Developing a Digital Twin for BESSYII SLS Based on EPICS and Microservice Design

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Introduction

—> Digital twins enable real-time monitoring and optimization in various sectors, including scientific research and Synchrotron Light Sources.
—> Integration of technologies like EPICS, microservice design, MongoDB, and visualization tools like dash and plotly enhances data communication, analysis, and visualization.
—> This paper showcases the integration of digital twin technology in Synchrotron Light Sources, offering a revolutionary approach for monitoring, optimization, and future

Data model

—> Each resulting feature are enriched by a sophisticated data model structured on object-oriented principles, providing a comprehensive understanding of the measurement process and ensuring streamlined code maintenance.

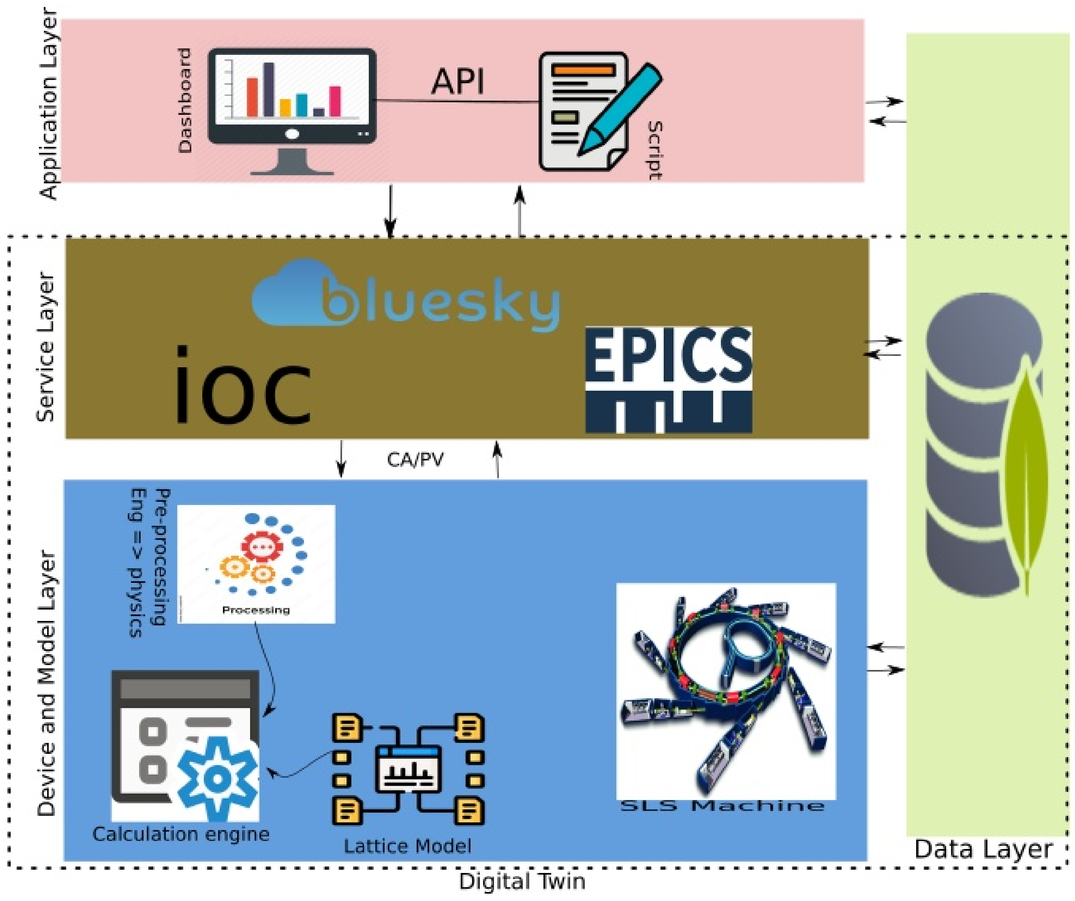
—> Data models demonstrate our data model's intricacies, capturing raw data, analysis parameters, and outcomes. This structured approach empowers researchers with clear insights, enabling informed, data-driven decisions.

Digital twin architecture

—> Utilized MongoDB in JSON format for adaptable storage, allowing effortless updates and serving as an alternative to conventional lattice files.

—> Versatile Experimentation: Leveraged Bluesky and Ophyd toolkit for defining and executing experiments, enabling diverse commissioning tasks and real-time analysis during measurements.

