Aalto CS-C2130 Project Proposal 2019–2020

Ceracrane — Certifying a crane weighing system

"Every line is the perfect length if you don't measure it." — Marty Rubin

"If you want a perfect measurement result, measure only once." — Unknown

1. Introduction

Millions of tons of goods are transported daily via harbors in containers. In harbors, the containers are manipulated with large container cranes, which weigh the payload during the lifting process. SOLAS convention sets minimum safety standards in relation to construction, equipment and operation of merchant ships. Since July 2016, SOLAS requires that when loading your cargo on board the vessel, the Verified Gross Mass or weight must be informed to the carrier. Update was made to enhance safety on ship by eliminating misreported container weights.

There's two ways to determine exact weight of container: either it's weighed separately before loading, or if exact weights are known for container, goods and package material; they can be summed up and declared. Information on container's to be exported is then sent to terminal and cargo planner creates a stowage plan. It is critical that correct weight information is at hand when creating the plan, as otherwise it can lead to imbalance and risk of ship capsizing.

However, the weighing system lacks a proper methodology, e.g. how to include the weighing uncertainty (i.e. how precise the outputted value is) to the actual payload mass, and how to ensure that the given uncertainty is affiliated to a certain crane and its weighing system. Also, the communication method between different parties is always mutually agreed which causes slowness and extra work to overall process.

Given this, the goal of the ongoing EU project EMPIR SmartCom is to change the current practices by *introducing a digital, machine readable format for the calibration certificates, called Digital Calibration Certificates (DCC).* This would allow not only better traceability of the fundamental uncertainties in our measurements, but also using the now digitally available information to better optimize industrial and commercial processes.

2. Project goals

The goal of this project is to **design and implement** a prototype system for **using digital calibration certificates** in an **industrial crane** payload weighing system. In addition, the digital calibration certificate should be used to ensure that the given mass values are affiliated to a certain crane and weighing system with this particular DCC.

The student group has a considerable amount of freedom in deciding how to implement such a prototype. We recommend the following structure for the project:

1. Concepting and technology prototyping
2. First prototype iteration: design, implementation, and user testing

3. Second prototype iteration: revised design and implementation
4. Limited field trial with a few users

We expect the project to start with a concepting phase, where the group defines a few use cases with the client, creates a number of user interface mockups, and tests them with real users in realistic settings. The number of use cases may be relatively low, initially just two or three.

3. Technologies

The DCCs will be primarily represented in XML, and digitally signed using standard XML tools and methods.

Other than using XML and XML signatures, the group can choose the actual technologies used for developing the app. However, we recommend using modern web technologies, such as JavaScript and associated technologies.

No proprietary tools are needed; all necessary tools are open source and free to use.

The crane system, which is to be used for the implementation of the project and demonstrating the functionality, is located at AIIC campus (Puumiehenkuja 5). The system consists of the crane itself and its digital twin, which is based on Siemens MindSphere operating system. The project requires some work with industrial data management solutions.

4. Requirements for the students

Students should preferably have:

- Good knowledge how to use web technologies
- Experience with ReSTful APIs
- Basic knowledge about computer security and cryptographic signing
- Preferably basic knowledge about measurement and metrology

The difficulty level of the project is technically medium. Understanding the use cases and business implications are probably harder than the actual technical implementation.

5. Legal Issues

Intellectual Property Rights (IPR):

Aalto asks the students to move their copyright to Aalto so that they may be used in the EMPIR SmartCom project. The results will be published as open source, under an OSS license of the students' choice.

Non-disclosure agreement (NDA):

If it turns out that using and/or accessing confidential information is necessary for the completion of the project, it is possible that an NDA will be signed between the project parties.

6. Client

The group members should have their own laptops or other computers, suitable for web development. Aalto will provide the group with Linux virtual machines or other servers, as needed for implementing the backend.

Client representatives

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7. Additional information

https://www.ptb.de/empir2018/smartcom/home

https://www.aalto.fi/en/aiic

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