THE BOAT: A SMART GARBAGE COLLECTION & WASTE TECHNIQUE USING IOT

Richa Saxena, Mohd. Arsh, Manasvi Agarwal, Jhalak Bhardwaj, Jyoti Saini and Monika Giri

Computer Science & Engineering, Moradabad Institute of Technology, Moradabad, India
[1]richasaxena2006@gmail.com
[2]arshmohammad834@gmail.com
[3]manasvi2908@gmail.com
[4]jhalakbhardwaj2000@gmail.com
[5]Sainijyoti73206@gmail.com
[6]monikagiri05736@gmail.com

ABSTRACT

The problem of drinking water insecurity in coastal areas stems from complex hydrogeological structures. Natural disasters and transboundary river problems make the supply of safe water more difficult than in other regions. The potential threat of industrial pollution increases the difficulty and hinders efforts to establish widespread and adequate access to safe and affordable drinking water in these coastal areas. Knowing that access to clean water close to home is a human right to maintain a healthy life demonstrates the urgent need to address water-related diseases and prevent pollution. To adequately address these issues, water parameters such as pH, turbidity, temperature, dissolved oxygen, and salinity must be carefully monitored. Our answer to these needs is an IoT-based water quality measurement system designed for efficiency and sustainability. The core of the solution is an intelligent sensor interface device with the ability to detect water quality parameters and transmit real-time data directly to an online system. Integrating multiple sensors with Arduino provides a comprehensive approach to monitoring water quality indicators. A serial communication link was established between the Arduino and the water TDS to ensure data transfer and display information on an online platform or web interface. To increase user access, each water source has a QR code, allowing individuals to quickly assess the safety of their water with a simple scan. This innovative system not only provides people with information about drinking water quality, but also provides governments with a valuable tool to monitor water quality in specific areas. In addition to home use, this adaptive system can also be used in agricultural and industrial environments. The design, development and implementation of these IoT-based solutions will enable authorities to take proactive measures and implement effective solutions in areas facing water quality issues.

KEYWORDS: *Real Time System, IoT, Arduino Nano, pH Sensor, WI-FI Module, Salinity, Dallas Temperature Sensor, Esp Sensor, Water Quality, Humidity Sensor.*

1. INTRODUCTION

The correct administration of freshwater is imperative, particularly considering the developing needs in farming, industry, and different divisions. The quality of freshwater is evaluated based on its "chemical, physical, and natural" components. Checking water quality plays a significant part in recognizing issues such as contamination, harmful chemicals, and defilement. The conventional strategy, still broadly utilized, incorporates the collection of water tests, research facility examination, and proposals for essential water treatment. The modern approach to checking water contamination includes three fundamental stages. Checking water quality through the conventional forms of water inspecting, testing samples, and investigative examination isn't as it were costly, challenging, and time consuming but too requires master input, making it less efficient. **[23,14]** With the movement of innovation, there's an opportunity to present robotization into water quality checking, advertising a more responsive and streamlined approach compared to manual strategies. Mechanical advancements have begun to clear the way for robotized frameworks that upgrade the observing of water quality, displaying a reasonable elective to conventional manual forms. Within the locales encompassing material, dying, and coloring units in Dhaka, Narayanganj, and Gazipur, the shallow aquifers confront serious contamination due to the unregulated release of untreated effluents into adjacent low-lying lands and streams. This contamination renders the aquifers unacceptable for different purposes. Businesses arranged along riverbanks utilize water from the waterway discharging both treated and untreated effluents**.[23]** Downstream communities depend on this water for water system, drinking, and other household exercises. The winning circumstance underscores the critical require for the advancement of moved forward strategies for real-time observing of water quality parameters. We have formulated a show to survey water sources, wherein the accumulated information is transferred and analyzed online utilizing remote communication. The framework, leveraging the extending reach of remote sensor systems all inclusive, holds considerable commercial value Moreover, it consolidates a feature to alarm far off clients in case of deviations from pre-established standard values for water quality parameters. This paper seeks after a dual objective. Firstly, it presents a clear, cost effective, and less complicated demonstrate for testing water quality. Furthermore, it includes information investigation to compare it with the Water Quality File (WQI). The assessment of water quality considers its physical, chemical, and natural traits. Endeavors have been contributed in formulating Water Quality Files (WQIs) to offer an comprehensive delineation of water quality based on different estimations. The Water Quality List (WQI) capacities as a metric for assessing water quality over diverse applications, making a difference anticipate its suitability for purposes like drinking, horticulture, or supporting sea-going life forms. Ordinarily, the WQI is gaged on a scale that ranges from 0 to 100.

