IOT BASED MONITORING FOR SUSTAINING LIFE BELOW WATER AND PROTECTING OUR MARINE ECONOMY

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Abstract

The primary goal of this project is to design and build a wireless sensor network system for monitoring water bodies for saving underwater life.The main source of pollution in the water bodies is excess level of nitrogen and phosphorous that results in degradation of oxygen level that is very dangerous for penguins, whales, sharks, etc inside the sea. The pollution monitoring is very important for saving ocean animals. In this a solar-powered sea pollution monitoring, system has been proposed the main goal of this system is tracking and measuring of different parameters that gives the measure of different water quality parameter and the end user are able to determine whether that water is suitable for marine life or not. The proposed system employs the use of IoT to make real-time data freely available across a wide area, and it is a very good solution for monitoring the weather for aquatic animals. The system monitors climate change inside water such as temperature of water, rain, moisture, light intensity, UV radiation, and even airborne carbon monoxide levels. These all parameters are responsible for increasing the acid level inside water. This acid level will results the reduction in oxygen level. The data from these sensors is sent to the server and displayed as graphical statistics. The information posted on the web server is easily accessible from anywhere, and the information gathered through these servers can also be used as a reference for taking the necessary action for problem solution. The project also includes an app that sends messages as a useful alert system to notify people also about the sudden weather changes of the coastal areas. The use of an API to analyse sensor data and forecast an accurate result in order to predict more sophisticated weather forecasts. It is a compact structure and having fewer moving parts, this design requires less maintenance. The components of this project are solar-powered and make use of rechargeable batteries and require little maintenance. All readings are displayed on an LCD display in prototype and send to server side. Every movement of our system is controlled by an Arduino micro controller from server side.There are many chemical and biological factors of water that affect the production of fish. India is the country of rivers and ponds.If the proper managements of rivers and ponds have been done with the help of this system than this system is very much useful for the production of fish and fulfilling the demand of food in future.

Keywords: PH sensor, Turbidity sensor, Temperature, Rain Sensor, Ultrasonic, LCD, Planktonic,Wi-Fi module, Zooplankton

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1. Introduction

Weather describes the short-term state of the atmosphere in a specific region, whereas climate is the statistical representation of the weather at a specific location for a given time period. Climate change always changes the weather patterns over time spans ranging from decades of years irrespective to conditions of the regions here the region under consideration is under water re.gion. According to studies, human activity is causing climate change on Earth as well as below the surface of water bodies such as rivers, ponds, and sea. Predicting the weather under water has been a difficult task for people all over the world in the last ten years. This can occasionally result in inaccurate weather forecasts. However, producing maritime weather information such as buoys is done to anticipate and reduce the possibility of endangering and injuring people's lives in coastal areas as well as the life of planktonic community under water and the marine animals life. A weather station on the land done this task by announcing about conditions are favorable or not. Researching weather patterns on the surface and below the depth both are very important for human as well as aquatic animals. The measurements of many parameters such as Acidic condition of water, temperature of water, the existence of fishes and other animals inside the water, air pressure on the surface, humidity on that particular day, wind speed and its direction, are comes in the category of sea weather. This prototype measure most of the above said parameters and transfer the data to the server side. The use of solar panel inside the system helps to improve the life time battery because some time its difficult to recharge battery inside water bodies. Engineers are becoming increasingly interested in the Internet of Things (IoT). It is the online connection of various items. Although self-driving cars and smart homes are frequently associated with the Internet of Things, many of the best IoT innovations are found in many sectors so the use of IoT is very useful in marine sector. The "water pollution monitoring system" is an example of this. Water pollution has become a major concern for everyone as the world's population has grown many developing and developed countries have becoming more to more industrialized day by day. When the point of surveillance has been come then the best way is to deploy the Sensor devices at various points to collect the information needed to forecast the behaviour of a specific area of interest. The primary goal of this paper is to design and implement an effective monitoring system that will enable remote monitoring of critical parameters via the internet, cloud storage of sensor data, and projection of the predicted trend on a web browser. This study proposes using a wireless embedded computing system to monitor the Temperature, Turbidity,PH levels, of the water the rain sensor are used to monitor the rain water and the use of ultrasonic sensor helps us to determine the existence of animal components of water bodies. A provision for alarm is also made if any parameter value such as that crosses its threshold value ranges, such as PH levels in water in a specific location exceeding the usual values, and so on. Furthermore, the solution temperature and PH values exceed to predefined limit. This system also play an important role in providing sophisticated remote monitoring for a specific parameters of interest.

