TEAM 22 Digital Twin of Purdue's Smart Manufacturing Lab

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Introduction

Smart Manufacturing Lab Completion:

- Completed in August 2024.
- Focuses on optimizing and improving flexibility on a single discrete manufacturing line.

Lab Objective:

- Develop efficient methods to use one line for producing various products as needed.

Project Contribution:

- Creation of a Digital Twin of bay 3030.

Purpose of the Digital Twin:

- Mirror the physical manufacturing space.
- Enable real-time monitoring.
- Allow for remote simulations.
- Provide data-driven insights to:
  - Improve manufacturing processes.
  - Identify potential issues.
  - Support flexible and adaptive production.

Materials and Methods

Software Evaluation:

- Tested and evaluated several free trials of different software platforms.
- Ultimately selected AWS (Amazon Web Services) as the primary software for the project.

Reasons for Selecting AWS:

- Offers a comprehensive suite of cloud-based tools.
- Aligns with project goals for building a Digital Twin of bay 3030.

Key Capabilities of AWS:

- Real-time data processing.
- IoT integration.
- Virtual simulation.
- Remote accessibility.

Benefits for the Digital Twin Project:

- Enables a scalable and flexible digital model.
- Provides strong system compatibility.
- Ensures robust data security while supporting collaboration.

Advanced Features:

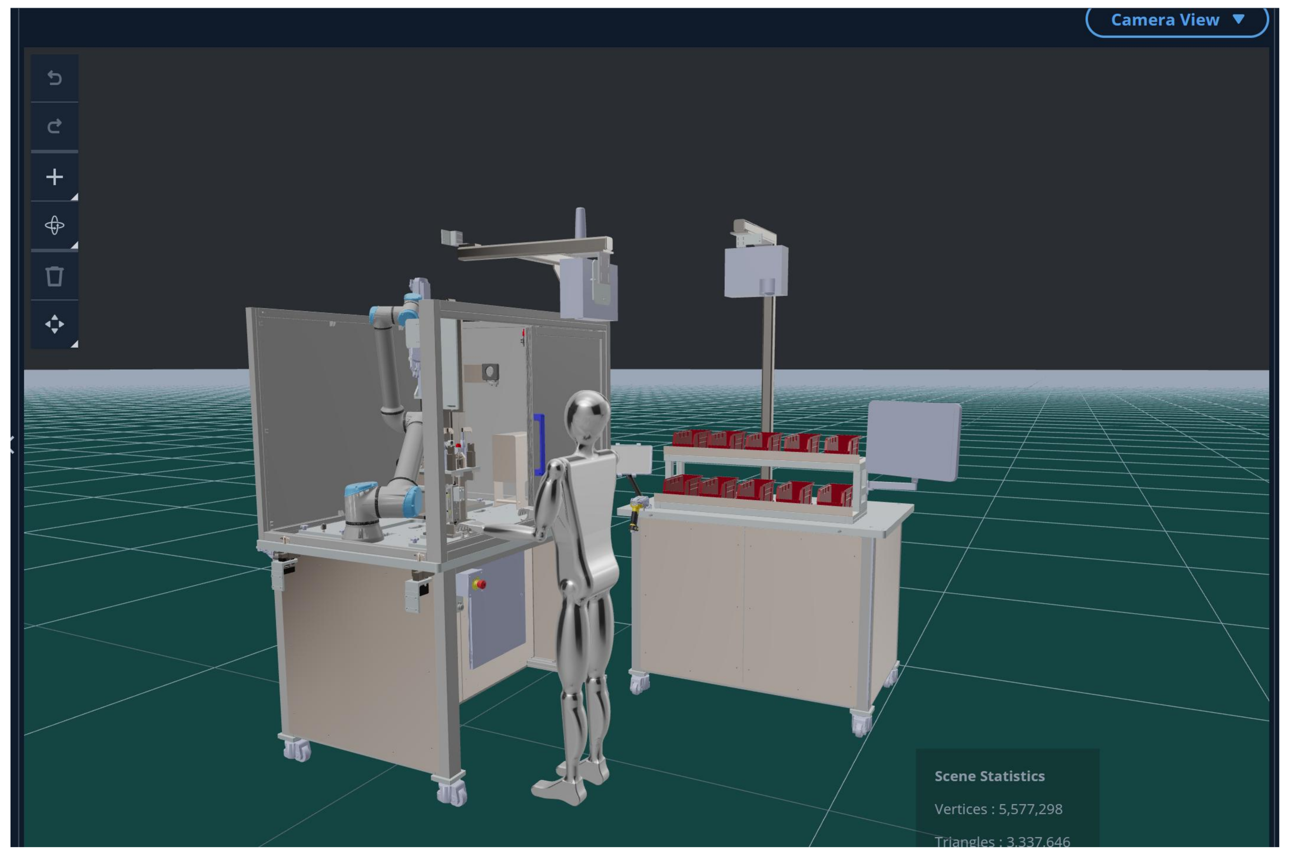
- Built-in machine learning support.
- Facilitates data trend analysis.
- Helps identify issues and generate optimization recommendations.