2. LITERATURE SURVEY

"Water Quality Monitoring in Rural Areas - The Cloud Economy Project", Nikhil Kedia 1st International Conference on Next Generation Computing Technologies (NGCT-2015), Dehradun, India, 1st edition, 2015. The whole process of water quality monitoring including sensors, Integrated design and information sharing were selected in this study to ensure the proper distribution of information by governments, network operators and residents. The location of the music cloud is also being investigated. Although we cannot automatically improve water quality at this time, efficient use of technology and adoption of cost-effective technologies can increase people's awareness of the problem. .The work of Inesh Patoliya and Jayati Bhatt "Continuous Water Quality" Monitoring System " This study It was clarified that the water quality should be monitored continuously to ensure the safe supply of drinking water and for this purpose, a method called monitoring was proposed of water quality in the Internet of Things (IoT) This paper presents the architecture of a monitoring system based on the Internet of Things (IoT) water quality monitoring that continuously monitors water quality. The system contains an array of sensors that detect a variety of water quality parameters, including temperature, turbidity, conductivity, pH, and dissolved oxygen. The microcontroller processes the measured values of the sensors and sends the processed values to the main controller, Raspberry Pi, via the Zigbee protocol. Finally, the sensor data can be viewed using a cloud based web browser. **[21,22]** Industry 4.0 as part of smart cities", by Michal Lom, Ondrej Pribyl and Miroslav Svitek. This study shows the convergence of Industry 4.0 and smart city projects. The term "smart city" has gained a lot of attention in recent years, especially after the 2008 global financial crisis. Creating urban models and maintaining people's quality of life are the main drivers for creating smart city projects. The concept of smart cities cannot be seen only as a technical field. Other factors such as law, psychology and economics must also be taken into account. According to the concepts of Industry 4.0, the Internet of Things (IoT) will be used to produce so-called intelligent products. Every little part of the product has its own intelligence. Additional knowledge is used from product manufacturing to further processing, examining the entire life cycle (knowledge processes). Another important aspect of Industry 4.0 is the Internet of Services (IoS), which includes, among other things, smart and logical transport (smart mobility, smart logic) and the Internet of Energy (IoE), which determines how environmental resources should be. assigned to use correctly. Public services (electricity, water, oil, etc.). Industry 4.0 can be seen as part of smart cities and IoT, IOS, IoP and IoE can be seen as elements that can create connections between smart city projects and Industry 4.0.Paper "QOI-Aware 'Internet of Things' Energy Management" by Zhanwei Sun, Chi Harold Li, Chatschik Bisdikian, Joel W. Branch, and Bo Yang wrote the Environment' This research aims to develop energy management that can occur in the high quality experience (QOI) in the sensitive context IOT, energy efficiency over time, is clear and compatible with the low-level methods used. In particular, the new concept of "person-aware" QOI takes into account the QOI requirements of an activity and the intelligent capabilities provided by sensors in the smart IOT environment. an innovative idea of the “critical coverage set” of a task to select the cells to perform the task over time. Electronic control decisions are made during operation as the best option for long-term traffic data and taking into account the duration of services. The concepts and methods presented in this paper are illustrated through a comprehensive case study of water level monitoring using a sensor network. Simulations are also performed to demonstrate the effectiveness of the proposed algorithm. "Adaptive Surface Analysis for Distribution Network Management of Water Systems," written by Sokratis Kartakis, Weiren Yu, Reza Akhavan, and Julie A . McCann. In this paper, we present a break detection and localization approach for cascading networks that integrates graph topology analysis, anomaly detection, and lightweight compression. We demonstrate that by using the differences in the arrival times of the measured vibration changes at the sensor location, we can accurately locate the water damage location by reducing the amount of communication between the music device and the backend server. Compared with the usual reporting situation, our findings can save up to 90% of communication. **[1]**

3. RESEARCH METHODOLOGY

In this section different research methodologies is mentioned .

