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Sustainable Water Quality Monitoring: A comparative Study between automated and manual collection in the amazon

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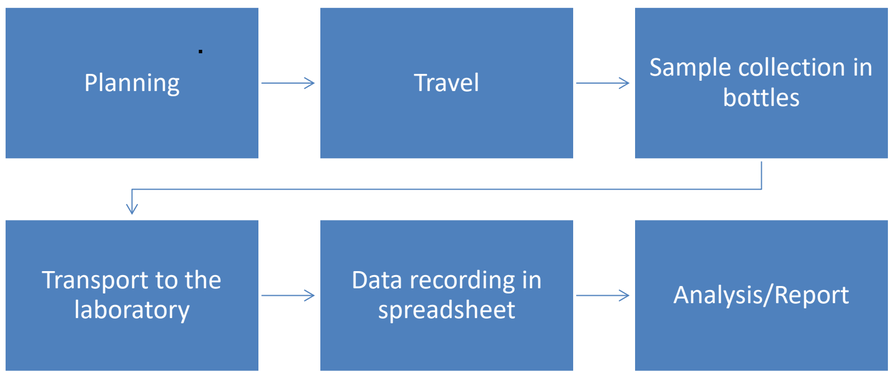
INTRODUCTION & AIM

Water quality monitoring is an essential activity for environmental preservation and the protection of public health, especially in ecologically sensitive regions such as the Amazon. Continuous analysis of physicochemical parameters enables the identification of environmental variations, potential sources of contamination, and trends that may compromise aquatic ecosystems. However, conventional monitoring methods based on manual sampling present limitations related to low sampling frequency, high operational costs, and dependence on local infrastructure.

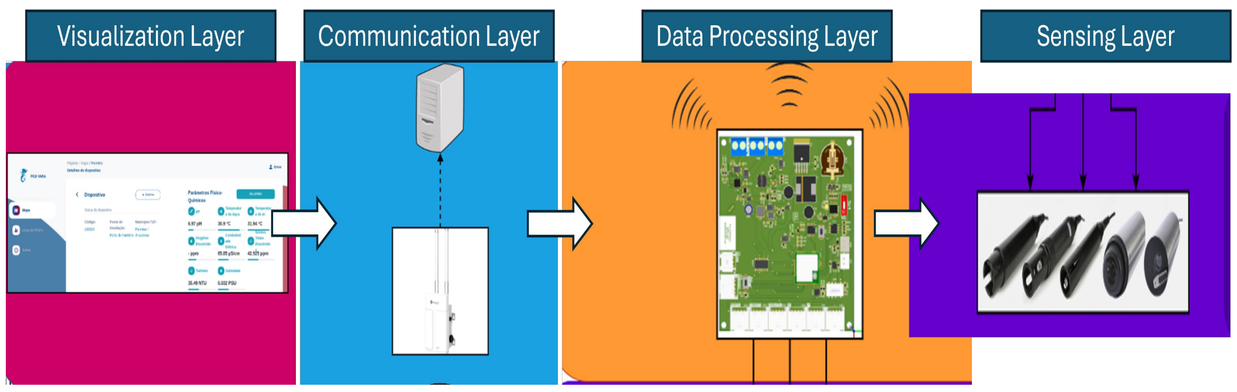
Figure 01 – Current manual collection process



METHOD

The study was conducted through a comparative analysis between different water quality monitoring methods, involving the use of an automated device and pre-calibrated commercial manual probes. The automated prototype was installed on a floating platform located at the Port of Parintins and configured to perform continuous measurements, transmitting the collected data via a LoRa communication module, ensuring operation even under limited connectivity conditions. The monitored parameters included pH, turbidity, electrical conductivity, water temperature, and dissolved oxygen, which are recognized as key indicators of water quality. The automatically collected data were compared to the values obtained from manual measurements to evaluate the accuracy, stability, and temporal consistency of the proposed system. The statistical analysis was based on the correlation between the two methodologies, aiming to identify the feasibility of using the automated system as a low-cost, reliable, and continuous solution for monitoring in remote regions of the Amazon.

Figure 02 – General architecture of the proposed system



RESULTS & DISCUSSION

The results obtained from the comparison between the automated system and the traditional manual sampling method demonstrated a high correlation between the recorded values for all analyzed parameters, indicating that the developed prototype performs comparably to the commercial probes used. It was observed that the automated device maintained greater consistency and stability in the measurements, reducing variations associated with human intervention and temporary environmental conditions during the manual sampling process.

Furthermore, the data acquisition frequency provided by the automated system enabled a more detailed monitoring of the temporal variation of water quality parameters, offering a more comprehensive view of the water body's conditions.