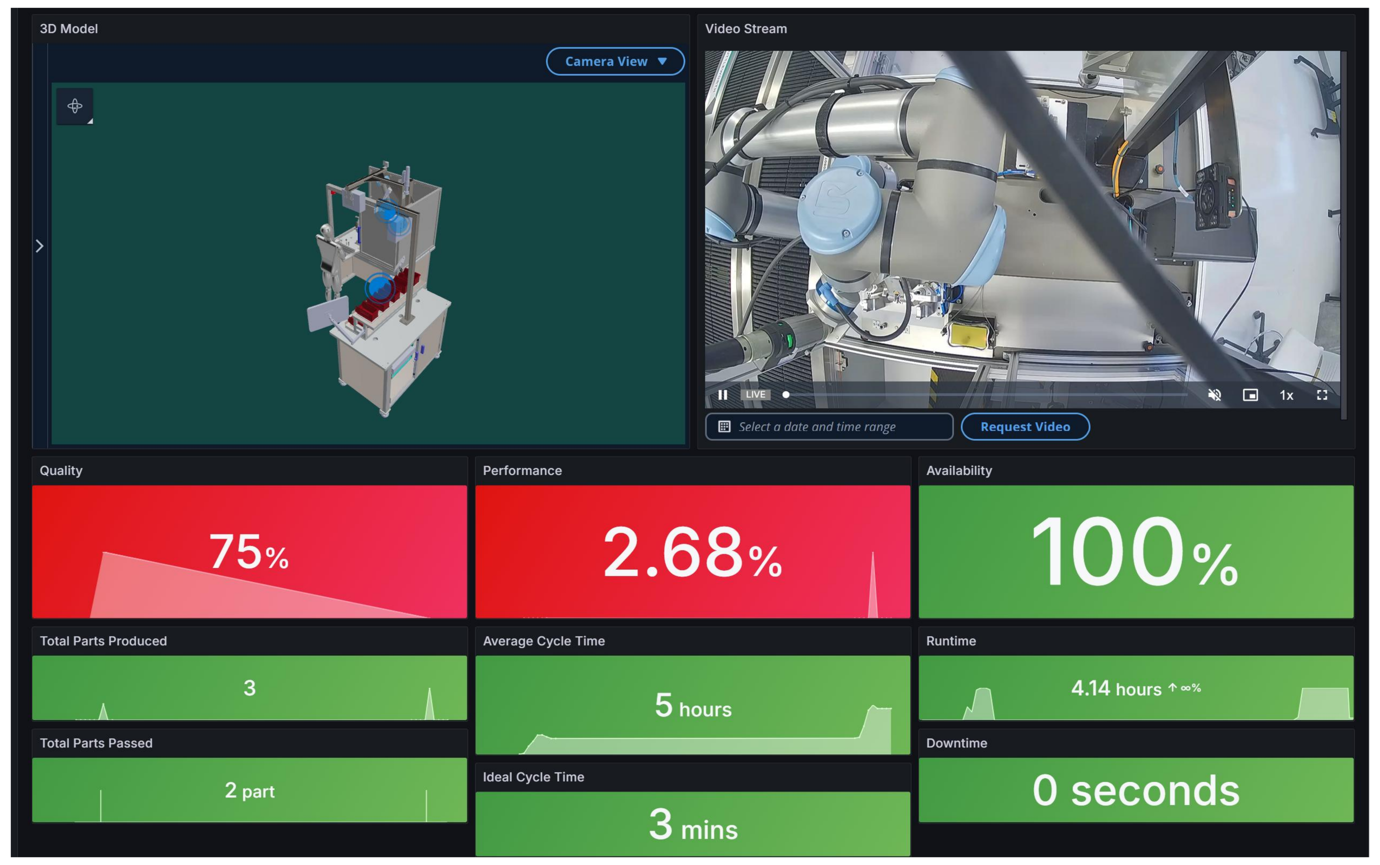
Overall Value:

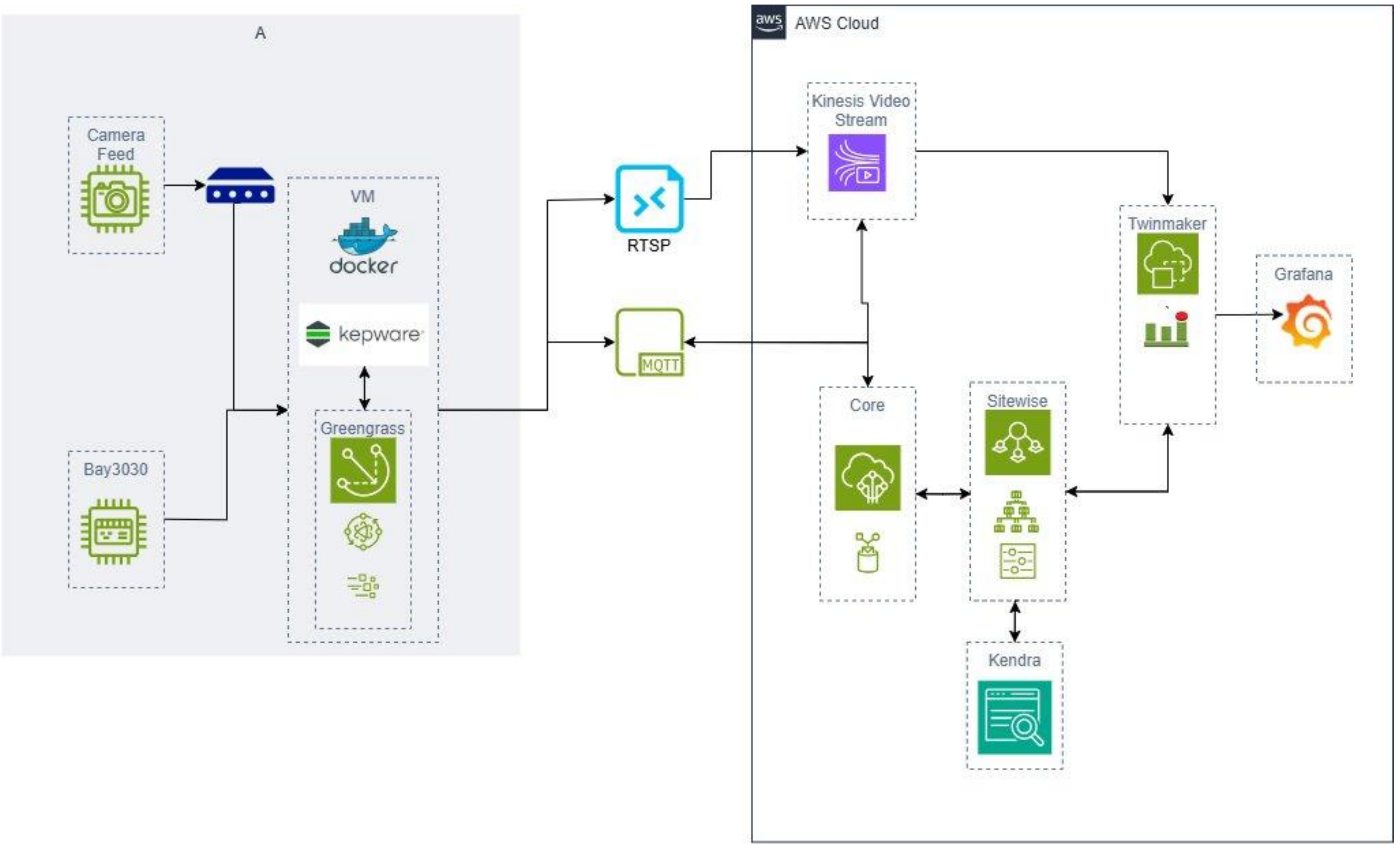
- AWS delivers the flexibility, power, and reliability needed to create a dynamic and future-ready Digital Twin environment.

Results

The final design integrates a Digital Twin of Bay 3030 from the Smart Factory Lab into Dudley Hall's manufacturing technology laboratories, creating a dynamic and interactive learning environment. This system mirrors the physical labs, processes, and ongoing projects to enhance the educational experience. By incorporating generative AI, the Digital Twin's capabilities are significantly expanded, enabling real-time process monitoring, virtual simulations, predictive modeling, and data-driven insights. Students and users can safely experiment with different setups, develop optimized solutions, and practice hands-on tasks remotely. The system is designed to be scalable and flexible, supporting remote access and adapting to curriculum changes while also improving lab safety and aligning with industry standards. Ultimately, the project meets client goals by effectively blending advanced digital tools such as generative AI with traditional manufacturing training techniques.







Conclusion

Purpose of Integration:

- Demonstrates the potential of combining advanced digital technologies with traditional manufacturing education.

Technology Utilized:

- Leverages AWS and generative AI.

Key Features of the Project:

- Scalable and interactive platform.
- Supports real-time monitoring.
- Enables virtual simulation and remote experimentation.

Educational Impact:

- Enhances student learning.
- Improves lab safety.
- Keeps the curriculum aligned with evolving industry standards.

Long-Term Value:

- Establishes a strong foundation for future innovations in:
  - Smart manufacturing.
  - Digital transformation in education.

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INDUSTRY PARTNERS

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