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"Fostering a Culture of Innovation and Entrepreneurial Excellence"

23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

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A-ST056: SMART WATER QUALITY DETECTOR

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ABSTRACT

Water pollution is a critical threat to public health and ecosystems, particularly in regions like Selangor, where water supply disruptions are increasing due to contamination at water treatment facilities. The Smart Water Quality Detector (SWD) offers an innovative solution by leveraging advanced sensors, IoT connectivity, and data analytics to continuously monitor water quality parameters, including pH, electrical conductivity, and dissolved oxygen. This real-time system enables early detection of polluted water before it reaches treatment centers, preventing blockages and minimizing delays in water supply. Traditional water monitoring methods are manual, costly, and prone to damage with prolonged use. SWD overcomes these limitations with a cost-effective, durable design that ensures accurate, automatic monitoring while reducing operational costs and extending sensor lifespan. It also provides early alerts to communities, allowing for preparedness and immediate corrective actions to avoid health risks from contaminated water. Aligned with Sustainable Development Goal 6 (SDG 6), SWD promotes sustainable water management by reducing pollution and ensuring access to safe water. This innovation offers a robust and accessible solution, addressing water quality challenges effectively and enhancing environmental and public health protection.

Keywords: Water Quality Detector, water pollution, SDG, environmental, water treatment.

1. Product Description

The Smart Water Quality Detector (SWD) is an innovative solution designed to tackle the increasing challenge of water pollution. Utilizing cutting-edge sensor technology, IoT connectivity, and data analytics, SWD monitors key water quality parameters, including pH levels, electrical conductivity, and dissolved oxygen, in real-time. This ensures immediate detection of contamination, allowing for proactive responses before polluted water disrupts treatment processes or impacts supply systems. Unlike conventional methods that rely on manual monitoring or costly equipment prone to damage, SWD is built for durability and efficiency. Its robust design ensures extended sensor lifespan, reducing operational costs while delivering precise and reliable data. The system's automated alerts notify communities of potential water supply disruptions, helping them prepare and avoid the health risks associated with consuming contaminated water. Designed with sustainability in mind, SWD supports Sustainable Development Goal 6 (SDG 6) by promoting pollution reduction, minimizing hazardous waste, and enabling sustainable water management. Whether for water treatment facilities or community-level applications, the SWD provides a smart, cost-effective solution to monitor, protect, and ensure the availability of safe water. With its user-

friendly features and innovative approach, SWD empowers communities and organizations to safeguard water resources effectively.