Figure 03 – Data collected manually with a pH probe.

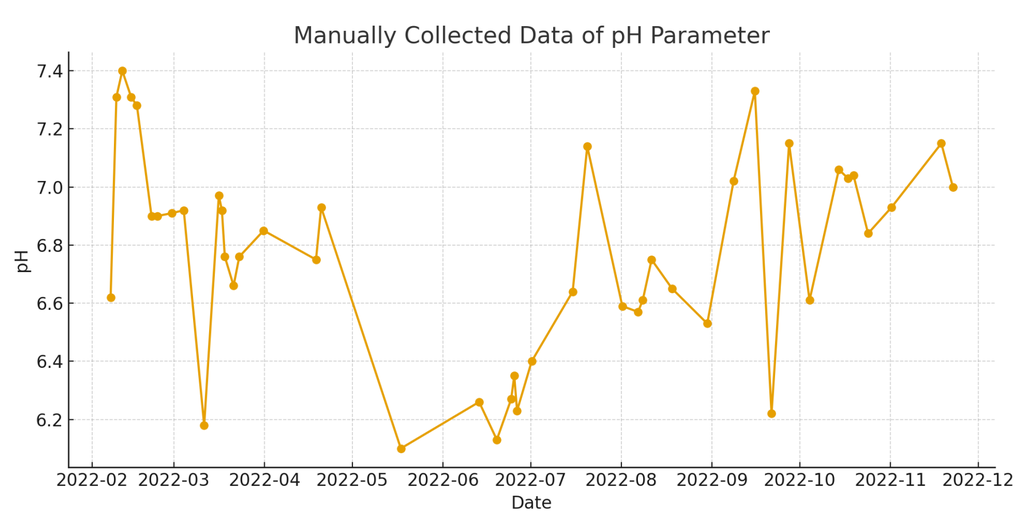
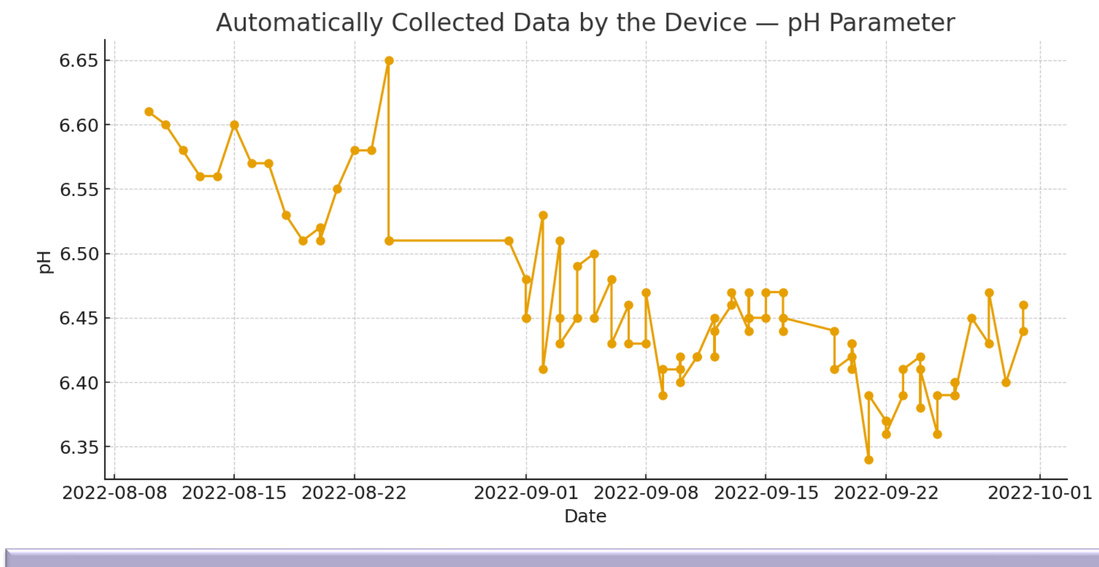


Figure 04 – Data collected automatically with device - pH



CONCLUSION

When comparing the manually and automatically obtained results, it is observed that both data sets present similar pH values, mostly ranging between 6.4 and 7.1, which is consistent with the natural waters of the Amazon River. However, the automatic measurements demonstrated greater stability and lower dispersion, reflecting the consistency of the developed system. The manual measurements, on the other hand, showed small punctual fluctuations attributed to environmental variations and human intervention. Therefore, the automated system proved to be efficient for continuous and reliable data collection, minimizing external interferences.