



**SANA**  
Model School

# **BIOSMART FILTER: A PROTOTYPE FOR AI- POWERED BIODEGRADABLE SEWAGE TREATMENT (PROTOTYPE)**

**Project ID:**

NSF-SCH-2025-348

**Name of Student:**

Syed Ibrahim

**School:**

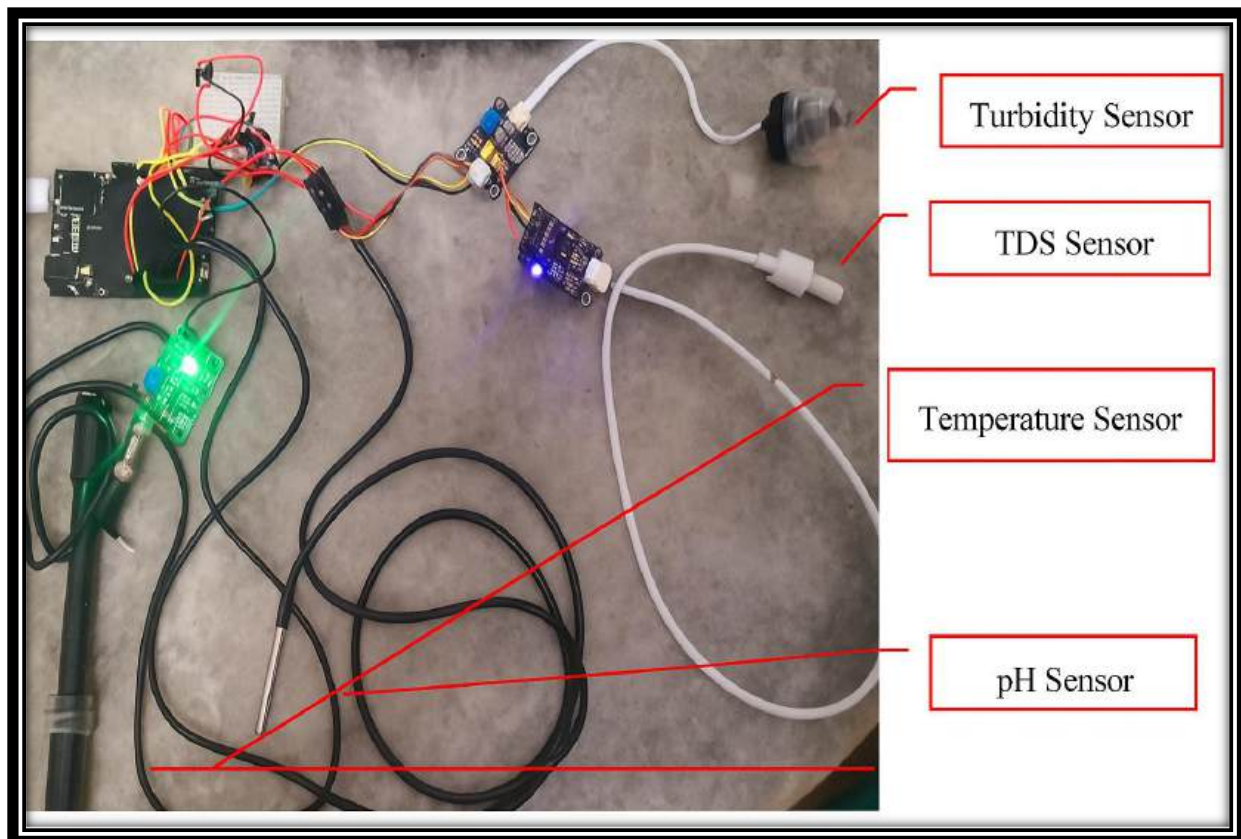
Sana Model School

**Address:**

Kattuppakkam, Chennai

## 1. Project ID and Title

- **Project ID:** NSF-SCH-2025-348
- **Project Title:** BioSmart Filter: A Prototype for AI Powered Biodegradable Sewage Treatment (Prototype)
- **Participant Name:** Syed Ibrahim
- **School:** Sana Model School
- **City & State:** Kattuppakkam, Chennai – 600056 , Tamil Nadu



