer used in this project is ceramic form it can be crystal form too. **Figure 9** illustrates a piezoelectic buzzer .

Figure 9: piezoelectic Buzzer (coutesy of robomart.com).

Whenever sensor value goes down threshold value or exceeds a buzzer gives a warning alarm.

Sensors:

For this project, we have used two sensors to measure two parameters of water. These are temperature sensor and Ph sensor. In addition to that we have also added flow sensor for measuring the water flow of a particular water source and ultrasonic sensors for measuring the water level.

Now we will give a brief description of sensors in this subsection. **Table 1** gives a summary of sensor specification in page 14.

1) **Ph**: Ph is the most important parameter of water. It indicates alkalinity or acidity of a sample. It's an analog sensor manufactured by DF Robot. Though digital meter is much accurate and gives continuous reading, we have to trade off between budget of my project and accuracy. Ph value is measured in the scale of zero to fourteen and temperature value is found between zero to eighty degree Celsius. This model is specially designed for arduino and comes with a BNC connector, a ph sensor circuit board and an analog cable for connection. In order to get correct value we might need to calibrate it (with solution) before testing the sample. Our target experiment output should be in range of ph 7-8 as we are testing alkaline sample (swimming pool water). It's a dual purpose sensor for measuring both temperature and ph value. Temperature sensor is used for measuring water temperature, on the other hand ph sensor for measuring ph value and temperature of surroundings. The circuit board consists of six pins to connect to any multipoint control unit. Those sixes named To, Do, Po, G,G for Temperature, limiting ph signal, analog ph value, analog GND, supply GND and 5 volt supply respectively. **Figure 10** (in the next page) shows the analog ph sensor used in this project.

Figure 10: Analog ph Sensor (courtesy of scidle.com).

2) **Flow:** Water flow sensor has a plastic valve body and inside the valve there is a water rotor and a Hall Effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow. The hall-effect sensor outputs the corresponding pulse signal. This model (YF–S201) works in the voltage 5v to 18 and can handle water speed up to 2 mpa. In every pulse 450 litters water passes through the valve and the formula for calculating flow rate is: Frequency (Hz) = 7.5 * Flow rate (L/min). Its working flow rate is 1 to 30 litters/per minute. **Figure 11** Illustrates an YF-S201 sensor.

Figure 11: YF-S201 flow sensor (fluxworkshop.com).

3) **Level:** HC-SR04 is most commonly used sensor for determining distance of an object. Transmitter, receiver and control circuit are three parts of HC-SR04. It has four pins vcc, ground, trigger and echo which connect it to arduino. Holding this sensor high above the water container will give us raise water from surface. It uses bellow formula to calculate the distance. Maximum threshold distance in the code for this project is 200 CM. **Figure 12** (in the next page) illustrates a HC-SR04 sensor.

Experimental distance = (high level time × velocity of sound (340M/S) / 2.

Figure 12: Ultrasonic sensor (courtesy of flipkart.com).

It can be easily interface with arduino board or other microcontroller. It used Io trigger for at least 10 us high level signal. This module automatically sends eight 40 kHz and detect whether there is a pulse signal back. If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

4) **Temperature:** There are different types of temperature sensors available in the market for sensing temperature of any object or surroundings. According to the information of intorobotics there are eleven types of temperature sensors which cover the entire domain of robotics and automations. These sensors vary because of sensor capacity. So choose of a particular temperature for a particular project depends upon its application. Those different types are usually Thermocouple, register temperature detector, thermistors, infrared semiconductors or thermometers. The temperature sensor used in this system is from DF Robot. We have chosen ds18b20 for our project. It's a cheap digital temperature senor which has a one wire interface. It means it only requires pin to communicate with the microcontroller. It is especially suitable for this project because its water proof. Because of its digital output it accurately measure temperature. **Figure 13** (in the next page) illustrates a sample of ds18b20 sensor.

Figure 13: Ds18b20 sensor (courtesy of potentiallabs.com).

Table 1: Summary of Sensor specification used in this system.

Sensor	**Manufacturer**	**Model**	**Range**
Ph	DF Robot	E-201	0-14
Ultrasonic	Texas Instruments	HC- SR04	2CM -4M
Flow	Unknown	YF-S201	1-30ml/min
Temperature	DF Robot	SEN-00072	-55 to 125°C

GSM shield: There are different models of GSM modules available in the market serving different purposes. Few of those are SIM 900, SIM 880C, SIM880L and SIM 808. In this project we will be using latest SIM 808 GSM/GPRS module from SIMCOM which supports quad-band networking. This module can be easily interface with arduino mega and is controlled by AT command via UART. It requires power supply of 12v from an AC100-240V to DC 12V 2A power adapter. **Figure 6.b** Illustrates a power adapter and **Figure 14** illustrates a SIM 808.