3.1 Requirement Analysis

The design and use of an Internet of Things (IoT) boat for the separation of biological and non biodegradable waste from rivers using a vehicle system requires a detailed requirements analysis. Boats and structures should use durable, water-resistant materials that can be held down by conveyor belts and waste distribution units. It is important to choose a conveyor belt system that is resistant to water damage and can handle any type of waste. Using a multiple combination approach, we integrated biological and non-biological sensors to improve the accuracy of residue detection. Navigation and autonomous control and navigation of GPS systems and anti-lock braking systems are critical to ensure safe operation. Information systems must be connected to the IoT for real-time data transmission and security measures. Along with energy efficient design, a reliable and stable power source, such as solar or batteries, is very important for ship power sources. Cloud integration for data storage and analysis, control panel and alarm system promote efficiency and monitoring. A focus on rigorous testing, compliance, public engagement and education is critical to successful delivery. Field testing and improvements based on feedback are essential to optimizing your boat and its performance in real conditions.

3.2 Technical Overview

It is a stand-alone room management system designed to independently separate waste with conveyor belts and prevent excess waste from being thrown into the bin. An IR sensor is used to detect the fullness of each tank in a different position. Auxiliary conveyor belts are installed separately on each bin and are connected to the main conveyor system. **[17,19]** The main conveyor belt collects debris from each auxiliary zone. The main conveyor has several categories of waste: wet, dry, waste (such as plastic, cardboard, paper), etc. The use of the Internet of Things (IoT) project allows the calculation of several categories of waste. As a result, the amount of each type of waste is also recorded.

3.3 Proposed Solution

Many small transporters pushing into the main transporter. At the beginning of each auxiliary transporter is a litter box. Garbage is thrown by infrared sensors on the top of the bin. Debris can be detected with an infrared sensor, which essentially performs the same function as the human eye, using a camera sensor. The radiation emitted by the infrared transmitter and received by the infrared receiver decreases as the waste approaches the infrared sensor due to the increase in the amount of waste. Debris can be detected by the reduction in energy of the infrared receiver. **[20,18]** After that, the waste moves onto the auxiliary conveyor and reaches the main conveyor. There is also an infrared sensor at the end of the main conveyor to detect debris. Then the isolated area begins. The bins are located in a separate area where sensors allow waste to be separated into wet and dry categories. If the waste is biodegradable and non biodegradable, it first falls into the corresponding bin from the circular platform turned by the servo motor, which is held at the bottom. When the waste falls into the appropriate container at the round base if defined as wet, and into the round bottom container if defined as dry. The integration of the Internet of Things is done to track and count waste. The Wi-Fi module chip is connected. The amount of waste belonging to wet and dry category is collected through IOT. **[16]**

3.4 Modules

- **Module 1: Hydro Cleaner**

This module collects waste from rivers with the help of IR sensors and this module is based on Arduino Nano.

- **Module 2: Trash Segregator**

This module segregates between biodegradable and non – Biodegradable wastes with the help of moisture sensor.

- **Module 3: Hydro Quality Check**

This module checks the quality of water with the help of TDS sensor and shows the Real time data on a system.

