5G Ports - driving efficiency through IoT and AI

CSIC Cambridge Centre for **Smart Infrastructure & Construction**

Introduction

The ongoing project brings together the technological advancements in the fields of 5G, IoT (remote sensing and condition monitoring) and predictive data analytics to improve the productivity and safety of the operation of the quay cranes at the Port of Felixstowe. The project is funded by the UK's Department for Culture, Media and Sports.

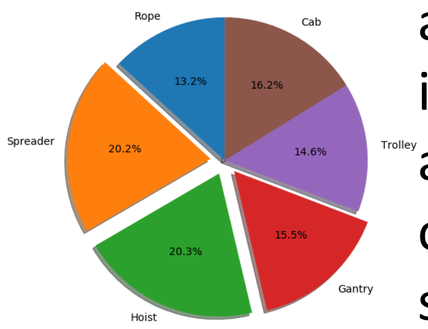
Hoist & Trolley motors
Vibration, Temperature, Gyroscope, Acoustic, Humidity, Shock load

Driver Cab and Rail
Vibration, Temperature, Gyroscope, Acoustic, Humidity, Shock load

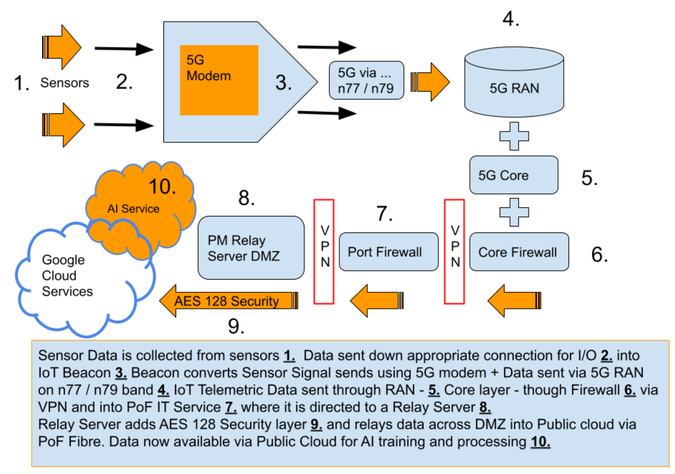
Gantry
Strain gauges

Internet of Things

A failure modes and effects analysis was carried out to identify the components that are contribute to the highest disruptions to port operations and to suggest sensors.



Data from the sensors are send via 5G to inform the AI training and processing. The outputs from the AI system will feed into a predictive maintenance decision-support-tool.



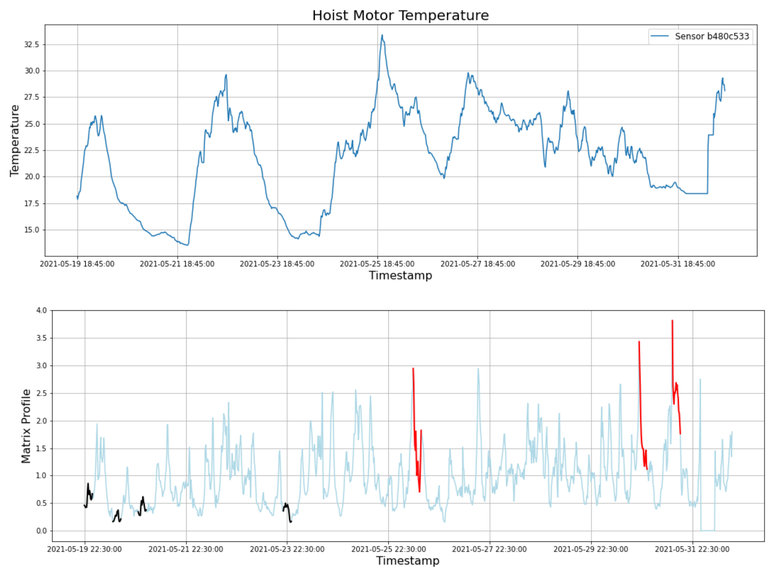
Sensor Data is collected from sensors **1.** Data sent down appropriate connection for I/O **2.** into IoT Beacon **3.** Beacon converts Sensor Signal sends using 5G modem + Data sent via 5G RAN on n77 / n79 band **4.** IoT Telemetric Data sent through RAN - **5.** Core layer - though Firewall **6.** via VPN and into PoF IT Service **7.** where it is directed to a Relay Server **8.** Relay Server adds AES 128 Security layer **9.** and relays data across DMZ into Public cloud via PoF Fibre. Data now available via Public Cloud for AI training and processing **10.**

High level data flow diagram

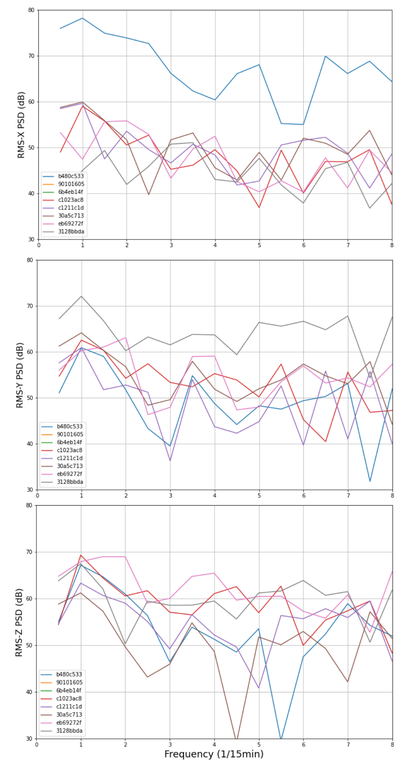
Predictive data analysis

The data collected on different engineering parameters from the sensors will be analysed to identify anomalies.

The patterns thus detected will be used to inform the engineers of issues before the problem disputes the crane's operation.



Matrix profile discords for anomaly detection on Temperature readings from Hoist Motor



Power Spectral Density of signals from vibrations sensors installed on the test crane

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