## 2. INTRODUCTION – Research Question

- *Water pollution and untreated sewage have emerged as one of the greatest environmental challenges in India and across the world.*
- *The increasing discharge of contaminants into water bodies has led to unsafe water for human use and agricultural purposes.*
- *This project aims to address this issue by developing a **low-cost, eco-friendly, and AI-powered biodegradable sewage treatment prototype** called **BioSmart Filter**.*
- *It uses **natural bio-adsorbents** (like coconut coir, banana peel powder, and activated charcoal) combined with **IoT-based sensors** — pH, TDS, Turbidity, and **Temperature (DS18B20)** — for real-time monitoring of water quality through the **Blynk IoT platform**.*
- *The goal of this research is to determine **whether biodegradable materials can effectively purify wastewater** and to measure the **extent of purification** using real-time data before and after filtration.*
- *The AI and IoT integration enhances the predictability of water quality, promoting a more sustainable and intelligent wastewater management system.*

## 3. Methodology and Procedures

### ❖ System Overview

- *The BioSmart Filter system consists of:*
  1. A **bio-filtration unit** made from natural biodegradable materials.
  2. A **smart sensor unit** with four sensors:
    - *pH Sensor*
    - *TDS Sensor*
    - *Turbidity Sensor*
    - *DS18B20 Temperature Sensor*

*These sensors collect continuous data about the water's quality.*

*The **ESP8266 NodeMCU** processes this data and sends it wirelessly to the **Blynk IoT dashboard** for monitoring.*

### ❖ Step-by-Step Methodology

#### 1. **Sensor Setup:**

*All four sensors (pH, TDS, Turbidity, and DS18B20 Temperature) are connected to the **ESP8266** through the **ADS1115 ADC module** for improved accuracy.*

## **2. Water Sampling:**

*Collect sewage water samples from a local source for testing.*

## **3. Filtration Process:**

*The BioSmart Filter is built using a layered arrangement of gravel, sand, activated charcoal, banana peel powder, and coconut coir. The wastewater passes through these layers, undergoing natural filtration.*

## **4. Data Collection:**

*The sensors collect data before and after filtration, transmitting it to Blynk via Wi-Fi.*

