IES COLLEGE OF ENGINEERING
(An ISO 9001: 2008 Certified Institution)
Chittilappilly P.O., Thrissur, Kerala - 680 551, Ph : 0487-2309966, 2309967
Fax: 2307077, E-mail: mail@iesce.info, www.iesce.info
Approved by AICTE. New Delhi & Affiliated to APJ Abdul Kalam Technological University

AI-Powered Water Quality Detection and Purification Recommendation System using Refractive Index

ABIN SANTHOSH [Reg. No. IES22CS006]
ADHITH SUNIL [Reg. No. IES22CS007]
ADHWAITH T T [Reg. No. IES22CS008]
ANITTA RAPHI E [Reg. No. IES22CS025]

Department of Computer Science and Engineering
IES COLLEGE OF ENGINEERING,CHITTILAPILLY,THRISSUR
Under the Guidance of Ms. MEETHU M B
Assistant Professor,Department of CSE

TARGETS OF THE MAIN PROJECT WORK

ACTIVITIES	STATUS	ACTIVITIES	STATUS
Domain & problem identified	Yes	Development of product	No
Literature Review	Yes	Testing	No
Objectives formulated	Yes	Obtained Result	No
Methodology / Design	No	Documentation	No
Created work plan and task allocation	No	Report submission	No

INTRODUCTION

- Water pollution from industrial and domestic waste poses serious **health risks** and **degrades water** quality.
- Regardless of **time—past, present, or future**—we must know our water before consuming it to protect health and ensure well-being.
- To consume water safely, ones must first **identify the impurities** and then choose the **right purification method**.
- The base paper reviews traditional physico-chemical analysis techniques like **pH, turbidity, TDS, and hardness**.
- Introduce **refractive index** as a novel parameter and **integrate AI** to enhance detection accuracy and suggest purification strategies.

PROBLEM STATEMENT

- Water quality monitoring is vital for safe usage, but current practices often separate pollutant detection, data analysis, and purification. This **fragmented approach** leads to delays in identifying harmful substances like TDS, turbidity, and pH, making water treatment **less effective** and increasing health risks.

OBJECTIVES

- review key **physico-chemical** parameters such as pH, turbidity, TDS, and hardness that influence water quality and health risks.
- introduce **refractive index** as an additional parameter for enhancing the accuracy of water impurity detection.
- support informed water usage decisions by providing users with clear, actionable **purification recommendations** based on detected contaminants.

EXISTING SYSTEM

- Traditional water testing uses lab methods like titration, spectrophotometry, and flame photometry to check chemical levels in water.
- These systems measure parameters such as pH, turbidity, temperature, DO, BOD, COD, nitrates.
- While accurate, these methods are time-consuming, require skilled personnel, and are not suitable for real-time or remote monitoring.
- Modern IoT-based systems use sensors iwith microcontrollers like ESP8266 to monitor pH, turbidity, and temperature in real time.
- These systems display data locally via OLED screens and transmit readings to cloud platforms, enabling mobile alerts and remote access through applications like Blynk IoT.

LITERATURE REVIEW

SL	NAME OF THE PAPER	OUTCOME	AUTHOR AND PUBLICATION DETAILS
1	AI-Driven Transformation of Water Treatment Technology	Explored AI's role in optimizing water treatment processes and industry innovation.	Lili Jin, Hui Huang, Hongqiang Ren, Frontiers of ESE, 2025
2	Emerging Trends in Real-Time Water Quality Monitoring	Highlighted IoT and sensor-based systems for global water sanitation challenges.	Preeti Verma, Pankaj Mehta, IntechOpen, 2025

LITERATURE REVIEW (Contd.)

SL	NAME OF THE PAPER	OUTCOME	AUTHOR AND PUBLICATION DETAILS
3	Effect of Temperature and Wavelength on Refractive Index of Water	Measured refractive index variations using fiber-optic sensors for water purity analysis.	Esra Kendir, Şerafettin, Indian Journal of Physics, 2022
4	Science and Technology for Water Purification: Achievements	Surveyed advanced purification technologies including membrane filtration and adsorption	Yuanfeng Qi and Kai He, MDPI Water, 2025

LITERATURE REVIEW (Contd.)

SL	NAME OF THE PAPER	OUTCOME	AUTHOR AND PUBLICATION DETAILS
5	Recent developments in water purification	Shows that advanced water-purification technologies: hybrid oxidation systems, advanced membranes, AI-driven purification	Ramakant, Shuchi, Manvi, IJ Advanced Chemistry Research,2025
6	AI for clean water: efficient water quality prediction	Real-time prediction of multiple water quality parameters enabling optimization	Ansari et al, Water Practice & Technology, 2024

LITERATURE REVIEW (Contd.)

SL	NAME OF THE PAPER	OUTCOME	AUTHOR AND PUBLICATION DETAILS
7	Water Expert (rule-based DSS)	Hybrid rule-based expert system for water decontamination decisions	Gutenson ,Drink. Water Eng. Sci. Discuss ,2015
8	DOxy: A Dissolved Oxygen Monitoring System	Low-cost IoT system calibrated for DO sensing using pulse-oximetry in water environments	Shaghaghi, MDPI ,2024

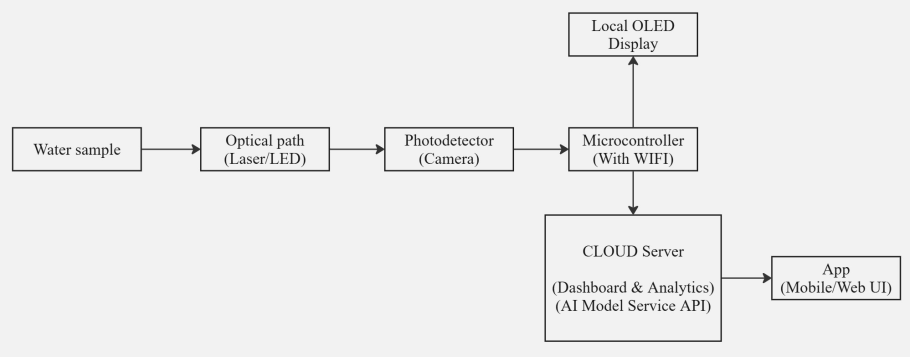
LITERATURE REVIEW (Contd.)

