Hybrid Framework for Water-Energy-Food Nexus Digital Twin Data Collection

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In our research, we investigate the integration of the water-energy-food (WEF) nexus into a unified system and claim it is a critical step in achieving food security, while minimizing environmental degradation. This approach recognizes the interconnectedness of these essential resources and highlights the importance of a holistic and modern strategy in addressing global sustainability challenges. We facilitate this integration through Digital Twins (DTs), offering a virtual representation of this nexus. A critical step in developing a WEF Nexus DT is the collection of relevant data. Our project demonstrates that a hybrid approach is essential to gather comprehensive data for an effective WEF DT model. While traditional methods remain invaluable, they need to be combined with state-of-the-art technology. For instance, water quality, a key parameter in the WEF DT, is currently best assessed through direct sampling rather than IoT sensors or satellite data. Equally, energy parameters can be effectively monitored via satellite, and food production data can be accurately collected using IoT sensors. This hybrid data collection framework underscores the need for a multi-faceted approach, integrating both conventional and advanced technologies, to build a robust and reliable WEF Nexus DT.