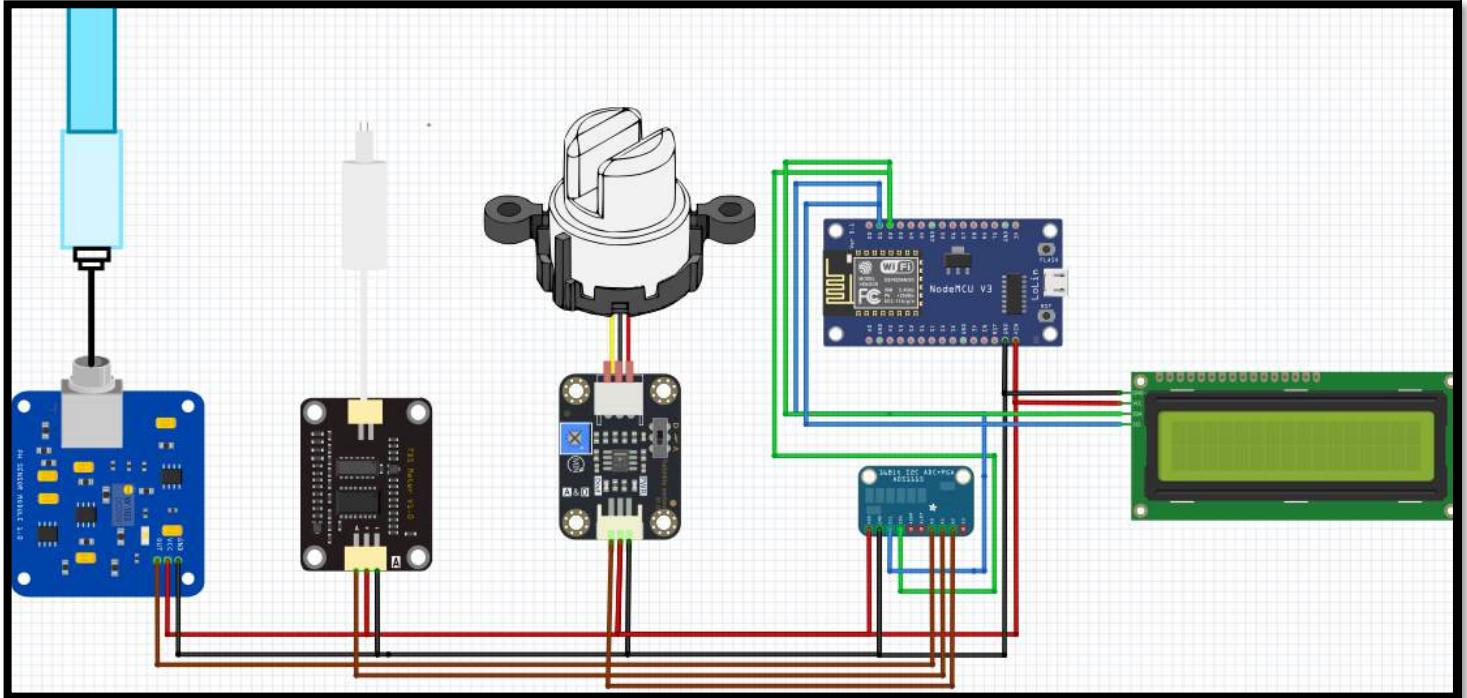
## **5. Data Analysis:**

*The change in pH, TDS, turbidity, and temperature readings is used to determine the purification efficiency.*

## **6. AI Prediction (Concept):**

*Collected data can be processed to predict trends in water quality using a basic machine-learning approach for future optimization.*

## ❖ *Circuit Diagram*



### **1. pH Sensor Module**

- **VCC → 3.3V (NodeMCU)**
- **GND → GND**
- **Analog OUT → A0 (NodeMCU)**

### **2. TDS (Total Dissolved Solids) Sensor**

- **VCC → 3.3V**
- **GND → GND**
- **Signal → ADS1115 Analog Input Channel (A0)**

### **3. Turbidity Sensor**

- **VCC → 3.3V**
- **GND → GND**
- **Signal → ADS1115 Analog Input Channel (A1)**

### **4. ADS1115 ADC Module**

- **VCC → 3.3V**
- **GND → GND**
- **SDA → D2 (GPIO4)**
- **SCL → D1 (GPIO5)**
- **A0 → TDS Sensor Output**
- **A1 → Turbidity Sensor Output**
- **ADDR → GND (Default address 0x48)**