2. Literature Review

In this section, the discussion began with the importance of monitoring life under water. Diversity is an important concept that is the key feature of our planet. According to the report on Economy of OECD, the in 2010 the global ocean economy is 1.5 trillion and its become double in the year 2030 [12]. Cavan et al. gives a review about the biochemical cycle, this work is about the dominant grazer of Antarctica[3]. Bax et al. gives the survey about the social need of marine biological life in this work a 10 year plan has been made for the monitoring of marine life underwater bio diversity. This plan is executed for the increasing the coordination between the various groups that work on the monitoring of marine life and oveserbing various physical, chemical and biological parameters. This plan is very much helpful in improving the coordination among various multidisciplinary groups and the use of various metadata also start with this planing[1]. Zooplankton play an

important role in low pollution level of sea Halfter et al. gives the comparison of two case study in southern ocean about the role of zooplankton in carbon export [7]. Levin et al. Gives the idea about the challenges of sustainability in the case of deep sea mining [8]. Mooney et al. Proposed the approach for the assessment underwater diversity in this the role of ocean sound wave are used these sound measurements are used to analyze the underwater situation of the interaction among biological community and the ecosystem [9]. Williams et al. proposed the need and model for the various interdisciplinary project for observing deep ocean. This work focus on monitoring about the deep sea fishery various impact, need and requirements are the part of this work[15]. A Blue paper on the ocean economy is published in 2020 in this a high level panel has been formed for the sustaining the economy of oceans. In this various ocean accounting initiative has been line up and national office works with the groups that are engaged in the collection of ocean data [5]. Now some work related to the animal component planktonic community has been given in this section the Feuilloley et al. gives survey about the environment change effect on pelagic fish community [6]. Santora et al. worked on the entanglement of whale inside sea this work show that the ecosystem shifts linked with the marine heatwave[14]. Work has been done by various national bodies for driving the reason of reduction in population of whale [10]. Beltrrn et al. worked on the seasonal resource pulses in sea water, this paper gives the idea about the factors that are responsible for degradation in this level [2]. McPhaden et al. elaborated the effect of climate change in southern oscillations [11]. M. Estes Jr. et al. Proposed in this work that marine biodiversity is the main feature of our planet and this diversity depends upon the climate change, pollution of water bodies, many other variables of sea such as temperature, carbon, and oxygen level of water and flow of currents inside the sea. This paper proposed the need of marine biological observations and managements that are very much helpful in supporting the blue economy[4]. Ratnarajah et al. gives a review article on the monitoring of the zooplankton in the changing climate because these zooplankton plays an important role in biochemical cycle and very much helpful in maintaining the pollution level under water in changing climate conditions [13].

3. Methodology for Protection of Sea Life

In this a section an article has been proposed for saving the life of underwater animals and zooplankton for monitoring the weather condition of sea and water bodies.For the development and growth of the planktonic community its animal component zooplankton play an important role this animal component maintaining the low pollution level inside the sea. The protection of this spice is prime important because they are unable to swim inside seas, lakes, and rivers. For the protection and monitoring of these debris the various factors are responsible some of them are increase level of temperature. PH level of water etc. For monitoring this all this system has been developed.

System Architecture

The system includes a microcontroller (ESP8266), as the primary processing unit. The microcontroller can be connected to sensors and other devices. The controller unit give command to the sensors to retrieve data from them, process the data, using the sensor data, and upload it to the internet via a Wi-Fi module.