3.5 Implementation

At first, the infrared sensor decides in case the waste can is full or not. The IR sensor identifies whether the canister is full and informs the PIC16F877A chip. At that point, in understanding with the microcontroller's coded program, a servo engine turns the squander container in a 180° revolution after 1 seconds, permitting the squander to drop onto the sub transport. The sub conveyor starts to turn. The rubbish is presently landing on the most transport. After a small delay, the most transport starts to roll whereas the sub conveyor ends operation in understanding with the time delay indicated within the microcontroller program. Trash is spilling into the isolation container, which has dry, wet, and metallic sensors. The dampness sensor and metallic inductive nearness sensor are mounted and associated inside the segregation container. In arrange to identify garbage arrival, an IR sensor is additionally mounted at the conclusion of the most transport. The computer program causes the isolation container to turn 180 degrees. The servo engine is joined to one isolated collecting containers. Depending on the kind of trash and where it falls in connection to the particular squander collecting holder, the servo engine pivots either clockwise or counterclockwise. **[15]** It is conceivable to track the sum of each kind of squander, such as dry, damp, or metal squanders. The Wi-Fi chip has been arranged and connected. The user's portable phone will get data from the Web of Things (IoT) module that screens the rubbish. The collection of each kind of squander on the containers is shown by the smartphone app.

3.6 System Architecture

The system architecture of the IoT-based waste sorting boat is designed with several integrated components to achieve efficient and independent waste management in rivers. The strong structure of the boat, made of durable and waterproof materials, is the basis of its functionality. At its core is a motorized conveyor belt system, which is responsible for collecting and sorting the waste into the boat's containers. Biodegradable and non-biodegradable sensors that can use machine learning algorithms play a crucial role in identifying and separating waste types. A microcontroller or processor manages these sensors, the conveyor belt and other connected components, ensuring coordinated operation. The communication module enables real-time data transmission between the boat and the central monitoring station, which facilitates remote monitoring and management. **[13]** GPS and navigation system integration allows the boat to navigate waterways independently, while barrier systems increase safety. A power management system that includes an energy source such as solar panels or batteries optimizes energy use. **[12,14]** Collected data is sent to a cloud-based platform for storage and analysis, which provides insight into tree sorting patterns. Drivers can monitor and control the boat through the user interface, and an alarm system notifies them of malfunctions or critical situations. Security features, including data encryption, ensure the integrity of communication between the boat and the central monitoring station. This comprehensive architecture combines various elements to create a powerful IoT-based solution for river cleaning and waste sorting.

In this section, we discuss the procedure for working with multiple components.

3.6.1 Arduino Nano:

The Arduino Nano is a small but powerful microcontroller board with an ATmega328P microcontroller at its core, which is used in the larger Arduino Uno. The compact design is ideal for projects with limited space. A USB connection allows the Nano to easily interface with a computer for programming and power. **[10,3]** It operates at 5V and can be powered via USB or external power supply. Despite its small size, the Nano offers a variety of digital and analog I/O pins to handle a variety of connections to sensors, transducers, and other components. Nano supports serial, I2C and SPI communications, ensuring compatibility with a wide range of devices and components. It was programmed using the Arduino IDE, which simplifies the coding and deployment process. Arduino Nano is popular among hobbyists, students, and professionals for a wide range of electronic projects, including mechanical engineering and prototyping.

Figure 3.6.1. Arduino Nano

3.6.2 Moisture Sensor:

A moisture sensor is a device designed to measure the moisture content of the environment, especially soil and other materials. These sensors play an important role in agriculture, horticulture and environmental monitoring by providing real-time data on soil moisture levels. Sensors typically use conductive or capacitive technologies to measure the electrical conductivity and dielectric properties of soil, which vary with moisture content. As soil moisture increases, the conductivity, or strength, increases and the sensor can calculate moisture levels. This information will help you determine the best watering method and prevent you from overwatering or drowning your plants. The simplicity and ease of installation of humidity sensors is an important tool to maintain optimal humidity conditions in various environments, contributing to the conservation of the material and improving the health of the plants. **[6]**