### **5. I2C LCD (16x2 Display)**

- **VCC → 3.3V**
- **GND → GND**
- **SDA → D2 (GPIO4)**
- **SCL → D1 (GPIO5)**

## 4. RESULTS – Data and Observations

### ❖ Observed Readings

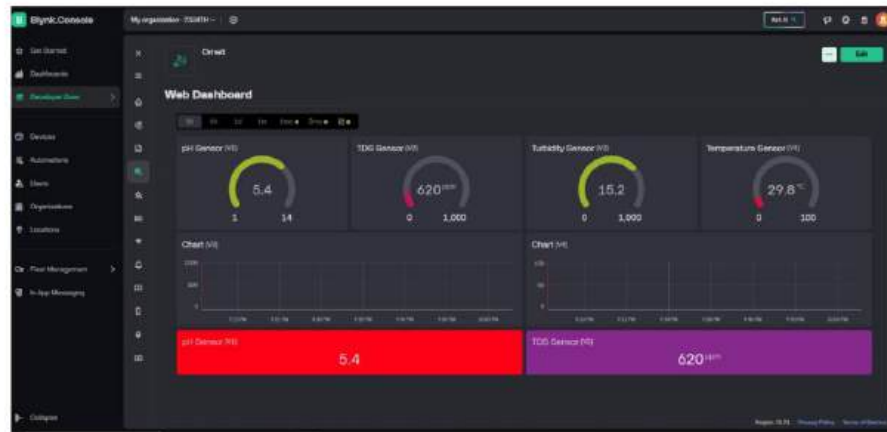
Parameter	Before Filtration	After Filtration	Observation
pH	5.4	7.0	The pH shifted from slightly acidic to nearly neutral, making the water safe and balanced for reuse.
TDS (ppm)	620	230	The TDS levels dropped greatly, indicating major removal of dissolved impurities and making the water suitable for domestic and agricultural purposes
Turbidity (NTU)	15.2	4.1	The turbidity decreased sharply, transforming the water from cloudy and impure to visibly clear and usable.
Temperature (°C)	29.8	27.1	A slight reduction in temperature was observed due to cooling through the filter media, confirming system stability during operation.

## ❖ Analysis

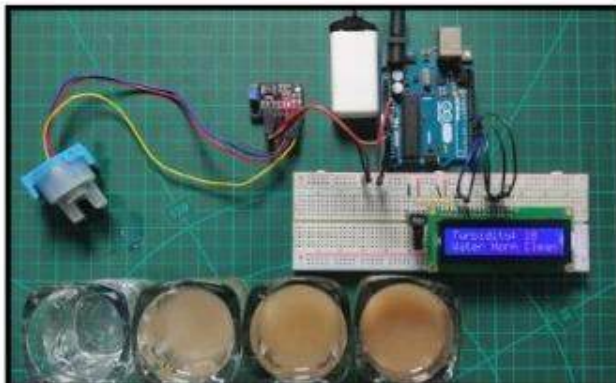
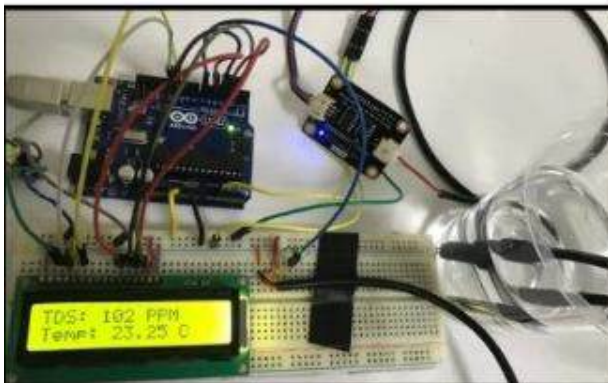
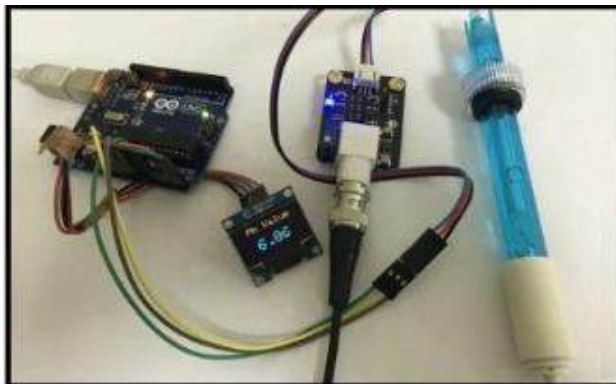
After filtration, the readings show a clear improvement across all parameters:

- The **pH increased** from acidic (5.4) to nearly neutral (7.0), making it safe for reuse.
- The **TDS dropped** from 620 ppm to 230 ppm, indicating effective removal of dissolved impurities.
- **Turbidity reduced** from 15.2 NTU to 4.1 NTU, giving visibly clearer water.
- The **temperature** stabilized slightly, showing minimal heat retention in the bio-filter.

