2023 ENGINEERING INSTITUTION OF ZAMBIA SYMPOSIUM

Building sustainable cities through the integration of I.o.T technology in environmental monitoring and management

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INTRODUCTION

- ✓ Internet of Things (IoT) refers to the collection of pervasive objects, that can interact by exchanging information with neighbors to reach common goals (Xia, et al., 2012)
- ✓ In environmental monitoring and management, this involves the deployment of interconnected sensors and devices to collect real-time data on environmental parameters such as air and water quality, climate conditions, waste levels, and wildlife activity, enabling informed decision-making and proactive management strategies to mitigate environmental issues and promote sustainability.
- ✓ Urbanization and industrialization are global phenomena that have accelerated in recent decades and have led to the rapid growth of cities and the consequent strain on environmental resources such as water and air. (National Geographic, 2020)

PROBLEM STATEMENT

- ✓ Environmental monitoring and management practices are usually confronted with formidable challenges in both air and water quality assessment especially in areas with extensive industrial and mining activities.
- ✓ The existing methods for air pollution monitoring and management utilized by the Zambia Environmental Management Authority for regulatory purposes exhibit significant limitations as they rely on periodic, manual measurements and portable equipment (Caravan and Portable Stalk) that fail to deliver real-time data (Chihana, *et al*., 2022)

PROBLEM STATEMENT

- ✓ Similarly, water quality monitoring faces its own set of challenges. Traditional methods employed by most companies which predominantly involve sampling and analysis lack the immediacy and comprehensiveness needed to effectively track and manage water pollution.
- ✓ These methods require Laboratory examination which is time-consuming, costly, and requires a lot of human resources. (Pasika & Gandla, 2020)

JUSTIFICATION

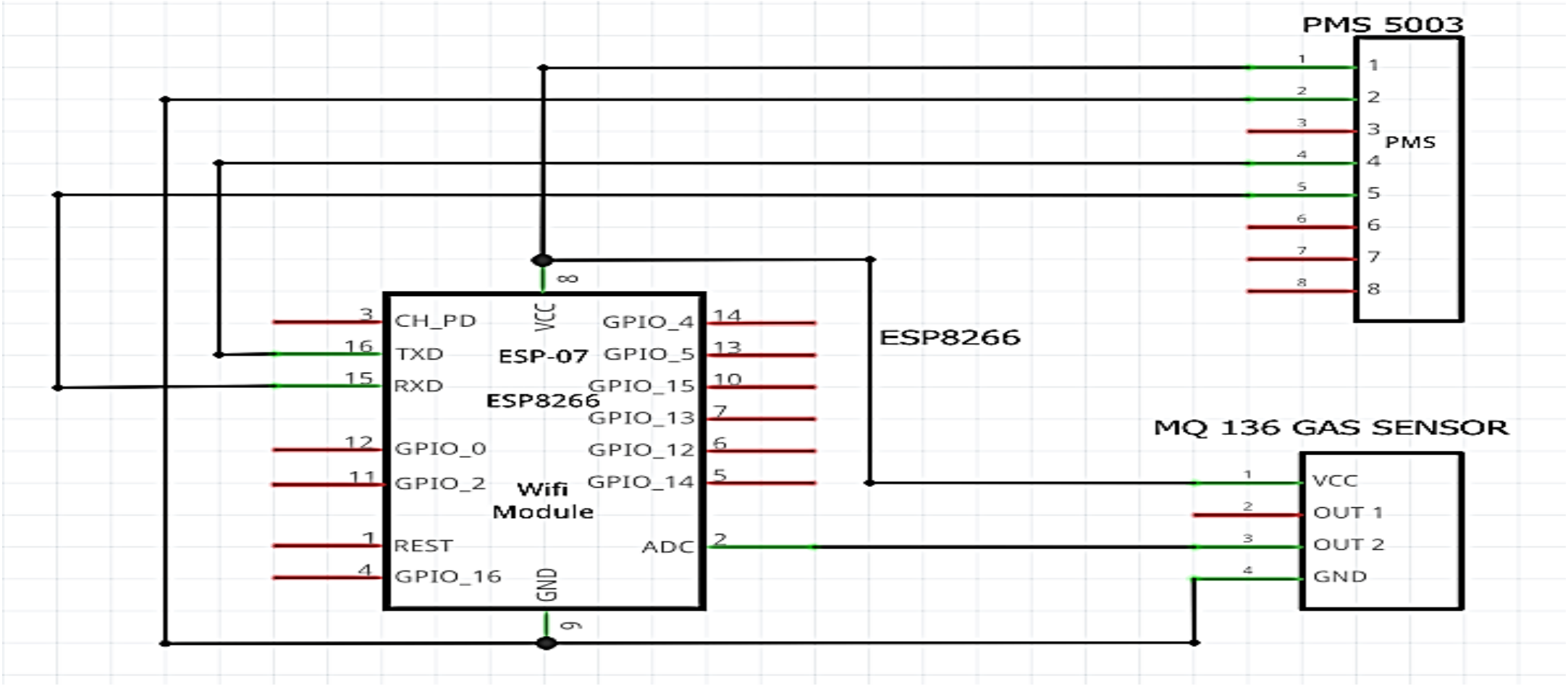
- ✓ This study proposes an Integration of advanced environmental monitoring and management systems that encompass both air and water quality.
- ✓ This solution involves the incorporation of fixed Internet of Things (IoT) technologies to provide real-time, comprehensive, and sustainable monitoring thus overcoming the limitations of periodic and manual measurements, and ensuring the sustainability of monitoring efforts.
- ✓ These systems are cost-effective as compared to the traditional methods and they do not require a lot of human resources and are not time consuming.