Figure 14: SIM 808 **(**Courtesy Of Alibaba.com).

Software: We wrote our code in arduino integrated development environment (IDE). The source was written in C and C++ language. It's easy to program and first we tested four of the sensors each individually then integrated the whole system. **Figure 4** shows the data acquisition process from sensors. Sensors are interfaced with arduino board. Afterwards we connected arduino through usb cable to an usb port and upload the code. Outputs are shown in the serial monitor of the IDE. **Table 2** gives a list of all libraries used for display; data acquisition and cloud data transfer.

Table 2: Libraries in a nutshell.

	Library	**Functionality**
GSM shield	Soft Serial	GPRS/GSM
Ultrasonic (HC-SR04)	NewPing	Data Acquisition
Ph sensor (E201)	Not required	Data Acquit ion
LCD	Liquid Crystal Display	Display
Flow sensor (YF-S201)	Not Required	Data Acquisition
Ds18b20	One Wire and Dallas Temperature	Data Acquisition
Communication Protocol	ArduinoHttpClient	Cloud Data transfer
Data format	ArduinoJson	Cloud Data transfer

Chapter 4
EXPERIMENTAL SETUP

Figure 15 illustrates a schematic diagram of our system. All the sensors, LCD and GSM shield connected to arduino mega. There is also a buzzer and LED connected to arduino mega. It is required to connect a register in between cathode and anode node of an LED. Otherwise LED will burn. We used 4.7 kilo ohm register for three separate LEDs. There is also 100 kilo ohm register connected in between LCD and arduino. Except D0 to D4 remaining eight pins are connected to arduino mega. These four pins are for read write purpose we don’t require those pins for our purpose.

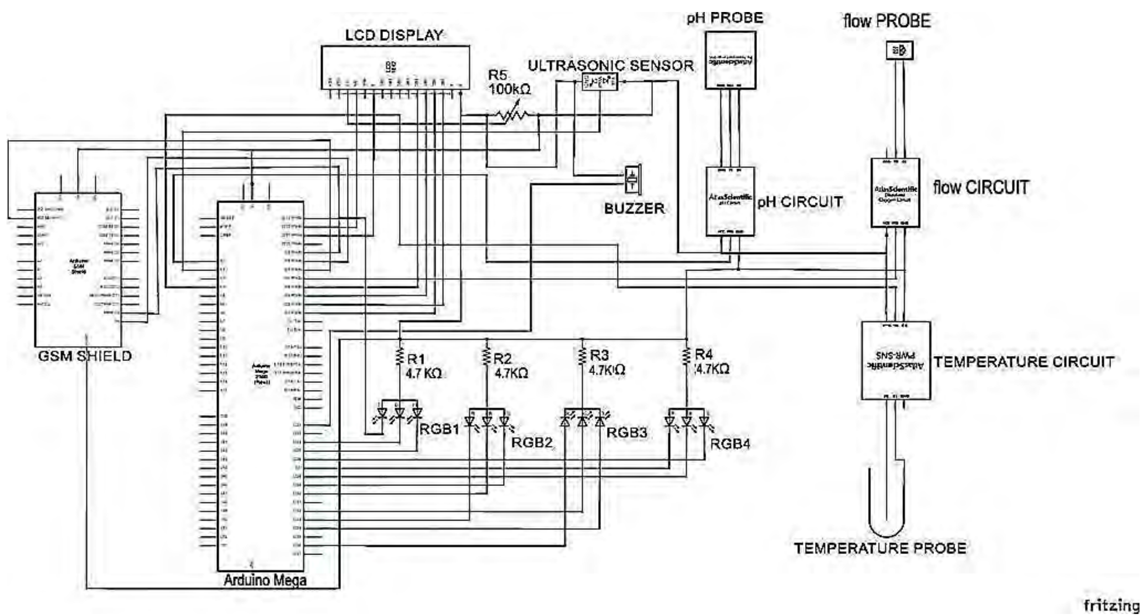

Figure 15: Schematic diagram of the System

Table 3: Summary of sensors interfaced with arduino.

Name of the Sensor	**Sensor Pin**	**Arduino Pin**
HC-SR04	VCC	5V
	GND	GND
	Echo	PWM 9
	Trigger	PWM 11
E-201	PO	AO
	GND	GND
	VCC	5V
YF-S201	Yellow	PWM 6
	Black	GND
	Red	5V
Ds18b20	GND	GND
	DQ	Digital 2
	VDD	5V

Table 4: Interfacing between Arduino and LCD display.

