SCOLOPENDRA

Software extension of the six-legged robotic platform

Author: Ing. Samuel Titko
Advisor: doc. Dr. Ing. Ján Vaščák

TECHNICAL UNIVERSITY OF KOŠICE

DCAI Department of Cybernetics and Artificial Intelligence

The aim of thesis

The diploma thesis extends software of the hexapod robot Scolopendra. The objectives of the software extension were:

1. Design of the software library for joint based robots management.
2. Design of the software package for hexapod Scolopendra.
3. The design of the virtual models i.e. digital twins in visualization and simulation.
4. Design graphical user interface for the remote control of the robot functionalities.

Implemented Technologies

1. Open3D library.
2. Webots simulation software.
3. .NET Framework WPF.
4. Socket interface.

Core Library

The Core library provides basic data structures for jointed the robots such as forward and inverse kinematics structure creation modules, visualization tools and client server based modules for making distributed architectures of the appliactions.

Software Package

The software package contains modules that extend Core library with modules, files and demo applications that are particularly designed for the Scolopendra hexapod. It also contains modules that provide interoperability with virtual model in the Webots simulator.
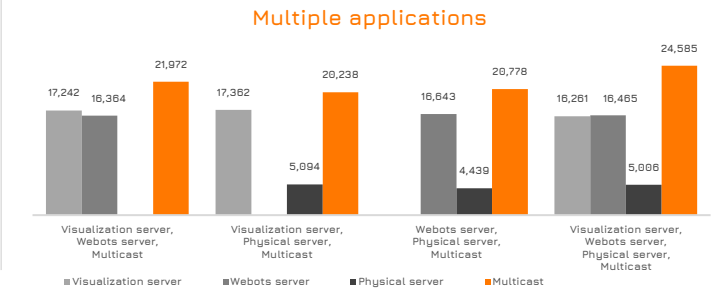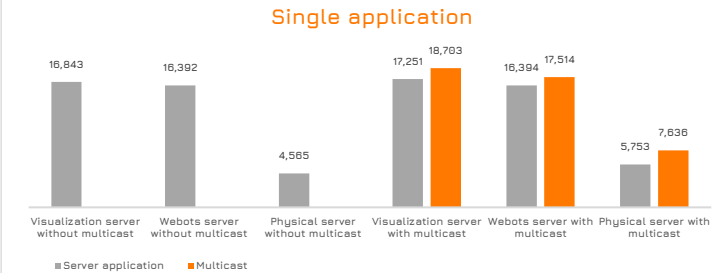
Applications Architectures

There are total of 10 combinations to establish communication between five application that the software package contains. Three architectures are simple connections between model and GUI three are the same but with the enabled multicast and the last four are combinations of multiple aplications.

Single application / Multiple applications
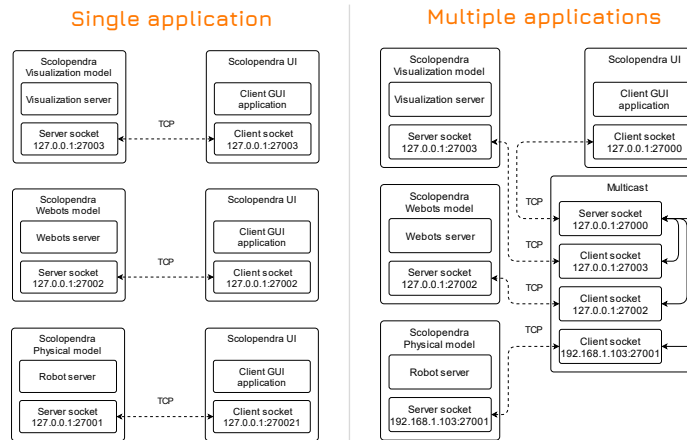
Performance tests

The aim of the tests was to determine which of these architectures has the highest impact on hardware performance of the desktop PC. Each test measures time of one computation cycle of the server application in milliseconds. Testing device parameters:

› CPU- Ryzen 7 3700X,
› GPU – Nvidia RTX 3070,
› RAM 32GB 3600MHz.

Single application

Values: Visualization server without multicast 16,843; Webots server without multicast 16,392; Physical server without multicast 4,565; Visualization server with multicast 17,251 / 18,703; Webots server with multicast 16,394 / 17,514; Physical server with multicast 5,753 / 7,636.

■ Server application ■ Multicast

Multiple applications

Values: Visualization server, Webots server, Multicast 17,242 / 16,364 / 21,972; Visualization server, Physical server, Multicast 17,362 / 5,094 / 20,238; Webots server, Physical server, Multicast 16,643 / 4,439 / 20,778; Visualization server, Webots server, Physical server, Multicast 16,261 / 16,465 / 5,006 / 24,585.

■ Visualization server ■ Webots server ■ Physical server ■ Multicast

Visualization Model

OPEN3D

Simulation Model

Webots™

Physical Model

Graphical User Interface

SCOLOPENDRA

Home   Model   About

SCOLOPENDRA

THE HEXAPOD ROBOT

Scolopendra hexapod is robot from bachelor thesis with title Scolopendra – Control design of a six-legged robotic platform.

The bachelor thesis was aimed to design and build hexapod robot from scratch. The design of every component was made using free CAD software Tinkercad. Whole construction consists of 62 3D printed components. The propulsion of legs is provided by 18 units of servo motors RDS-3115-MG controlled by PWM signals. Servos are connected to two PWM controllers marked as PCA9685. Microcomputer Raspberry Pi is used as a brain of the robot.