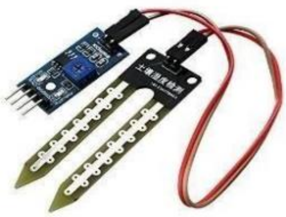

Figure 3.6.2. Moisture Sensor

3.6.3 TDS Water Conductivity Sensor:

Total Dissolved Solids (TDS) is a device designed to measure the conductivity of water and provide information about the concentration of dissolved solids in water. This measurement plays an important role in the assessment of water quality because it contains minerals, salts and various organic and inorganic substances in dissolved form. Typically, testers using the conductivity scheme immerse the electrodes in water to measure the conductivity between the electrodes. Calibration is a critical process involving standard solutions containing known concentrations of TDS to convert conductivity values into meaningful TDS measurements. Sensors and outputs are expressed in parts per million (ppm) or milligrams per liter (mg/l). Widely used in industries such as agriculture, aquaculture, environmental monitoring, water treatment and laboratories, these sensors contribute to water quality control. Regular maintenance, including electrical cleaning, and following the manufacturer's repair instructions are essential to ensure accurate and reliable readings over time. It is important to note that TDS sensors generally measure dissolved solids but do not detect ions or chemicals in water. Further experimental methods are required for detailed analysis. **[8,11]**

Figure 3.6.3 TDS Water Conductivity Sensor

3.6.4 Dallas Temperature Sensor:

Dallas temperature sensors, which refer to a family of digital temperature sensors manufactured by Maxim Integrated under the DS18B20 brand, are widely used in temperature measurement devices. These sensors use a single communication protocol, which allows multiple sensors to be connected to the same bus. **[7,9]** Known for their accuracy and ease of use, Dallas temperature sensors provide digital temperature readings without the need for analog-to-digital conversion circuitry. Each sensor has a 64-bit address, which is easily identifiable in various sensor configurations. These sensors are used in a variety of applications, including weather stations, industrial automation, and electronic devices that require temperature control. Due to its easy installation and stable performance, Dallas temperature sensors are widely used for temperature detection in a variety of fields.

Figure 3.6.4 Dallas Temperature Sensor

3.6.5 ESP Microcontroller:

ESP microcontrollers, such as ESP32 or ESP8266, are a powerful and affordable option for IoT projects. Built-in Wi-Fi provides a seamless connection, perfect for applications ranging from home automation to wireless networking. The ESP32, on the other hand, is designed for Internet of Things projects and comes with a dual-core processor, more GPIO pins, Bluetooth connectivity, and a touch sensor. Both microcontrollers provide full GPIO functionality for interaction with various components and support programming using the Arduino IDE. **[5]** Support for platforms such as Platform IO and low-power versions promotes flexible and energy-efficient development. Offering wireless connectivity and agility for a variety of applications, ESP microcomputers have become a staple of IoT communities and professionals due to their strong community and easy to-access programming environment.

Figure 3.6.5 ESP Microcontroller

4. RESULT & DISCUSSION

Pure water maintains a pH of approximately 7, which is similar to the pH of the human eye and GV mucous membrane. Human health concerns due to the low pH levels found in lemon-enriched water include skin irritation and eye burns on contact. This acid reduces the effectiveness of antibiotics. However, water with a pH above 7.5 is considered alkaline, and highly alkaline water, such as calcium hydroxide, may be unsafe to eat. Turbidity, a major concern for humans and aquatic life, should not exceed 5 NTU for safe drinking. Pure water is safe to use around 2-3 NTU. However, water with a turbidity greater than 5 NTU can cause serious health problems, especially when mixed with other substances. Monitoring the temperature between 17 and 30 degrees is very important for human life, agriculture and biological life. Regular evaluation of these parameters ensures the safety and quality of water for various applications. This technology shows the implementation of a core technology called ML that has been integrated into the IOT to find solutions that make the environment safer. **[4,1]** This article will open new doors for you to tackle the waste management that has been bothering you and avoiding you. This could be the beginning of creating a healthy environment by introducing advanced technology.

4.1 TDS Sensor

In Figure 4.1 shows the TDS sensor, IoT-based ships use dissolved solids (TDS) sensors to measure the concentration of dissolved solids in water. It helps monitor water quality by providing information on the amount of dissolved substances such as salts and minerals.