AIM

This paper discusses the Internet of Things sensor-based systems and how they can be utilized by Zambian industries such as water utility companies, mines, government agencies like ZEMA, and manufacturing companies in environmental monitoring and management thus ensuring compliance with regulations and the conservation of natural resources.

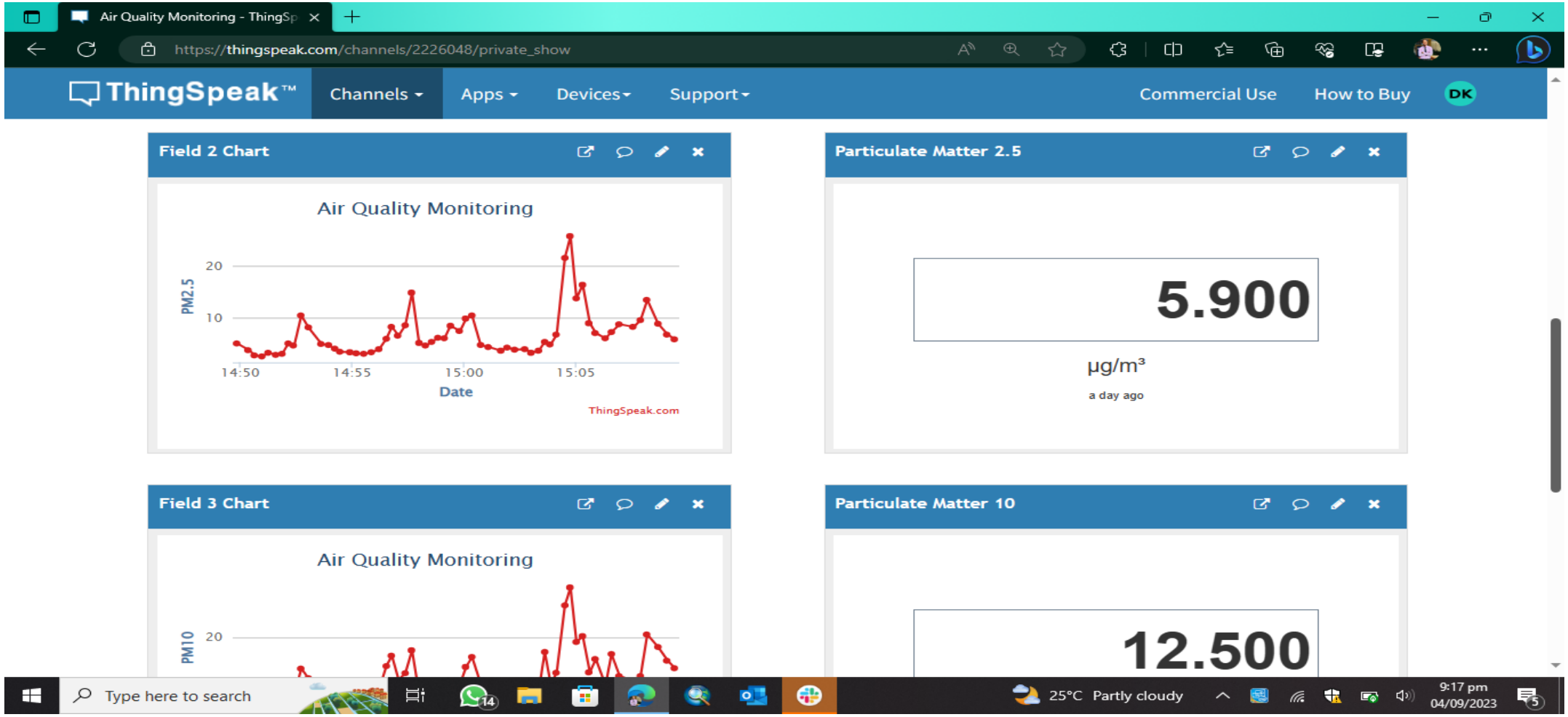
METHODOLOGY - IOT TECHNOLOGY

Proposed system design – Air quality monitoring



METHODOLOGY - IOT TECHNOLOGY

Visual representation of data on thing speak



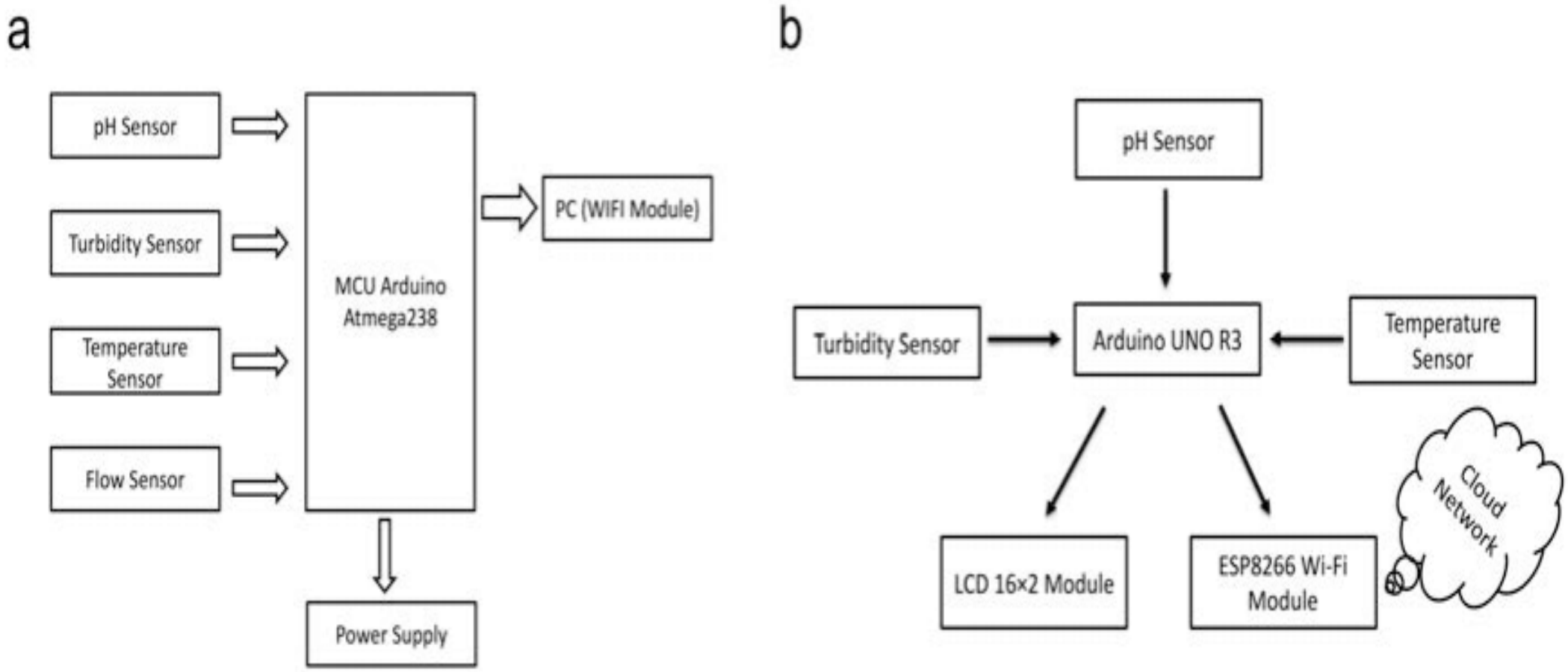
METHODOLOGY - IOT TECHNOLOGY

Proposed System Design – Water quality monitoring system

- ✓ Chowdury, *et al*. (2019) developed an efficient system for continuous monitoring of river water quality in remote locations using wireless sensor networks to emphasize low power consumption, cost-effectiveness, and high detection accuracy.
- ✓ The system aimed to measure crucial water parameters such as pH, dissolved oxygen, turbidity, and conductivity at remote sites then gather data from various sensor nodes and transmit it wirelessly to a base station.