2. Design Framework and Data Representation of SWD.

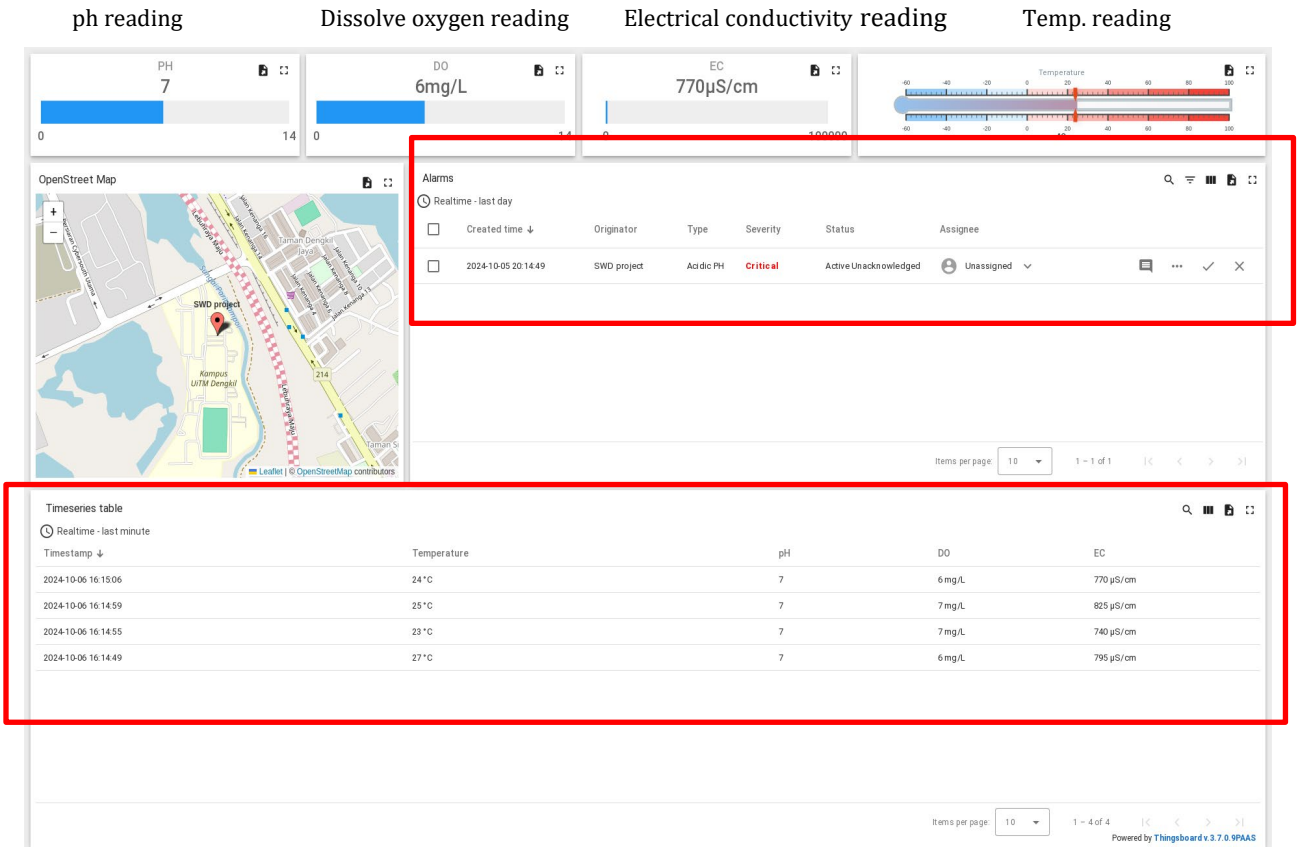

Figure 1. SWD Dashboard

The dashboard for the Smart Water Quality Detector is designed to provide users with a comprehensive, real-time view of critical water quality parameters. It features intuitive visualizations and functional components to ensure ease of use and quick decision-making.

Key Features of the Dashboard:

1. Temperature Reading: Displays real-time water temperature to monitor environmental conditions.
2. Electrical Conductivity (EC) Reading: Tracks the electrical conductivity of the water, which is an indicator of the ionic concentration and potential contaminants.
3. Dissolved Oxygen (DO) Reading: Shows the amount of oxygen dissolved in the water, an essential parameter for aquatic life health.
4. pH Reading: Monitors the acidity or alkalinity of the water, which is crucial for maintaining a balanced ecosystem.

5. Time-Series Table: Presents a detailed log of all recorded readings (temperature, EC, DO, and pH) in a tabular format, enabling users to analyze trends and historical data effectively.
6. Alarm Indicator: Integrated alert system that activates when any parameter exceeds the normal threshold, highlighting potential water quality issues that require immediate attention.

   General Alarm System Recommendations:
   pH: Alarm at < 6.0 or > 9.0
   DO: Alarm at < 5.0 mg/L
   EC: Alarm at > 1,000 µS/cm

The dashboard combines dynamic charts, tables, and visual alerts, ensuring a user-friendly interface that simplifies water quality monitoring. This design ensures that even users without technical expertise can quickly interpret the data and respond to anomalies, making it highly suitable for diverse applications such as aquaculture, industrial water treatment, and environmental monitoring.

Table 1. Data Monitoring Table

Sample	pH	DO (mg/L)	EC (µS/cm)
1	6.8	5.5	780
2	7.1	6.3	810
3	7.4	5.8	795
4	6.5	7	740
5	7.2	6.5	825
6	6.9	6.1	770