LCD	Arduino
1. GND	GND
2. VDD	5V
3. Contrast	Register to GND
4. Register Select	Pin 12
5. Read/Write	GND
6. Enable	Pin 10
7. Data bus 0	Not Connected
8. Data bus 1	Not Connected

LCD	Arduino
9. Data bus 2	Not Connected
10. Data bus 3	Not Connected
11. Data bus 4	Pin 5
12. Data bus 5	Pin 4
13. Data bus 6	Pin 3
14. Data bus 7	Pin 23
15. Black LED+	Resister to 5V
16. Black LED-	GND

Table 5: Interfacing between Arduino and SIM 808.

Arduino	SIM 808
TXD	RXD
RXD	TXD
GND	GND

ARTIK Cloud: ARTIK cloud is an open data exchange for Internet of things. It is interoperable with other devices. It consists of extensive APIs, SDKs, and other tools for building connections between applications, devices, and clouds. Now a days this device agnostic and scale able cloud platform is commonly implemented in all internet of things applications, including smart homes, smart cities, and industrial internet of things. Unlike other cloud platform ARTIK cloud platform provides end to end security both in hardware and application level. Because of its developer friendly environment beginner without prior experience in internet of things can get themselves accustomed to it easily. To use this platform developer has to open an ARTIK cloud account. After user log into his account he will be in his own personalize dashboard. In his dashboard he can connect devices to ARTIK Cloud, create Rules, and review, visualize, and export his data in JSON or CSV format. In the dashboard he can create his application and device types and create Manifests for your device types. **Figure 16** illustrates data transfer process from hubs to cloud service.

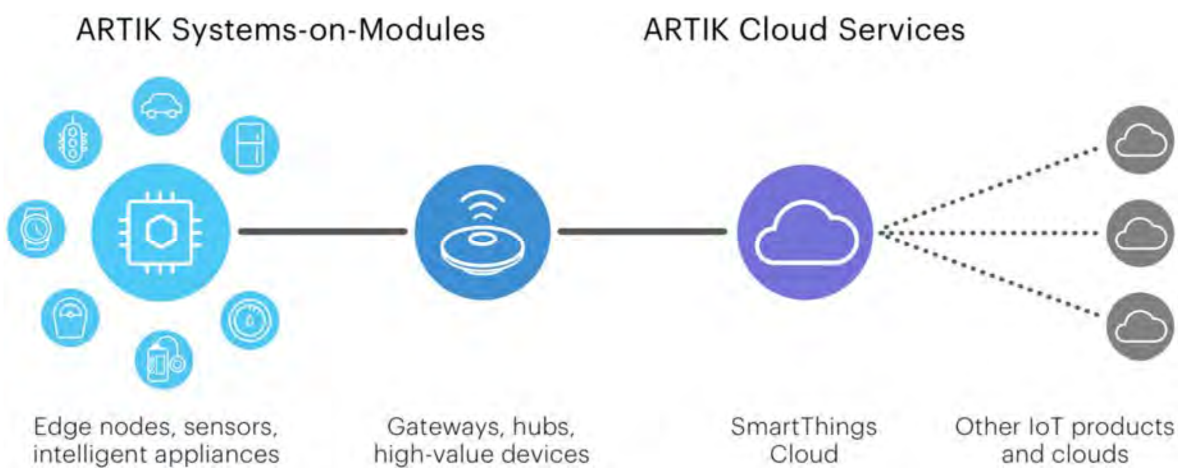

Figure 16: Architecture of ARTIK Cloud (Courtesy of ARTIK Cloud blog).

In this project arduino mega act as a high value device and all the sensors are connected to it.

