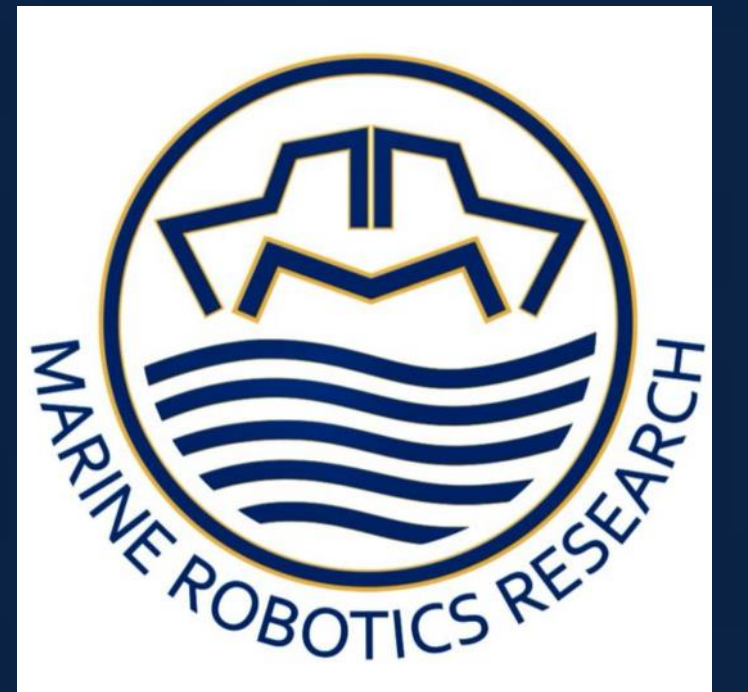


Water Sampling with Applied Microcontrollers

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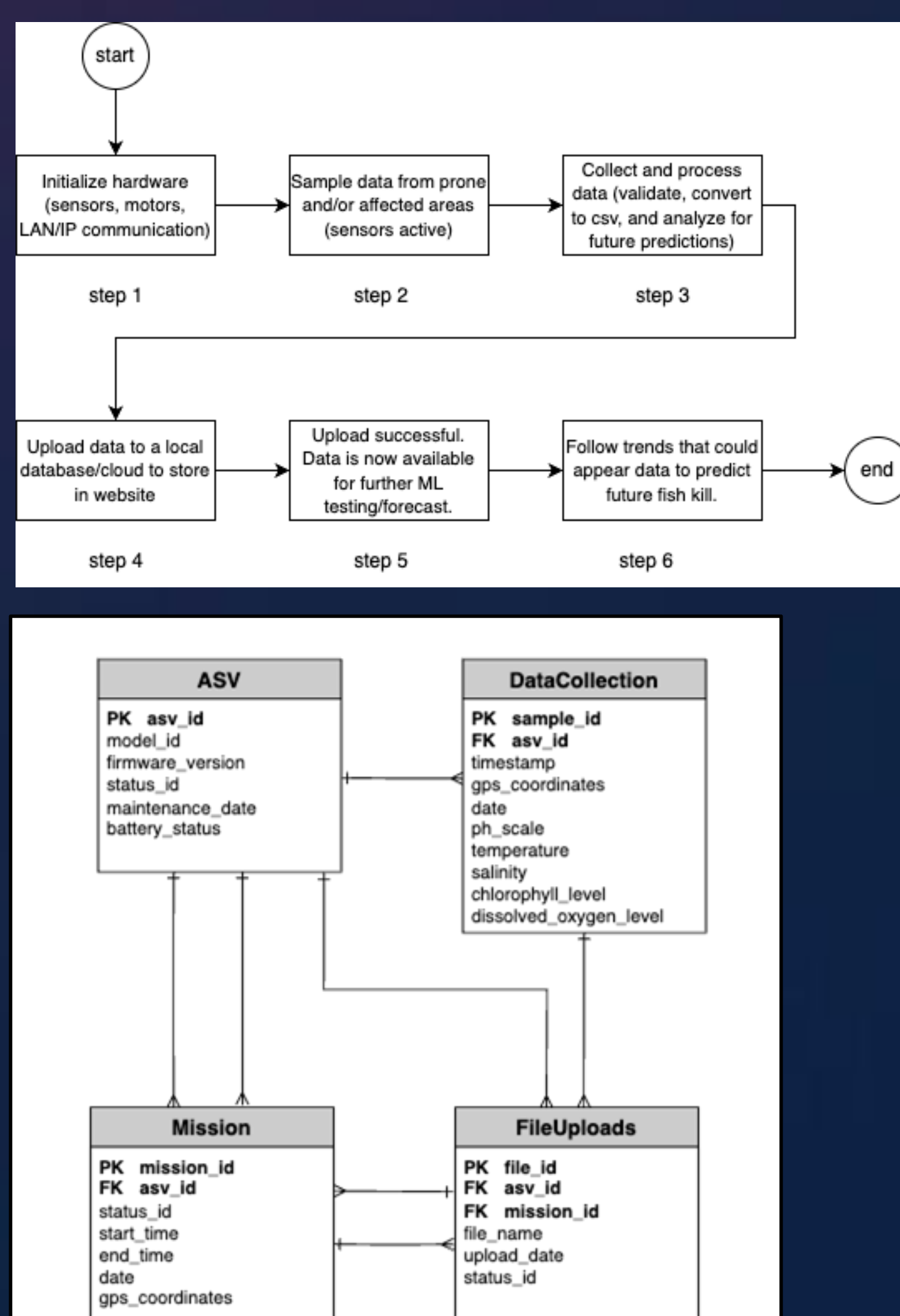