SL	NAME OF THE PAPER	OUTCOME	AUTHOR AND PUBLICATION DETAILS
9	Water Quality Monitoring System Based on IoT	Arduino-based system with pH, temp, water level + automation	Dr. B. Shravan Kumar, G. Rohith, A. Sai Balaji, E. Tanishq, IJETRM, March 2025
10	Low-Cost IoT System for Turbidity Measurement	Real-time turbidity monitoring using low-cost sensors	Nur Amalina Binti Rosle, Bin Alias, IEEE, 2024

PROPOSED SYSTEM

- **AI-Powered Refractive Index Analysis:** Utilizes laser-based refractometry and machine learning to detect water quality based on optical properties.
- **Hybrid Training Dataset:** Combines lab-based spectrophotometry data and sensor-based readings to train robust classification models.
- **Smart Purification Recommendations:** Suggests optimal purification methods like filtration, UV, chemical treatment based on detected contaminants.
- **Cloud-Enabled Monitoring:** Supports real-time data logging, remote access, and continuous model refinement via cloud integration.
- **Scalable Deployment:** Designed for portability and affordability, ideal for use in rural, urban, and disaster-prone regions.

PROPOSED SYSTEM



Methodology workflow

Sensor Setup & Signal Acquisition

- Calibrate laser and photodetector system.
- Capture optical signal changes through water sample.
- Record auxiliary parameters: temperature, pH, turbidity.

Preprocessing & Feature Extraction

- Denoise, normalize, and compensate for temperature drift.
- Derive refractive index features from signal profile.
- Optionally convert signals to image-like format for CNN.

Methodology workflow (Contd.)

AI Model Development

- Train CNN or ML model (classification/regression).
- Validate using k-fold cross-validation and metrics (F1/MAE).
- Export model in edge-compatible format (e.g., TFLite).

Edge Inference & Local Feedback

- Deploy model on microcontroller (ESP8266/RPi).
- Perform real-time prediction from sensor input.
- Display water quality status via OLED or LEDs.

Methodology workflow (Contd.)

Cloud Integration & Recommendations

- Log data to cloud (Firebase/ThingSpeak) via Wi-Fi.
- Visualize dashboards, issue alerts.
- Map predictions to actionable purification advice.

TOOLS / MATERIALS / RESOURCES USED

Hardware specifications:

- Laser Diode and Photodetector
- Microcontroller: ESP8266
- OLED Display Module (I2C interface)
- Power Supply: 5V regulated adapter or battery pack

Software specifications:

- Programming Language: Python
- AI Frameworks: TensorFlow, Scikit-learn
- Cloud Platform: Firebase or ThingSpeak
- Development Environment: Jupyter Notebook, VS Code

ADVANTAGES

- **Quick Detection:** Measures water quality instantly using light-based refractive index sensing.
- **Smart Recommendations:** AI suggests the best purification method based on detected impurities.
- **No Chemicals Needed:** Works without adding any chemicals or damaging the water sample.
- **Easy to Use:** Simple setup with microcontroller and display, no lab skills required.
- **Remote Monitoring:** Sends data to cloud platforms so users can check water quality from anywhere.

WORK PLAN

ABIN SANTHOSH	Monitoring and Reporting, Quality Assurance
ADHITH SUNIL	Designing and Coding
ANITTA RAPHI E	Documentation, Resource Allocation
ADHWAITH TT	Testing and Validation

FEASIBILITY ANALYSIS

1. **Economic Feasibility**
   - Low-cost hardware: laser diode, photodetector, ESP8266.
   - Reduces lab testing expenses and manual sampling.
   - Major costs: AI model development and cloud integration.
2. **Operational Feasibility**
   - Easy deployment in homes, farms, and industries.
   - Real-time water quality alerts and purification suggestions.
   - Reduces health risks by enabling timely action.

FEASIBILITY ANALYSIS

3. **Technical Feasibility**
    - Uses AI models trained on refractive index data.
    - Compatible with microcontrollers and cloud platforms.
    - Scalable with cloud services and edge computing.

4. **Legal & Ethical Feasibility**
    - Complies with environmental data regulations.
    - Requires transparency in data collection and usage.
    - Promotes safe water practices and public awareness.

FEASIBILITY ANALYSIS

5. Scalability & Future Feasibility

- Can be scaled to smart cities, rural areas, and industries.
- Future upgrades: IoT sensors, mobile apps, advanced AI.
- Long-term solution for global water safety and sustainability.

SCOPE OF PROJECT

- Foundation for future integration with **IoT-based** water monitoring networks, enabling continuous and remote data collection.
- Extended to mobile platforms, making water testing accessible through smartphones and **portable devices**.
- Opens avenues for further **research** in AI-driven environmental monitoring and smart purification systems.
- Serve as a prototype for **smart city infrastructure**, contributing to automated water safety networks.

CONCLUSION

This AI-powered water quality detection system uses refractive index analysis and machine learning to provide fast, non-invasive, and accurate assessment of water safety. It offers smart purification recommendations and remote monitoring, making it a practical and scalable solution for improving water quality in both urban and rural environments.

Thank You