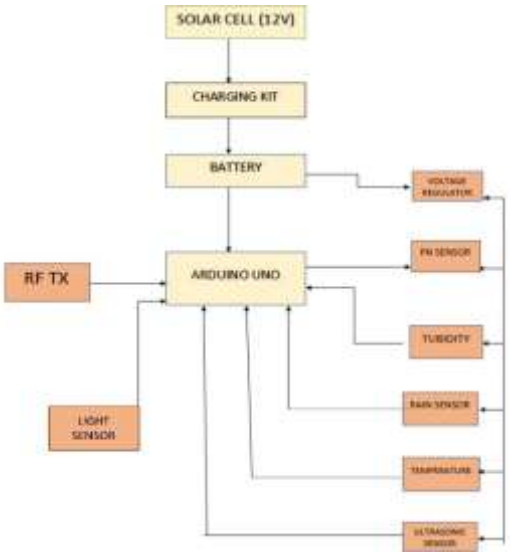

Fig. 1. A complete transmit block

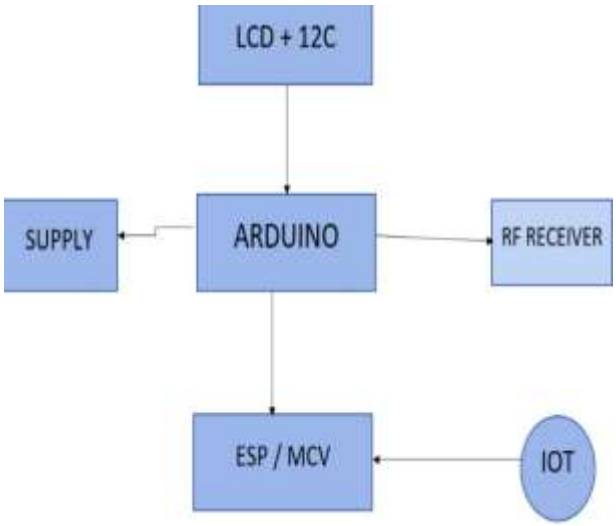

Fig. 2. A complete Receiver block

The complete transmitter and receiver block diagram for the complete system is shown in the Fig.1. and Fig. 2.,

Various components of the system

In this section a complete description about the various components and sensors are given one by one, Solar Panel, AURDINO UNO,Wi-Fi Module Solar panels are used to capture solar energy. Solar panels are made up of many solar cells connected in a network of parallel lines.The solar panel used in this prototype model are able to charges a 9V, 2000 mAh energy storage battery.The Arduino Uno is an open source microcontroller based on the Microchip AtMega328p. It is a 40-pin integrated circuit with digital and analogue input/output (I/O) pins that can connect to various expansion board (shield) types and other circuits. The board has six analogue I/O pins and fourteen digital I/O pins, six of which are capable of PWM output. It can be programmed via a type B USB cable with the Arduino IDE (Integrated Development Environment). It accepts voltages ranging from 7 to 20 volts, but it can also be powered by external 9-volt batteries or a USB cable. The ESP8266 Wi-Fi Module or node MCU is a low-cost open source IOT platform. It is a self-contained SOC (System on Chip) with an integrated TC/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP-12E module on the Node MCU

ESP8266 development board contains an ESP8266 chip with a Tensilica Xtensa 32-bit LX106 RISC microprocessor. It has interfaces for UART, SPI, and I2C. This microcontroller supports RTOS and has a clock frequency range of 80MHz to 160MHz that can be customized. The Node MCU is powered by a Micro USB jack and a VIN pin, and it has 128 KB of RAM and 4 MB of Flash memory for storing data and programmed.