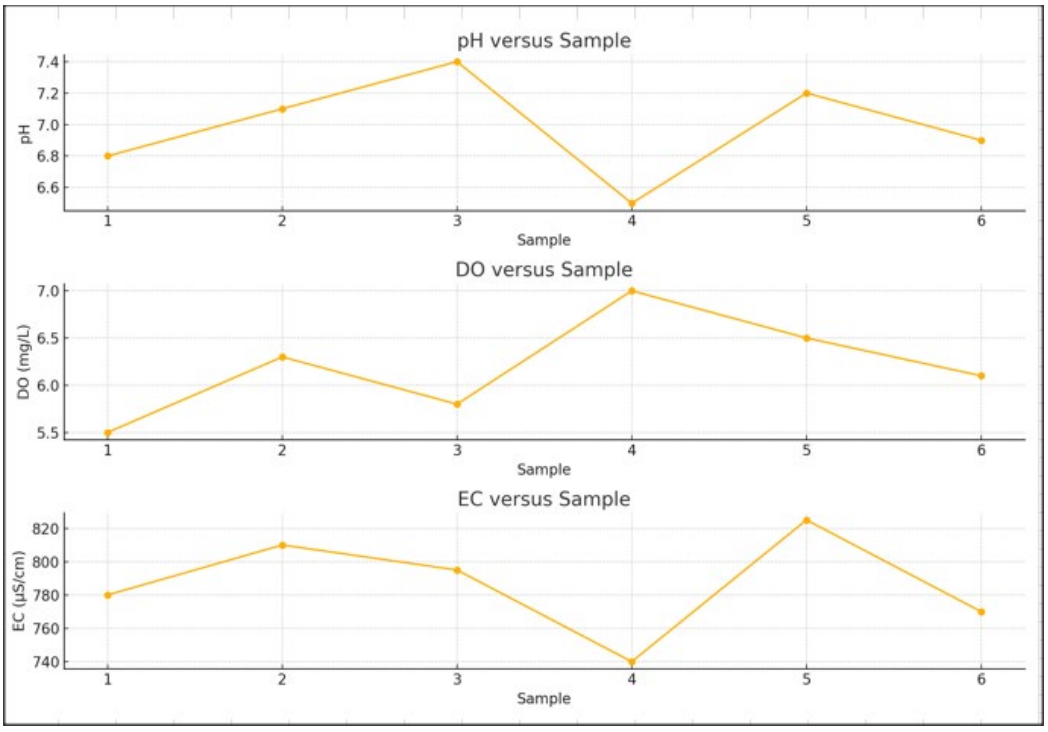

Figure 2. Trends of pH, DO, and EC readings across six samples

Graph Analysis and Prediction

pH Analysis

The pH values exhibit minor fluctuations, ranging between 6.5 and 7.4, indicating a relatively stable environment. The highest pH value is observed at Sample 3 (7.4), followed by a drop at Sample 4 (6.5) and a recovery to 7.2 at Sample 5. This pattern may reflect external influences such as increased organic material or pollutants leading to the dip in Sample 4, with natural recovery or remediation processes restoring balance at Sample 5.

Prediction: The pH is anticipated to remain within the 6.5 to 7.4 range, with minor fluctuations. Regular monitoring is advised to mitigate potential acidity issues during occasional dips.

Dissolved Oxygen (DO) Analysis

DO levels vary between 5.5 mg/L and 7.0 mg/L. The highest concentration is recorded at Sample 4 (7.0 mg/L), while the lowest is at Sample 1 (5.5 mg/L). These fluctuations may result from factors such as water temperature, the presence of algae or aquatic plants, and pollution levels.

Prediction: DO levels are expected to remain within the 6.0 to 7.0 mg/L range, with occasional dips due to environmental factors. A drop below 5.5 mg/L could stress aquatic life, emphasizing the need for regular monitoring.

Electrical Conductivity (EC) Analysis

Electrical conductivity ranges from 740 µS/cm to 825 µS/cm, reflecting variations in ion concentrations. The lowest EC value occurs at Sample 4 (740 µS/cm), while the highest is at Sample 5 (825 µS/cm). These changes likely correlate with variations in dissolved salts, minerals, or potential contamination.

Prediction: EC is projected to fluctuate between 750 and 830 µS/cm. Sustained increases may signal rising mineral content or pollution, necessitating further investigation to prevent water quality deterioration.

Overall Observations and Long-Term Outlook

The trends indicate relatively stable water quality despite periodic fluctuations in pH, DO, and EC.

Potential concerns include:

- pH values consistently dropping below 6.5, leading to increased acidity.
- DO levels falling below 5.5 mg/L, potentially stressing aquatic ecosystems.
- EC levels exceeding 830 µS/cm, signalling heightened salinity or contamination.

Continuous monitoring is essential to detect early signs of water quality degradation and address potential risks promptly.

