

This thesis was submitted to the Institute of Mechanism Theory, Machine Dynamics and Robotics

Cross-Compiling ROS2 Humble to WebAssembly

Master Thesis

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Aachen, 31 March 2023

Master Thesis

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Formula symbols and indices

Lower case latin letters as formula symbols

Upper case latin letters as formula symbols

Lower case greek letters as formula symbols

Upper case greek letters as formula symbols

Indices

List of abbreviations

General abbreviations

1. Introduction

Motivation for work

1.1. Motivation

2. Literature Review

2.1. State of the Art

2.1.1. ROS on Web

Advantages and disadvantages

2.2. Relevant Works

2.2.1. ROSbridge

2.2.2. ROS Control Center

2.2.3. ROSboard

2.2.4. ROSlink

2.2.5. Foxglove Studio

2.3. State of WASM

2.3.1. Unity WASM

3. Concept Realization

3.1. Concept

Ideal scenario: - click on a link and run ROS - connect to a robot via bluetooth - share simulations and algorithms

3.2. Technical Levels

3.2.1. User Levels of Interaction

3.2.2. Technical Levels of Implementation

3.3. Scope

- Middleware replacement (why sockets don't work)
- JavaScript "ROS master"

4. Methodology

- Development environment - Building tools - Testing tools (chrome, firefox)

4.1. Development Environment

4.2. Cross-Compilation Tools

4.3. Testing Environment

5. Middleware Implementation

- What does the middleware do? - ROS supported middleware implementations - Why it needs to be replaced - Minimal implementation (minimal set of functions) - Design of middleware packages (tree diagram or something)

5.1. DDS Middleware

5.1.1. FastDDS

default

5.1.2. Eclipse

5.1.3. Gurum

5.2. Custom Middleware

5.2.1. Email

5.2.2. Zenoh

5.3. Substituting ROS 2 Middleware

At run time

At build time

5.4. Custom Middleware Design

6. Package Building Process

- Emscripten - Colcon - Toolchains

7. Design of Web Elements

- Web workers, what are they? why are they needed? - Communication channels - Registry of topics/subs/pubs - Message handling

8. Package Management and Distribution

- Automating package building - rostack?

9. Concept Assessment

- Survey - Performance measures - Limitations

10. Summary

11. Outlook

- Compiling on the browser - Packaging Gazebo - WASI

List of Tables

List of Figures

A. Illustrations

B. Tables