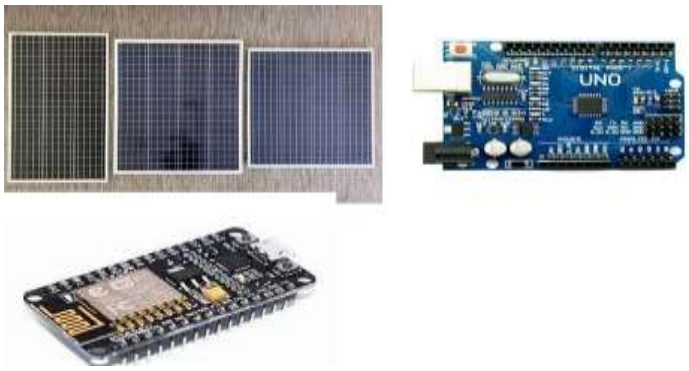

Fig. 3. Hardware units Used in Circuit

Various sensor units

Now the details about the five sensor unit used in this architecture has been discussed in this section. A PH sensor can be used to determine the acidity and alkalinity of the water. The pH scale is 0 to 14, with 7 representing neutral. Readings below 7 indicate an acidic nature, while readings above 7 indicate an alkaline nature. It is powered by a 5V supply and interfaced with Arduino. The pH of a solution should be between 6 and 8.5. The next sensor is temperature sensor. The temperature sensor indicates whether the water is hot or cold. It is an electronic device that measures the temperature of its surroundings and converts that data into electronic data, which is then stored, monitored, or signalled as temperature changes. The temperature sensor DS18B20 has a temperature range of -55 to 125 °C. Because it is digital, the sensor produces accurate results. The turbidity of water determines its clarity. It indicates how much the transparency of the water has decreased. The tool used to measure water turbidity is known as a turbidity sensor. It computes the amount of light scattered by the suspended particles in water. The turbidity of water increases as the total suspended solids (TSS) content increases. Formazin Nephelometric Units (FNU) or Nephelometric Turbidity Units (NTU) are commonly used to express turbidity levels (NTU). The turbidity should be between 0 and 5NTU. Rain sensor is used for rain detection and generating the alarm with the help of this device end user are able to determine that whether the parameters change is because of rain or other factor.The HC-SR04 ultrasonic sensor used to determine the distance of an object. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1” to 13 feet.

Fig. 4. Sensor Units

Software section

An Arduino or Raspberry Pi can be controlled via an online platform called think speak. On a virtual dashboard, its become possible to drag and drop widgets to create a graphical user interface for our project. It is possible to control Arduino or ESP32 pins directly from a phone using the Thinkspeak library. The Think server has five ports that can be used for various levels of security because the connection between the app and the server is always SSL/TTL encrypted, it is always secure.

Design and Implementation

Arduino collects data from all connected sensors before sending it via serial communication to the Wi-Fi module and, finally, to the server. Users can view real-time data with the blynk programme. If the values are outside the acceptable range, the blynk programme will display a notification about the water quality. If the action has not takeen within a certain amount of time after the email then alert provision also appears in the thinkspeak application, an email is sent to the concerned authority automatically. This data is uploaded to the thinkspeak cloud using the wifi module.The Thinkspeak application is created and connected to the server where the sensor data is stored. This application is then installed on Android smartphones in order to view the results. Thus, by installing this system with Wi-Fi in all the sea sites or on the river sites, it is possible to determine the quality and weather of the water. In that manner the monitoring of the water bodies from single location is also possible.

