

Software Requirements Specifications

Version 1.1

1. Introduction

1.1 Purpose

The purpose of this document is to define functionality of “Communication Model for Cooperative Robotics Simulators” project. The intended audiences are major project professor and project committees.

1.2 Scope

This document covers the requirement specification of “Communication Model for Robotics Simulator”. The Communication Model for Robotics Simulator will provide fundamental communication for simulated robot to pass messages between simulated robots. The fundamental communication method consists of broadcast and point-to-point communication.

1.3 Definitions, acronyms and abbreviations

- 1.3.1 Broadcast communication refers to one-to-many communication which message is originated in one site and distributed to all simulated robots within the same local area network.
- 1.3.2 Point-to-point communication refers to one-to-one communication which each message has only one specified destination address.
- 1.3.3 Propagation delay refers to the time lag between the departure of a signal from the source and the arrival of the signal at the destination.
- 1.3.4 Range limit refers to the longest range which each simulated robot can communicate with others simulated robots.
- 1.3.5 JDK or A Java Development Kit is a program development environment for writing Java applications.

1.4 References

- IEEE Recommended Practice for Software Requirements Specification IEEE Std 830-1998
- “Cooperative Robotics Simulator” project overview description
<http://www.cis.ksu.edu/~sdeloach/CRSimulator/downloads/Cooperative%20Robotic%20Simulator.pdf>

1.5 Overview

The rest of this document provides more detail in requirement specification of this software. Section 2 describes overall description including product perspective, product functions, user characteristics, constraints and assumptions. Section 3 provides specific requirement and critical use-case diagram.

2 Overall description

2.1 Product Perspective

This project is a part of “Cooperative Robotics Simulators” research project at CIS department, Kansas State University. The Cooperative Robotics Simulators consists of three main components, Robot Simulator, Environment Control Panel and Environment Simulator. It requires an interface between communication model and environment simulator. This interface provides communication for simulated robots and provides the ability for environment control panel to set some variables for the communication model, which are propagation delay time, broken links, range limit, and message delivery probability of each simulated robot and for the entire system. The environment simulator is the central component for Robot Simulator and Environment Control Panel to connect to Communication Model.

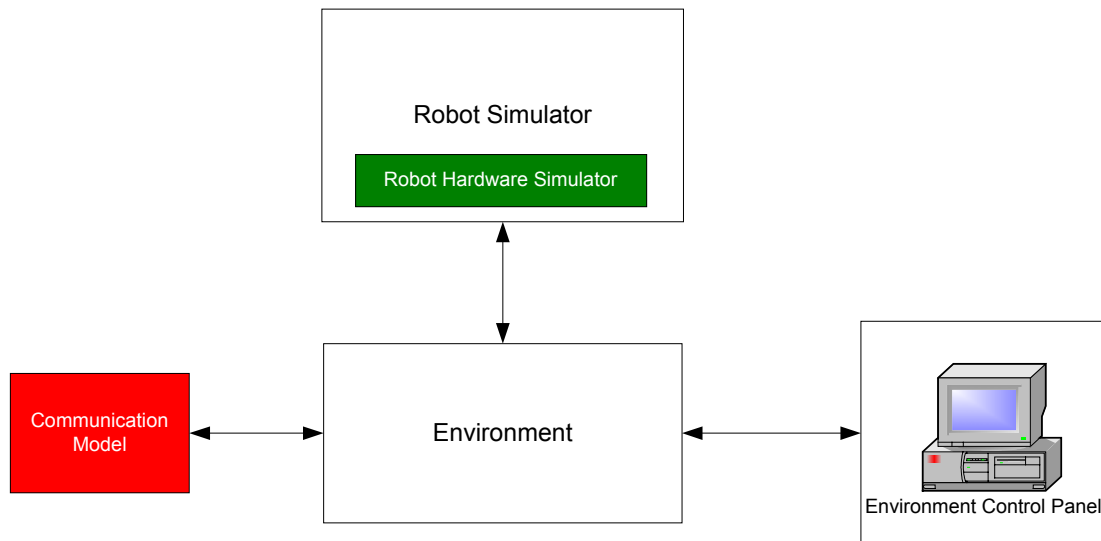


Figure 1. Interfaces between communication model and the other components of the Cooperative Robotics Simulator System.

2.2 Product functions

- 2.2.1 Provides broadcast communication for simulated robot to send messages within local area network.
- 2.2.2 Provides point-to-point communication for simulated robot to send messages to another robot.

- 2.2.3 Allow simulated robots to choose communication methods, which are broadcast, and point-to-point communication.
- 2.2.4 Allow Environment Control Panel to define propagation delay time.
- 2.2.5 Allow Environment Control Panel to simulate broken links.
- 2.2.6 Allow Environment Control Panel to define range limit for each simulated robot.
- 2.2.7 Allow Environment Control Panel to set message delivery probability for each robot and for the entire system.

** The environment control panel will access the interface via environment.

2.3 User characteristics

The intended user for this software is developer of the Cooperative Robotics Simulator who participates in the component related to communication.

2.4 Constraints

- 2.4.1 This project will be designed to provide capability of running in distributed manner, or on a single machine.
- 2.4.2 The project will be developed in Java using standard libraries.
- 2.4.3 The project should run on all JDK complaint platforms.
- 2.4.4 The design of the project should not rule out the web interface capability.

