**DIPLOMA THESIS**

**Documentation**

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| Author(s) | Luca Alexander Gekle, Maximilian Silvester Kampl, Marko Daniel Schrempf |
| Form, academic year | 5AHWIN, 2024/25 |
| Topic | Container-Tracking & Umweltdatenerfassung (CONTRUDE) |
| Co-operation partners | HTL Leoben |

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| Assignment of tasks | Containers on a cargo ship are exposed to various environmental influences. Within a container ship, forwarding and storing environmental data from individual containers is beneficial for quality assurance, but it is often difficult to implement due to the challenging radio frequency propagation conditions. |

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| Realisation | **Kampl:**  Collection of environmental data (e.g., temperature, air pressure, etc.) using microcontrollers, as well as forwarding the information under challenging radio frequency propagation conditions.  **Schrempf:**  Analysis and evaluation of various frameworks for persisting environmental data, as well as the architectural structure of the overall application.  **Gekle:**  Development of a frontend for displaying environmental data on container ships. |

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| Results | **Kampl:**  Development of three prototypes based on an ESP32 microcontroller board. Implementation of a mesh network to send the collected sensor data to a central server, with the chosen data transmission protocol ensuring efficient data transfer and processing.  **Schrempf:**  Design and implementation of the server-side software architecture, considering modular approaches using software containers. Design of interfaces for persisting and providing the generated data—distinguishing between time series data and master data.  **Gekle:**  Development of a simulator to reduce the number of required hardware prototypes while still allowing testing of the concept on a ship-sized scale. Additionally, the development of a web application is included, allowing users to view the position and neighboring or nearby containers and their environmental data. |

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| Illustrative graph, photo  (incl. explanation) |  |

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| Participation in competitions  Awards | No |

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| Accessibility of the  Diploma Thesis | <https://github.com/bitsneak/Contrude>  hardback diploma thesis |

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| Approval  (Date / Signature) | Examiner | Head of College |