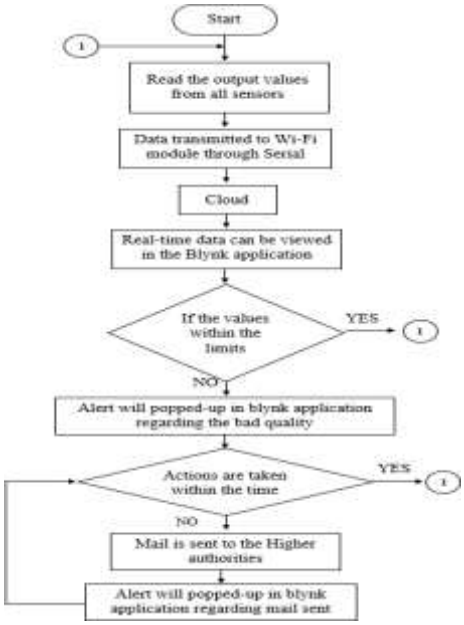

Fig. 5. Flow Chart of working

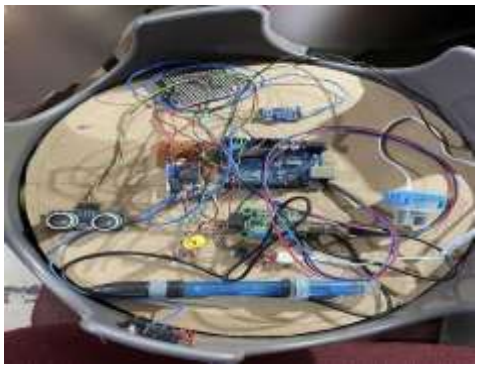

Fig. 6. Proposed model with sensors (Prototype)

4. Testing of Model

Manual observations are made at least once per day, and automatic measurements are taken at least once every hour.Testing of prototype has been done inside the water of Yamuna River(Near Kalindi Kunj Delhi), Chithera Pond(Near Dadri), Hindon River (Ghaziabad) and Samrat mihir bhoj park (Opposite Alpha2 Greater Noida, Water Supply is throug Greter Noida Authority and Rain Water). These Locations are shown in Fig 6., below,

Fig.6. Picture of Different sites

The Parameters observed is PH value, Turbidity and the temperature. The level of Plankton and water colour has also been observed. The ultrasonic sensor present in this system is very much useful is observing the articles inside water. The pH value of different locations are given in Fig.7.

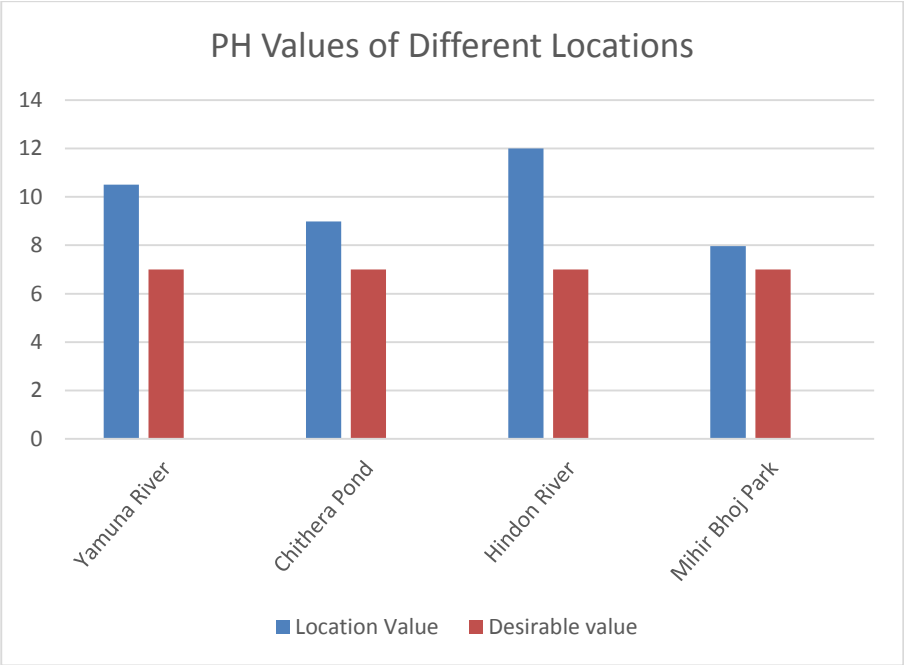

Fig.7. PH Value Comparison of Different sites with desirable values

The Desired values for different parameters is suggested water quality by Debalakshmi Das [16] for pond fish culture. Another parameter for fish health is Turbidity level of water, if this level is less than 12 or greater than 80 this is the indication of a stressful condition for our fish life so if we want to consider any site for aquaculture then turbidity has also been considered keeping this in mind that there is no interrelation between this parameter and pH value.