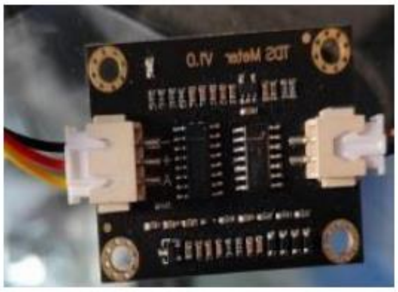

Figure 4.1 TDS Sensor

4.2 Esp 32 cam model front

In Figure 4.2 shows the front of the ESP32 Cam model, By integrating the ESP32-CAM into an IoT system, users can monitor their ships and the environment in real time. This helps in remote control, navigation and decision making based on camera video information.

Figure 4.2 Esp 32 cam model front

4.3 ThingSpeak Server

In Figure 4.3 there are two fields that shows Two different charts Filed 1 shows the Temperature reading and Field 2 shows the Electrical Conductivity readings. ThingSpeak is an IoT analytics platform service that allows you to collect, view and analyse real-time data streams from the cloud. You can send data from your device to ThingSpeak, which will monitor the data in real time and send alerts.

Figure 4.3 Think Speak Server Readings

5. CONCLUSION

Automating water quality monitoring is critical to environmental protection, and the introduction of mobile and sensor systems will facilitate this process. The Wi-Fi module allows you to evaluate the water quality. This automated approach has not only proven to be costeffective, but saves time and resources by eliminating the need for manual intervention. Its versatility and scalability make it a valuable asset in a variety of situations and play an important role in water quality monitoring. The autonomy of the system corresponds to the nature of the use of new technologies to increase efficiency and reliability and to protect the environment. **[2,3]**

6. FUTURE SCOPE

This platform is an open and modular system that allows the future addition of (bio)electrochemical sensors, such as advanced pH detectors or dedicated trihalomethane sensors, which are important for the detection of common toxic chlorine byproducts. The advantages of the miniaturized use of high-resolution sensors in water distribution networks are clear. Expandable capabilities and integration of various sensors enable the system to effectively identify water sources of arsenic, highlighting its adaptability and advanced capabilities for comprehensive water quality monitoring.**[1]**

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AUTHORS

Richa Saxena received her M. Tech degree in Computer Science & Engineering in 2013 from TMU and pursuing PHD. She is currently an Assistant Professor in the CSE Department at MIT with 14 years of professional experience. She has wide expertise in Cloud Computing with a strong background in Networking. Ethical Hacking. Python. IoT and has completed several STCs from NITTTR. Chandigarh and FDP's workshops and trainings from various recognized organizations**.**

Mohammad. Arsh is a driven and inquisitive student researcher with a passion for Academic exploration and intellectual growth. Currently pursuing Bachelors of Technology in Computer Science and Engineering from Moradabad Institute of Technology and graduating in 2024. He has connected their interest in IOT, Cloud Computing, Cyber Security and Computer Networks. He has done a lot of various Courses like Linux from Great Learning, Java Offered by Edureka.

Jyoti Saini, an undergraduate B.Tech student in department of Computer science and engineering at Moradabad Institute of Technology and will graduate in 2024. I have done certification in C programming language and Python by Spoken Tutorial from IIT Bombay, HTML, CSS, JavaScript, Java, C/C++, python etc. I have great passion for both front end, backend Web Development and Strong skills in Responsive Design. Detailed -oriented with focus on Delivery Quality work I am interested in many of the technical fields such as IOT, Cloud Computing etc.

Jhalak Bhardwaj is an undergraduate B.Tech student in department of CS&E at Moradabad Institute of Technology and will graduate in 2024. She has done Certification in Web Development from Duke University by Coursera and also doing 2 months internship in Full Stack Web Development offered by Corizo Company, basic python, C++, C programming etc.

Manasvi Agarwal is an undergraduate B.Tech student in department of CS&E at Moradabad Institute of Technology and will graduate in 2024. She has done Certification in Web Development from Coursera and also done Spoken Tutorial Python Course. She is fascinated towards Web Development, Cloud Computing and IOT.

Monika Giri is an undergraduate B.Tech student in department of CS&E at Moradabad Institute of Technology and will graduate in 2024. She has done Certification in C programming from Spoken Tutorial and Python Programming from Cisco Netcad Academy. She is interested in following technologies like IOT, Cloud Computing and Web Development.