PROBLEM

Biscayne Bay, a vital ecosystem in South Florida, faces significant environmental challenges due to pollution, rising temperatures, and human activity. Monitoring water quality is critical for preserving this delicate environment, yet current methods often rely on manual data collection, which is time-consuming, costly, and prone to human error.

There is a growing need for autonomous solutions to collect and analyze water quality data efficiently, providing continuous and accurate monitoring while reducing operational costs. Addressing this problem can help environmental agencies and researchers implement timely interventions and preserve marine biodiversity.

SYSTEM DESIGN



Photos



CURRENT SYSTEM

1.High Costs: Deploying personnel and maintaining stationary sensors is expensive over time.

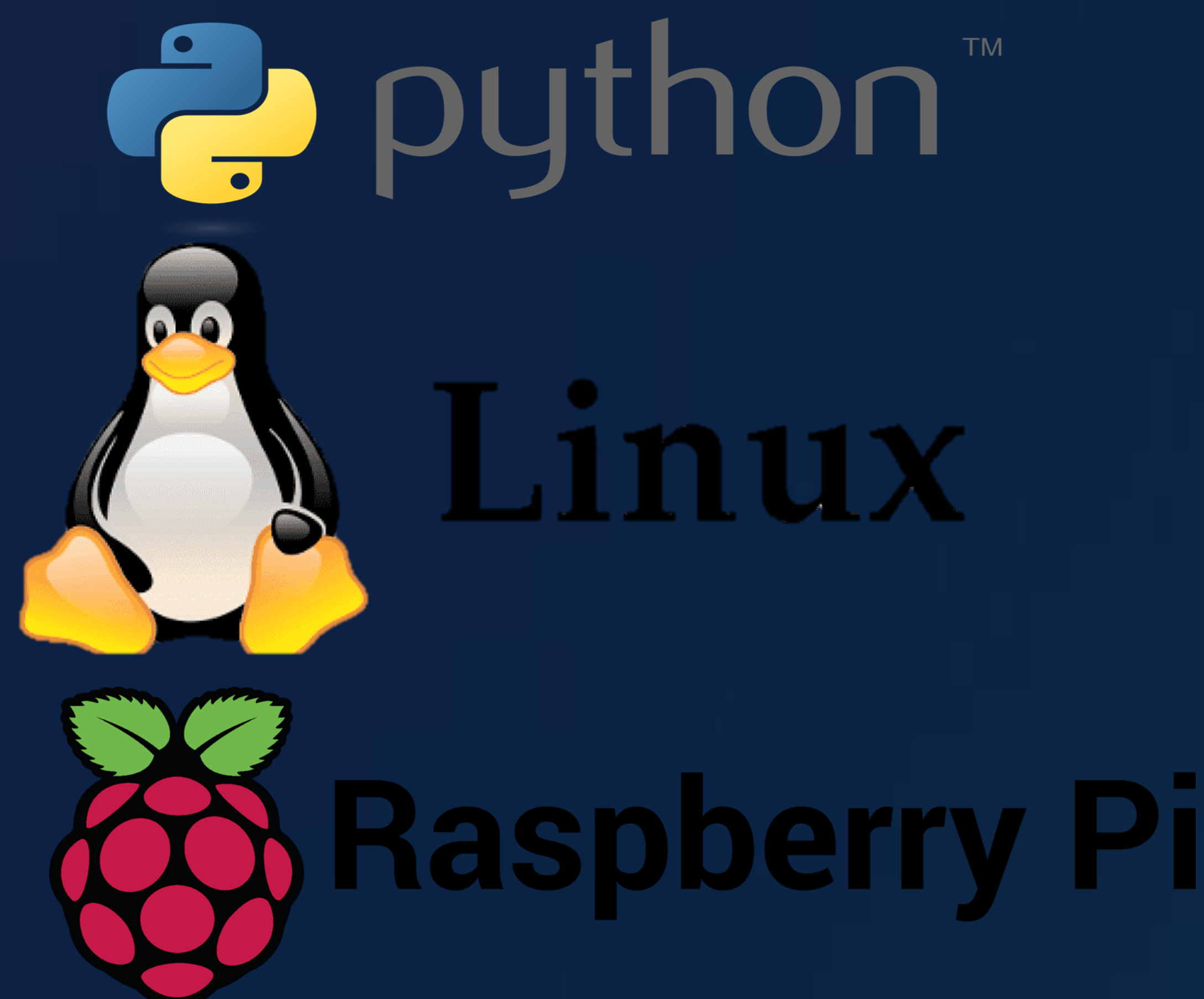
1.Limited Coverage: Stationary sensors only provide localized data, and manual sampling cannot cover large areas efficiently.