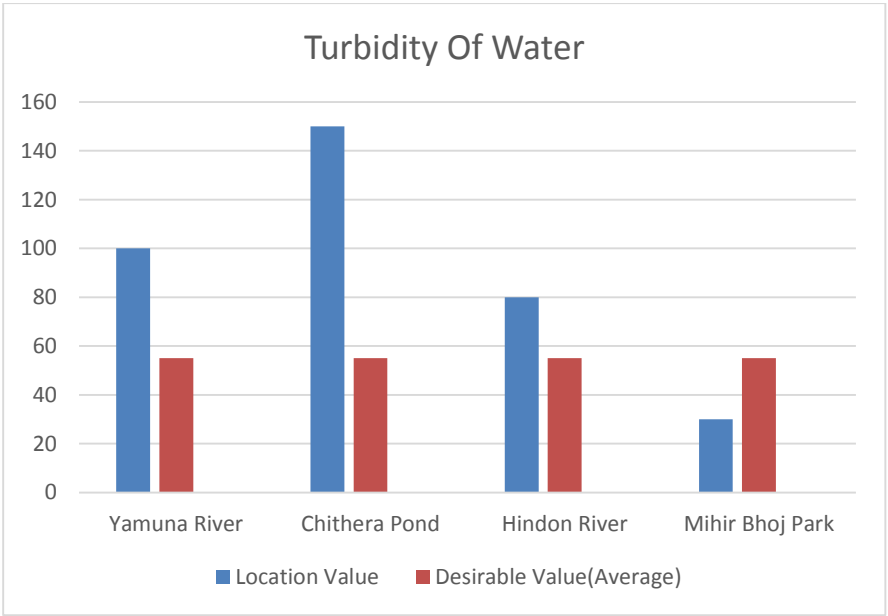

Fig. 8. Relative Turbidity value of Different sites against average desirable level

Table.1. Comparative study of Different Sites

Parameters		Turbidity		pH		
Sr. No.	Site Name	Desirable Range	Stress	Acceptable Range	Desirable Range	Stress
		30-80	<12,>80	7- 9.5	6.5 - 9	<4, >11
1-	Yamuna River		100		10.5	
2-	Chithera Pond		150	8.98		
3-	Hindon River	80				12
4-	Mihir Bhoj Park	40			7.97	

The temperature of sunny day in the month of May has been observed the acceptable range of this is 15-35ºC , Desirable range is 20-30ºC & stress ful condition is <12ºC and >35ºC. Acceptable water colour is light green to brown. The clear water and dark green and brown water is the sign of stress for fish. The Plankton desirable range is 3000-4500 , the <3000 ,>7000 planktons are stressful for fishes. According to above three discussed parameters these sites performance is shown in table2,

Table.2. Comparative study of Different Sites

Sr. No.	Site Name	Temperature	Water Colour	Plankton's
1-	Yamuna River	25.8ºC	Brown	On site 5000
2-	Chithera Pond	29ºC	Dark Green	8000
3-	Hindon River	22ºC	Light Green	7000
4-	Mihir Bhoj Park	25ºC	Light Green	3000

5. Conclusion

A low-cost, real-time monitoring system for water pollution and marine weather has been developed and tested. This technology provides continuous transmission of real-time water data while utilizing renewable energy sources such as solar energy. The system verifies weather and water quality more quickly and manually than the previous method, and it makes water monitoring easier. By deploying this device in every municipal pond, River and sea, water quality, weather, and overall sea quality can all be monitored from a single location. An Android app can be used to access the quality of water using this technology. The system is very cheep so its become easy for a personal weather station, collecting the weather measurement. That are operated by a private individual, club, association, or even business that gives the idea about water structure to end user then end user take necessary action of inform various government bodies for taking necessary action.The level of debris inside the water bodies slowly degrading, so this may lead to the death of ocean animals,with the help of this system, its become possible to monitor all rivers and sea easily.

Declarations: Authors declare that this work has been composed solely by himself and that it has not been submitted any where else.

Ethical Approval: Authors have got approval from G,L Bajaj Institute for conducting this type of research inside college campus and publish this in any research paper.

Competing Interests

The authors declare no competing interests

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Availability of data and materials

Data will be available on request from corresponding Author.

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