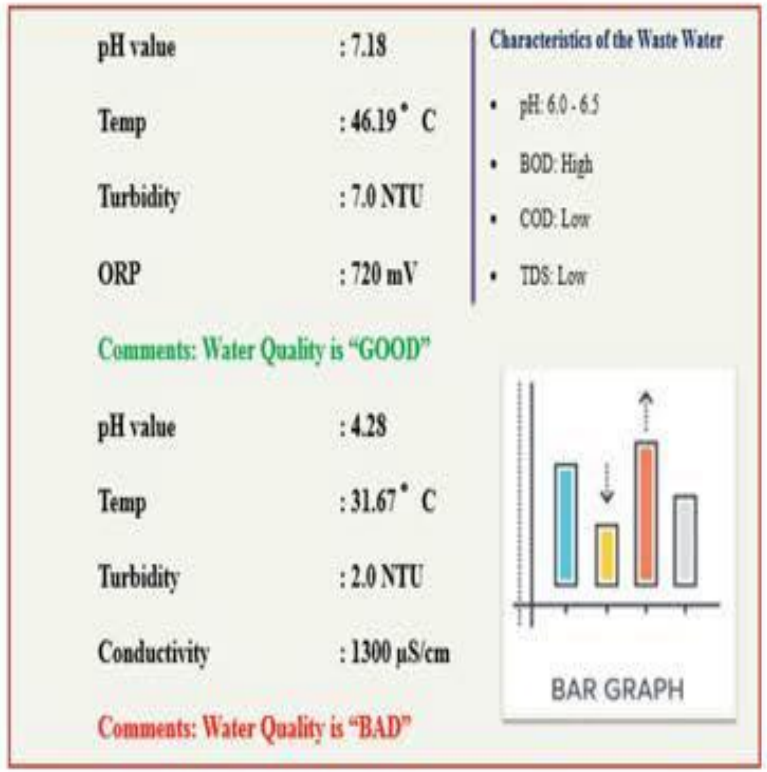
METHODOLOGY - IOT TECHNOLOGY

Proposed System Design – Water quality monitoring system

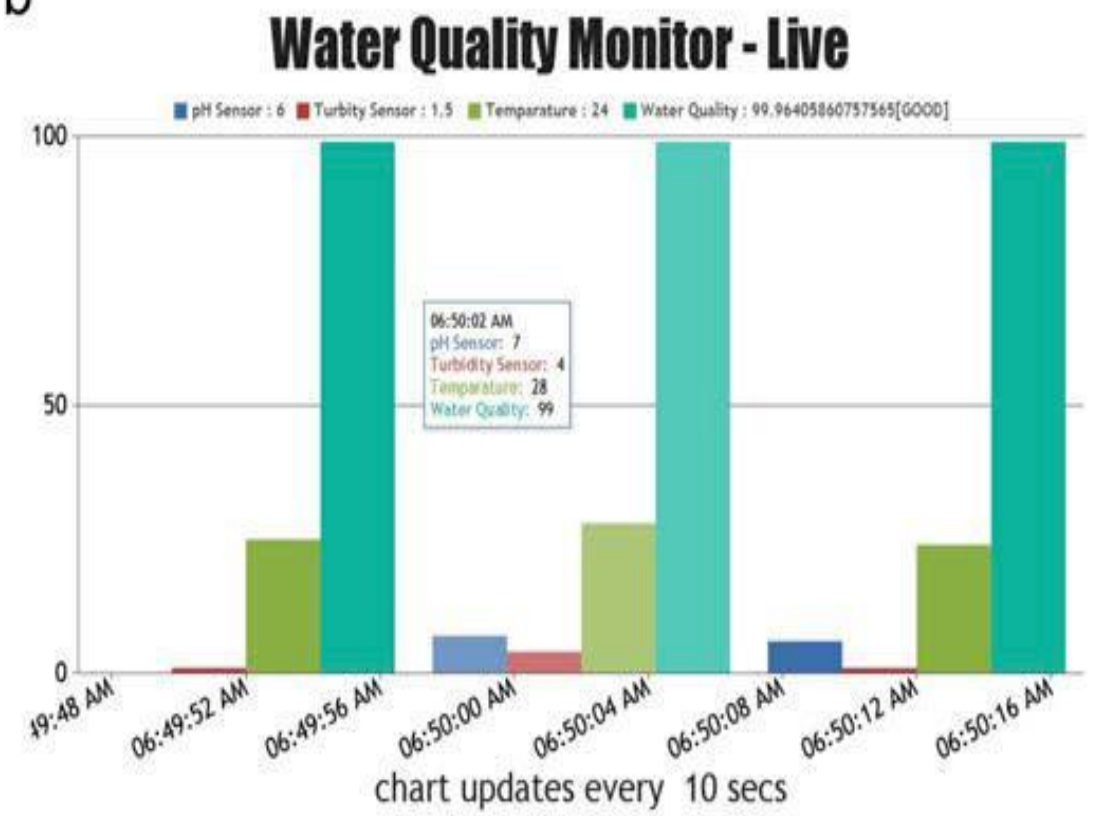


METHODOLOGY - IOT TECHNOLOGY

a



b



(a) The figure displays the resulting sensed pH, temp, turbidity, and ORP values. (b) The time series representation of sensor data with decision.

CONCLUSION

- ✓ This paper addresses the critical challenges posed by urbanization and industrialization which have led to escalating pollution levels and deteriorating air and water quality globally.
- ✓ It advocates for the integration of fixed Internet of Things (IoT) technologies to revolutionize environmental monitoring, particularly in regions marked by extensive industrial and mining activities thus overcoming the limitations of traditional monitoring methods.
- ✓ Through a thorough review of relevant literature and the development of a prototype model for air quality monitoring, this study has demonstrated the feasibility and efficacy of IoT-based solutions.

CONT`

- ✓ The proposed systems offer comprehensive, cost-effective, and sustainable alternatives to traditional monitoring methods, which often suffer from limitations such as periodic sampling and manual analysis.
- ✓ The findings of this study not only contribute to the body of knowledge on IoT applications in environmental monitoring but also have practical implications for industries and regulatory agencies, particularly in regions marked by intensive industrial and mining activities like Zambia.
- ✓ By embracing IoT-based solutions, stakeholders can enhance their capacity to monitor and manage air and water quality effectively, thereby safeguarding public health, preserving natural resources, and promoting sustainable urban development.

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THANK YOU FOR YOUR ATTENTION.