1.Inconsistent Data: Human error and sporadic sampling intervals result in incomplete or inaccurate datasets.

1.Slow Analysis: Collected data often requires significant time for processing, delaying actionable insights.

These challenges hinder the ability to perform continuous, large-scale, and cost-effective water quality monitoring. A more scalable and autonomous approach is necessary to address these shortcomings effectively.

Languages & Tools



REQUIREMENTS

1.The system must autonomously navigate Biscayne Bay to collect water quality data.

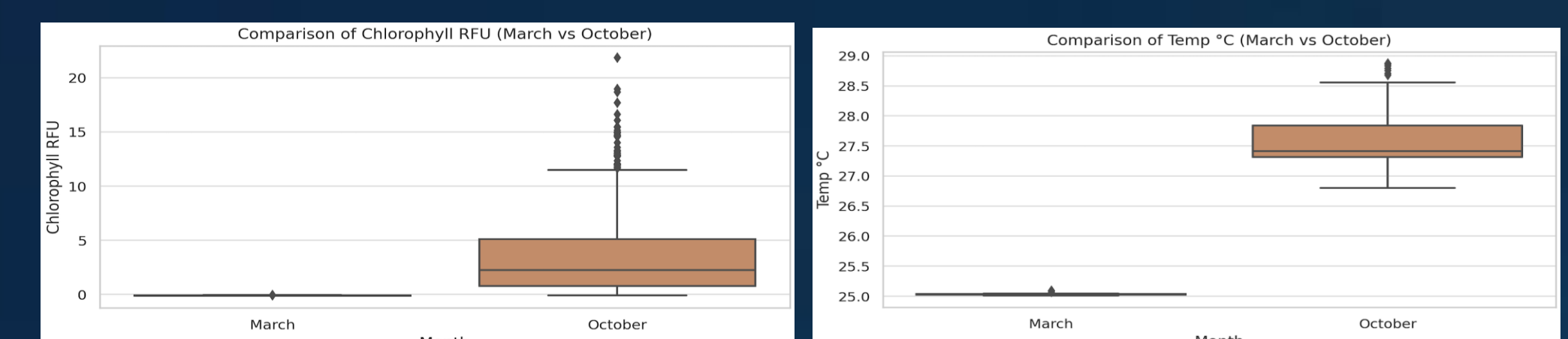
1.It should measure key water parameters such as pH, temperature, salinity, and dissolved oxygen.

1.Data must be transmitted to a central database in real-time or at regular intervals.

1.The system should integrate modular components for easy maintenance and upgrades.

Data Integration

The data integration aspect of the ASV system focuses on seamlessly collecting, processing, and analyzing water quality data for actionable insights. Real-time sensor data is transmitted to a cloud platform where it is aggregated and stored, ensuring accessibility for further analysis. Machine learning (ML) models are implemented on this data to identify patterns and predict future water quality trends. By training the models on historical and real-time data, the system can forecast parameters such as temperature fluctuations, pH levels, and pollution hotspots. These predictions enable proactive environmental management, helping stakeholders address potential issues before they escalate.



Conclusion

The development of the autonomous surface vehicle (ASV) system represents a significant advancement in water quality monitoring and environmental preservation. By addressing the limitations of traditional methods, the ASV provides a scalable, efficient, and cost-effective solution for real-time data collection across dynamic aquatic environments.

Through the integration of advanced navigation, robust sensor systems, solar-powered operation, and machine learning capabilities, the ASV not only monitors current conditions but also predicts future trends, enabling proactive environmental management.

Successful field testing in Biscayne Bay validates its reliability and scalability, highlighting its potential for widespread application in preserving aquatic ecosystems. This project demonstrates how innovative technology, and marine robotics can transform environmental monitoring, contributing to sustainable management and conservation efforts worldwide.

REFERENCES

- Aguirre, L. (2021, April 2). *Saving biscayne bay: Researchers worry about risk of another fish kill this summer*. WPLG. <https://www.local10.com/news/local/2021/04/02/saving-biscayne-bay-researchers-worry-about-risk-of-another-fish-kill-this-summer/>
- Biscayne Bay Commission. Biscayne Bay Commission | Water Quality Dashboard. (n.d.). <https://protectingfloridatogether.gov/BiscayneBayCommission>
- Clearpath Robotics. (n.d.). *The CLEARPATH robotics heron USV*. MIT Marine Autonomy Lab : Robot - Heron browse. <https://oceanai.mit.edu/autonomylab/pmwiki/pmwiki.php?n=Robot.Heron>
- EXO2 multiparameter sonde. Multiparameter Water Quality Sonde for Unattended Monitoring. (n.d.). <https://www.ysi.com/exo2?srsId=AfmBOoi9qt7bU nsZvUS28ct9Nd039EOdgilda6Dhfz1xqcceDBaxlx2>
- NOAA. (n.d.). National Oceanic and Atmospheric Administration. <https://www.noaa.gov/>