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MTConnect based smart manufacturing framework and its applications

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Introduction

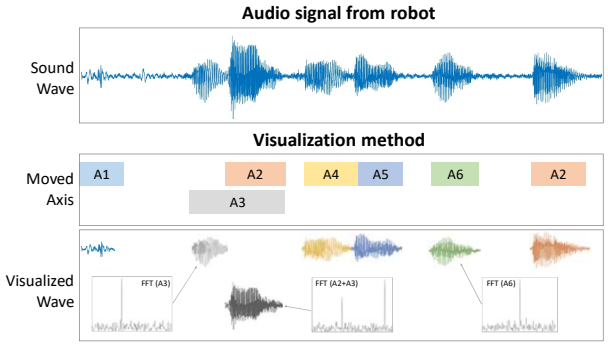
- **Smart manufacturing**: to connect different types of machines, cyber physical systems (CPS), customer, supply chain, and etc.
- **MTConnect**: middleware for cloud manufacturing, Internet based framework to monitor manufacturing data.
- **Objectives**: to improve MTConnect framework for flexible communication, smart control, improved data visualization and analytic tools.

Two-way MTConnect framework

- The **two-way MTConnect** framework is developed using raspberry PI (plug-and-play & wireless communication) and event based machine control via HTTP or direct TCP/IP.

In-situ on-machine audio signal monitoring for machine inspection

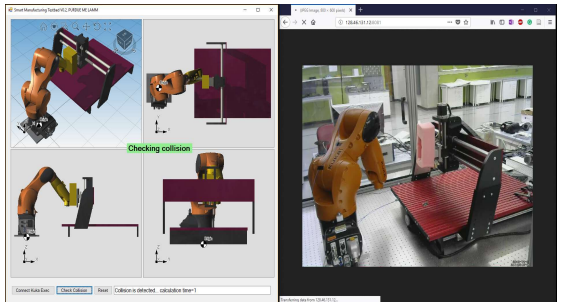
- **Stethoscope with a microphone** is attached to the robot in order to capture detailed **audio signals** from machines.



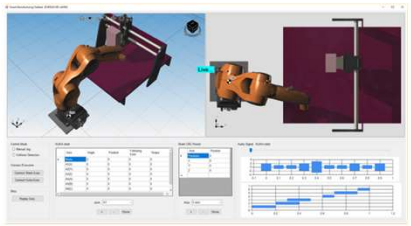
< Visualization example: audio signal for joint movements >

Sensor-less collision prediction using a virtual twin

- **Virtual twin (VT)** is constructed from 3D CAD model (STEP) of machines using Eyeshot, commercial 3D modeling software.
- In VT, collision is checked by interference of **oriented bounding box(OBB)** between 3D model entities moved by predicted trajectory.

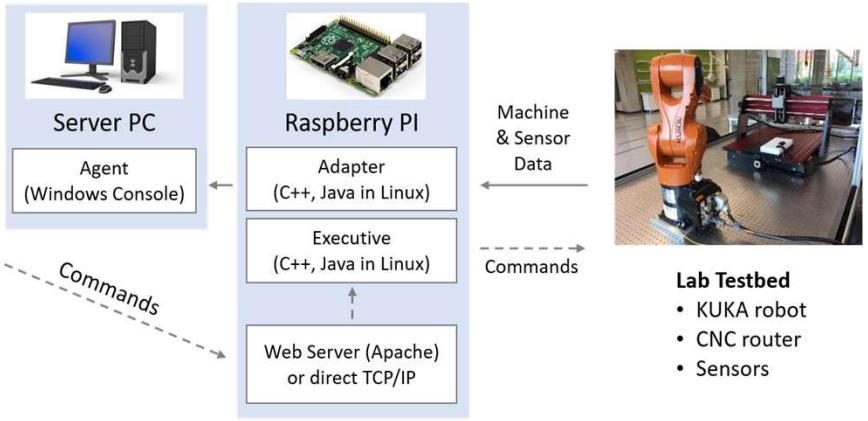


< Virtual twin for collision checking & Testbed >



Developed User Applications (C#)

- Virtual twin
- Machine information: mode, position…
- Sensor value: stethoscope, accelerometer
- Data visualization for analytics



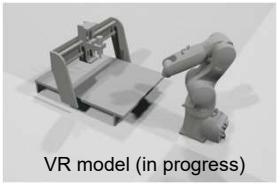
Lab Testbed

- KUKA robot
- CNC router
- Sensors

< A schematic of two-way MTConnect framework >

Conclusions & Future works

- **Conclusion: Two-way MTConnect based framework** has been developed and its **applications** are presented for smart manufacturing technology.
- **Future works**
  - VR/AR Visualization (Unreal 3D engine)
  - Sensor fusion
  - Machine learning



VR model (in progress)