BEFORE



AFTER



## 5. DISCUSSION – Interpretation of Results

- The results show that biodegradable materials can efficiently purify wastewater.
- The combination of **coconut coir, banana peel powder, and activated charcoal** helped in both **adsorption of pollutants** and **neutralization of acidity**.
- The IoT setup successfully monitored water quality in real-time through **Blynk**, allowing instant observation of the effect of each filtration layer.
- The **temperature sensor** helped confirm stable thermal conditions, ensuring consistent sensor readings.
- Possible minor errors could arise from:
  - Sensor calibration drift
  - Inconsistent flow rate
  - Uneven layering in the bio-filter

However, repeated tests produced similar results, confirming the reliability of the system.

## 6. CONCLUSIONS

The **BioSmart Filter** demonstrates that biodegradable and natural materials can purify wastewater effectively when combined with **smart digital monitoring**.

- Water quality improved in all tested parameters, showing a strong potential for rural and small-scale sewage treatment.
- Integration of the **DS18B20 temperature sensor** enhanced data reliability by ensuring all readings were thermally stable.
- This prototype offers a **low-cost, environment-friendly, and educational solution** that promotes awareness of sustainable water treatment practices.

## **7. APPLICATIONS / UTILITIES**

### **1. Domestic Use:**

**Can be installed in homes to monitor and improve tap or borewell water. Real-time readings of pH, TDS, turbidity, and temperature help ensure the water is safe for daily consumption.**

### **2. Sewage and Wastewater Treatment:**

**Serves as a low-cost, intelligent pre-filtration unit to detect contaminants and improve purification efficiency in local treatment systems.**

### **3. Agricultural Application:**

**Helps farmers assess irrigation water quality, ensuring soil and crop health by maintaining suitable pH and TDS levels.**

### **4. Industrial Monitoring:**

**Monitors factory effluents to ensure compliance with environmental standards before discharge, preventing water pollution.**

### **5. Emergency Relief Use:**

**Portable setup can be deployed during floods or natural disasters to quickly check and purify contaminated water for immediate use.**

### **6. Educational and Research Purpose:**

**Acts as a demonstration model to teach students about sustainable technology, sensor-based monitoring, and environmental protection.**

## 8. COST ESTIMATION

<b>Component</b>	<b>Approx. Cost (₹)</b>
pH Sensor	1400
TDS Sensor	500
Turbidity Sensor	450
DS18B20 Temperature Sensor	60
ESP8266 NodeMCU	250
ADS1115 ADC Module	125
Miscellaneous (wiring, breadboard, Blynk)	275
Biodegradable Filter Materials	140
<b>Total Estimated Cost</b>	<b>₹3,200</b>

## 9. FUTURE SCOPE

- **Automated AI Control System:**

*Integrate advanced AI algorithms to automatically adjust filtration rate and predict when filter layers need replacement based on sensor trends.*

- **Enhanced IoT Integration:**

*Upgrade to **ESP32** for faster processing and add **cloud data logging** for long-term water quality tracking.*

- **Solar-Powered Operation:**

*Introduce renewable energy support to make the system fully self-sustaining and ideal for remote or off-grid locations.*

- **Improved Biodegradable Layers:**

*Experiment with additional organic materials like **rice husk, orange peel, or neem bark** to further improve adsorption efficiency and filter lifespan.*

- **Compact Modular Design:**

*Create a portable version for households or emergency use, allowing quick setup and maintenance.*

- **Community Water Monitoring Network:**

*Connect multiple BioSmart Filters via IoT for **real-time water quality mapping** across different areas to support Smart City initiatives.*

## 10. BIBLIOGRAPHY

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