Figure 3. SWD Prototype

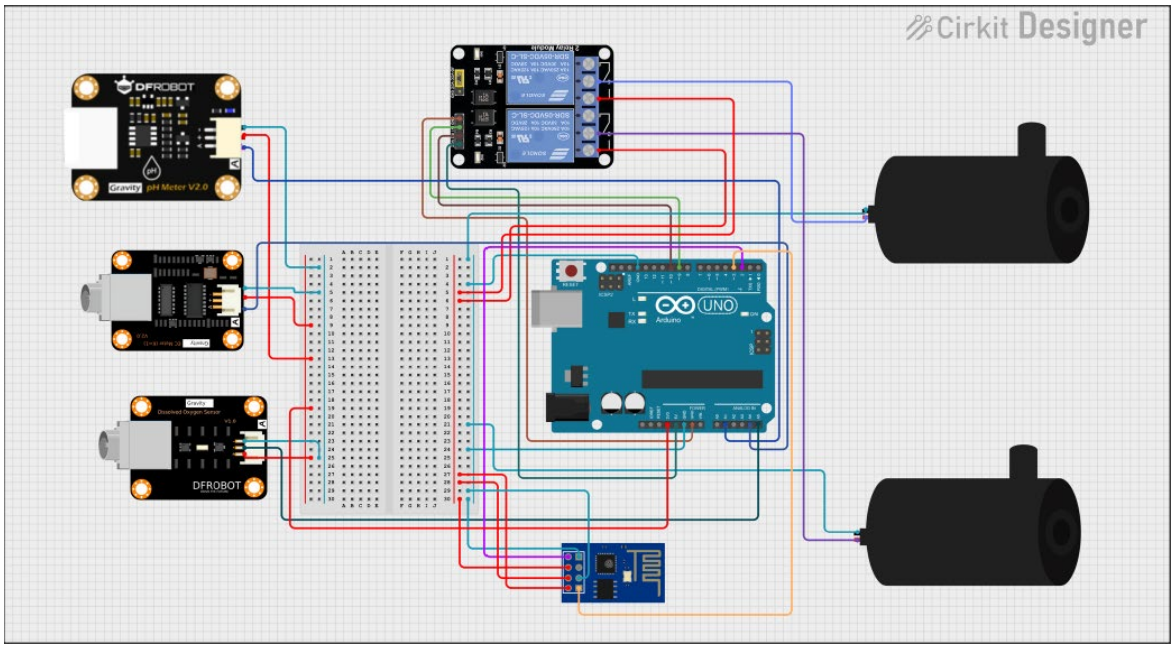

Figure 4. Schematic Diagram

3. Novelty and uniqueness

The Smart Water Quality Detector (SWD) introduces groundbreaking innovations that address long-standing challenges in water quality monitoring. Unlike traditional systems that rely on manual processes or expensive, fragile equipment, SWD combines advanced sensor technology, IoT connectivity, and real-time data analytics to offer a fully automated and efficient solution. Its ability to continuously monitor critical parameters like pH, electrical conductivity, and dissolved oxygen in real-time sets it apart. The SWD can detect water contamination before it reaches treatment centers, preventing blockages, reducing treatment delays, and ensuring uninterrupted water supply, a feature absent in most conventional methods. Another key innovation is the SWD's enhanced durability, designed to withstand long-term submersion without damage. This improvement extends the lifespan of sensors and reduces maintenance costs, addressing a major limitation of current technologies. Furthermore, its cost-effective design makes advanced water monitoring accessible to broader communities and organizations. SWD's integration with IoT ensures instant alerts for contamination, enabling rapid responses to potential hazards. This proactive capability ensures community preparedness and protects public health. Aligning with Sustainable Development Goal 6, SWD is not just a technological leap but a vital tool for sustainable water resource management, making it a truly unique and impactful innovation.

4. Benefit to mankind

The Smart Water Quality Detector (SWD) offers substantial benefits to society by ensuring access to safe and clean water, a fundamental need for human well-being. By enabling automated monitoring, SWD provides accurate, real-time data, saving time and reducing

reliance on manual processes. This ensures timely detection of water contamination and prevents the consumption of polluted water, thereby safeguarding public health. The system's innovative design reduces operational costs and extends sensor lifespan, making water quality monitoring more sustainable and accessible. Early notifications to communities allow them to prepare for water supply interruptions, minimizing disruptions to daily life. Moreover, instant alerts facilitate immediate corrective actions, reducing health risks associated with contaminated water. Aligned with Sustainable Development Goal 6 (SDG 6), SWD promotes sustainable water management by reducing pollution, minimizing hazardous waste, and enhancing water treatment efficiency. Its proactive approach ensures better public health, environmental protection, and improved quality of life for all.