—> Real-time Visualization: BBA measurement results are showcased in a REST client, providing real-time representation of alignment variations. Researchers can interactively assess experiment outcomes, enhancing the user experience through dynamic result interpretation.
—> Foundation for Future Research: The integration of data modeling, real-time visualization, and user-friendly interfaces in our digital twin serves as a model for synchrotron light source facilities. This approach streamlines current experiments and establishes a data-driven future, paving the way for advanced scientific research at Bessy II.

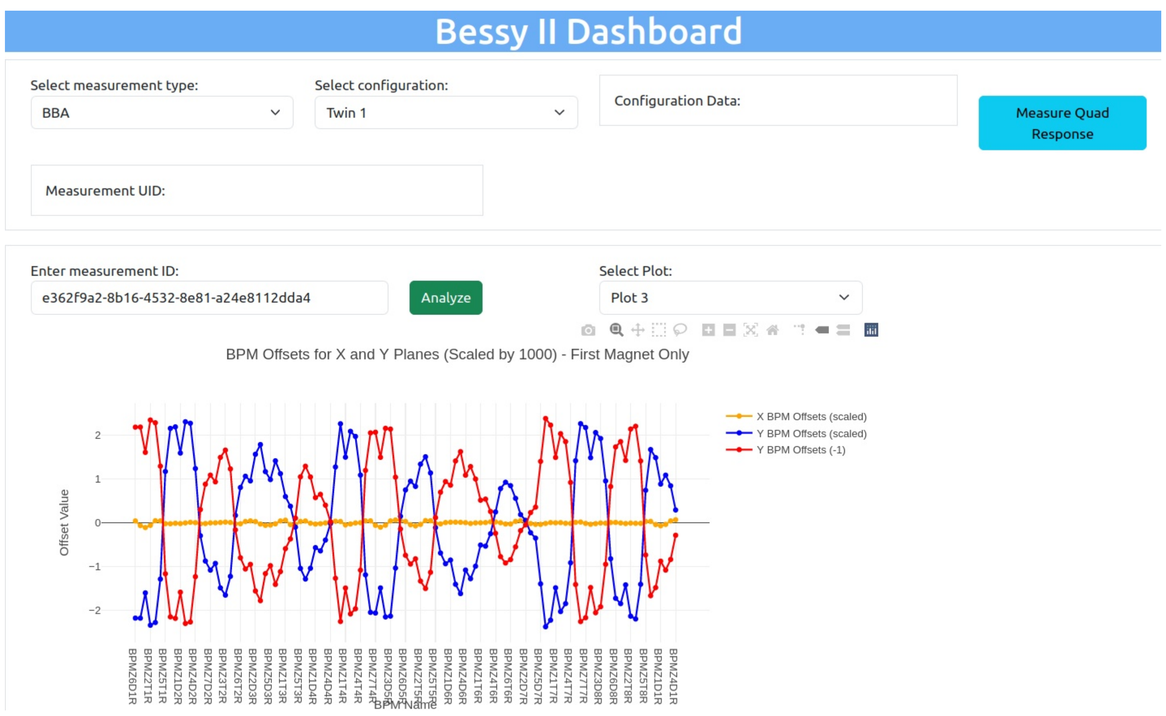


—> Comprehensive Solution: Integrated Bluesky, MongoDB, thor scsi engine, and specialized packages, providing a holistic solution for managing machine structure with efficient and flexible storage.

—> Efficient Communication: Implemented REST API services for seamless interaction between components developed in various languages and frameworks, enabling simplified access to the digital twin for end users.analysis during measurements.

Exploring Integration

—> We are actively considering the integration of models through the Function Mock-up Interface (FMI) standard to facilitate seamless collaboration and interaction between various simulation tools.



CONCLUSION

In summary, the development of a digital twin for BessyII and MLS Synchrotron Light Sources using EPICS, microservice design, and REST API services will greatly enhanced system monitoring and optimization. The integration of EPICS and the adoption of a microservice architecture will enable seamless communication between components, improving interoperability and reliability. The digital twin provides a flexible and scalable solution for managing and optimizing synchrotron light sources, with potential for further customization and extension.

To conclude, the digital twin implementation will revolutionize system monitoring and optimization. The implementaion of end user scripts as REST API will empower users with advanced data analysis and visualization capabilities. Overall, the digital twin presents a flexible and scaleable solution for effectively managing and optimizing synchrotron light sources.