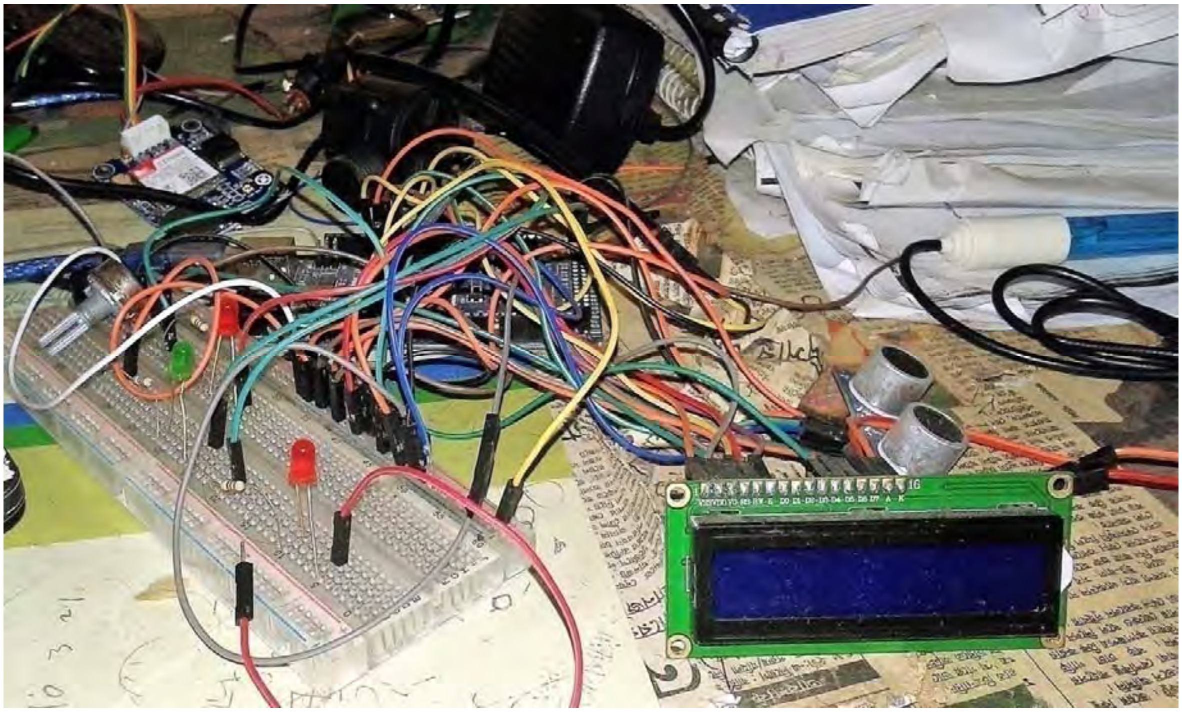

Figure 17: Snapshot of hardware set up for monitoring water quality.

Chapter 5

RESULTS

In this Project, we have tested three water samples from three different water sources. Those three samples were swimming pool water, industrial water and normal tap water.

If the ph value is above basic (means higher than 7) water is alkane. If it is below 7 the water is acidic. The optimum value for pool water is 7.4. As it is the same as the ph in human eyes and mucous membranes. Low ph value in swimming pool water is harmful for human health because it can cause skin irritation and eye burn if you open your eyes under water. As a result of this low ph value chlorine and other disinfectants won't be as effective as it was for higher value. So swimming pool will be habitant for micro organs, bacteria's and unsafe for swim. On the other hand, ph value higher than 7.8 can cause coldness in the water and scaling along the sides of someone's pool.

Though swimmer might not notice any difference while swimming but the bacteria could be harmful when it comes in touch of your body. So swimming pool water ph range must be kept between 7.2 to 7.8.

We collected three swimming pool water samples from three different places in-order to make our system full proof. Two of the samples among those three samples gave ph value of 7.3 & 7.1.But the other one gave ph reading of 6.5 which is bellow standard range of ph value in any swimming pool. From the above evidence we came to a conclusion that our system is working expectedly for ph parameter. It is also fair to remark on the water sample of which ph value was low that it not maintained regularly by the concerning authority.

Adding substances such as sodium bi-sulphate and sodium bicarbonate for high and low PH value respectively can stabilize the ph level to normal.

Furthermore for recreational pools used for general purpose should not have a temperature higher than 29'C. All three swimming pool samples we tested for temperature gave value between 26-27'C. We tested multiple times during days and nights in order to find out any abnormal output. Luckily there wasn't any temperature value above maximum range specified.

It is imperative to keep water in right level in swimming pool for healthy pool water filtration system. The water level should be at least one third up the opening of your pool's skimmer. Ideally, though, the water should be level with the half-way point of the skimmer's opening. As our system is not water proof yet, we can't place it to the pool skimmer to measure the water level. Instead of that we place it into ground above water and the value found was 125 CM.

Waste water released from industries has usually ph in the range of 6.5 to 8.5 before water treatment. Our waste water sample also gave low ph value of 5.5. So it not safe to drink or use in any domestication purpose. Using flow sensor we can calculate water used in different purposes such as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility, optimize water and minimize costs.

If the ph range is in between 6 to 8.5 surface water is impure and drinkable. Normal tap water temperature should be roughly 13'C whether as hot tap water temperature should be around 50 degrees Celsius.

FUTURE WORK SCOPE

Due to limitation of time and budget we focus on measuring quality of water parameters. This project can be extended into efficient water management system of a local area. [Ref: 3] shows how you can control water flow by clicking on or of button on a webpage. A motor will be attached to the water pipe and it will control the water flow from one water carrier to another. This way we can reduce water consumption. Moreover other parameter which wasn't scope of this project such as turbidity and electronic conductivity can be quantified also. So additional budget is required for further improvement of overall system. We can also work on making a mobile application for remote water monitoring which user can download and install in his or her device and can get real time notification. In future instead of this flow sensor which was used and has the capacity of measuring up to 30 mile liters of water, we could another model which will measure up to 60 mile liters of water accurately.

CONCLUSION

We successfully conducted our research and monitored water parameters such as temperature, ph. Moreover we quantified relative value for water level and measure water consumption through flow sensor.

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