5. Innovation and Entrepreneurial Impact

The Smart Water Quality Detector (SWD) fosters a culture of innovation by integrating advanced sensor technology, IoT connectivity, and data analytics to address critical water pollution challenges. Its unique ability to detect contamination in real-time before water reaches treatment centres promotes proactive problem-solving and showcases the potential of modern technology in environmental sustainability. This project inspires entrepreneurship by encouraging the development of cost-effective and durable solutions for water quality monitoring, reducing barriers for broader adoption across communities and industries. By addressing pain points such as high costs and sensor durability, SWD opens opportunities for further innovation in environmental monitoring and IoT-based systems. Within institutions and industries, the SWD serves as a model for leveraging technology to create impactful, scalable solutions. Its alignment with Sustainable Development Goal 6 (SDG 6) demonstrates how entrepreneurial initiatives can address global challenges, driving sustainable economic and social development.

6. Potential commercialization

The Smart Water Quality Detector (SWD) demonstrates strong potential for commercialization due to its innovative features, cost-effectiveness, and alignment with the increasing demand for sustainable water management solutions. Its real-time monitoring capabilities and durable design address critical market needs, making it an attractive option for water treatment facilities, municipalities, and industries dependent on clean water. The affordability and extended lifespan of SWD sensors reduce operational costs, ensuring accessibility for both developed and developing regions. Moreover, its IoT connectivity and automated alerts align with modern infrastructure demands, enabling scalability across diverse applications such as agriculture, aquaculture, and urban water systems. In Malaysia, we aim to collaborate with water companies such as Pengurusan Air Selangor Sdn Bhd (Air Selangor) and Ranhill SAJ to integrate the SWD into their operations, enhancing water quality monitoring and management. This initiative aligns with our mission to address local water challenges while contributing to Sustainable Development Goal 6 (SDG 6). The SWD's compatibility with government, NGO, and environmental organization efforts focused on pollution reduction and safe water access further enhances its market viability. Its versatility and potential impact position it as a highly promising product for both local and global markets.

7. Acknowledgment

We would like to express our sincere gratitude to Centre of Foundation Studies UiTM Dengkil for providing the resources and support necessary to develop the Smart Water Quality Detector. Deeply thankful to all team members for everyone's determination, technical expertise, and encouragement throughout this project which enabled us to pursue this innovation from planning, testing, prototyping, and refining the SWD. Lastly, we extend our heartfelt thanks to our community for their valuable insights and feedback, which helped shape the development of this project to address real-world challenges effectively.

8. Authors' Biography

Wan Adibah Hanis Wan Aziz is a Lecturer at UiTM Dengkil Selangor, specializing in information technology, software engineering and database. Before transferring to UiTM Kampus Dengkil, she served at UiTM Kampus Machang, Kelantan, for almost 3 years, where she honed her expertise and further developed her passion for teaching and technology. Her academic career reflects a strong commitment to fostering technological knowledge and skills in students, preparing them for success in the ever-evolving tech industry.

Hafiy Addin Hizamel is an aspiring Software Engineer with a strong background in programming, electronics, and innovation. Currently a student at UiTM Dengkil, he is a straight-A student and mentor in STEM subjects, excelling in academics and leadership roles. Notably, he has achieved recognition through various projects and competitions showcasing his problem-solving and technical skills. Passionate about solving real-world problems, he aims to make impactful contributions to the tech industry.

Afiqul Aniq Mohd Farid is a student studying engineering at UiTM Dengkil, Selangor, I am dedicated to expanding my knowledge and skills in the field of engineering. I strive to excel in my academic pursuits and actively participate in various extracurricular activities to broaden my horizons. One of my notable achievements is being awarded as a student representative council member during my time in secondary school. This role allowed me to develop leadership skills, represent my peers, and contribute positively to the school community. I am passionate about engineering and look forward to applying my skills and knowledge

to make a difference in the field. I am committed to continuous learning and growth, both academically and personally, to achieve my goals and contribute meaningfully to the engineering industry.

Muhammad Iman Danish Mohd Shalifuzam is a 19-year-old Foundation in Engineering student at UiTM Dengkil Selangor, with a strong interest in Electric and Electronic Engineering. Beyond academics, Iman Danish is an accomplished racing car driver, having secured multiple victories in various racing series across Malaysia. His dedication to competitive excellence extends to e-Sports, where he earned a medal at SUKMA Sarawak 2024. Balancing academic pursuits with his passion for motorsports, Iman Danish strives to merge his engineering knowledge with his love for racing and technology.