3. Specific requirements

3.1 Use cases

3.1.1 Primary High-Level, Use-Case diagram

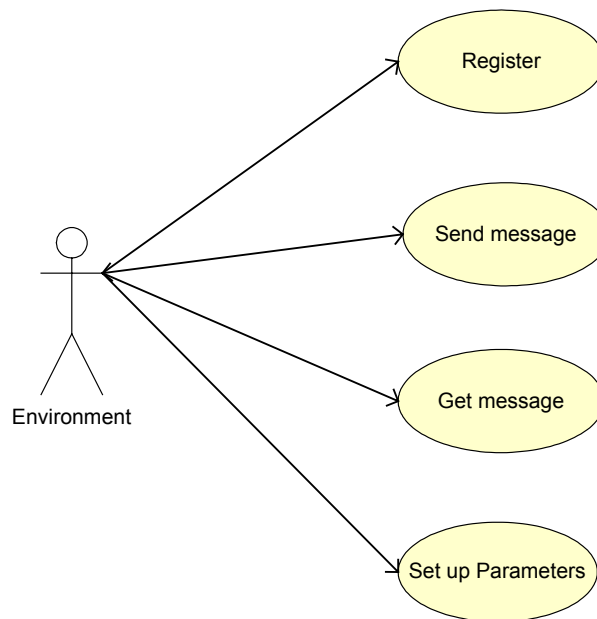


Figure 2. Use-Case Diagram for the Primary, High-Level, Use Cases of the Communication Model for Cooperative Robotics Simulator.

- **Register**

Simulated robot registers to the system before starting communication sessions to allow communication model knows about robots and set some start-up parameters such as having only some types of communication.

- **Send message**

Simulated robot has a request to send messages to the other simulated robots within the same local network.

- **Get message**

Simulated robot has a request to get messages from the system.

- **Set up parameter**

Environment can set the communication parameters, which will be used to control the communication between simulated robots

3.1.2 Primary Low-Level Use-Case diagram

3.1.2.1 Send message Use Case

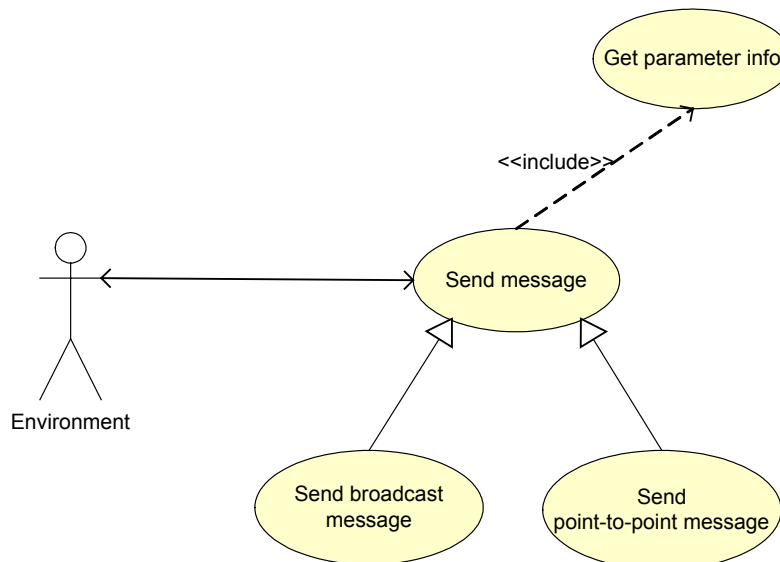


Figure 3. Use-Case Diagram for the Primary Low-Level Use Cases Detailing the Low-Level Use Cases Associated with the High-Level Send message Use Case.

- **Send broadcast message**

Simulated robots can send broadcast message along the local network, which can receive by all simulated robots in the same network.

- **Send point-to-point message**

Simulated robot can send message directly to another robot.

- **Get parameter info**

Both send broadcast message and send point-to-point message will send message depend on the communication parameter such as delay time, broken link and range limit.

3.1.2.2 Set up parameters Use Case

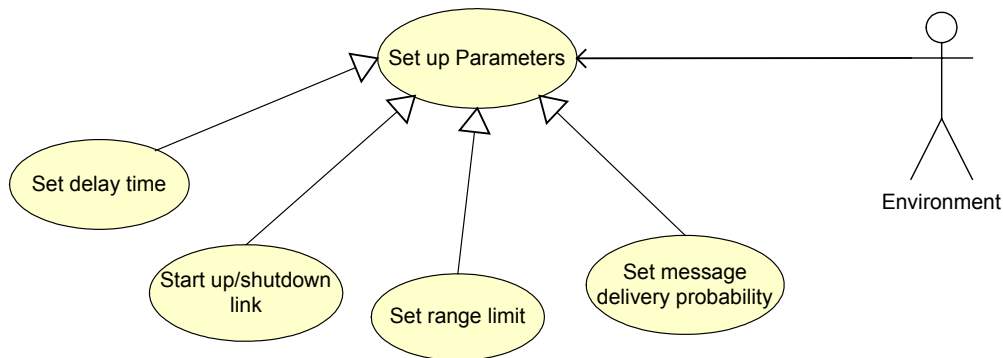


Figure 4. Use-Case Diagram for the Primary Low-Level Use Cases Detailing the Low-Level Use Cases Associated with the High-Level Set up parameters Use Case.

- **Set delay time**

Environment can set delay time, which will create a time lag between the source and the destination. Delay time can set between each pair of robots or for the entire system.

- **Start up / shutdown link**

Environment can start up and also shutdown the communication link for each robot. The link can be activate for send only or receive only or both of them The communications will success only sending the messages through active link

- **Set range limit**

Environment can set the range limit, which is the longest destination that each simulated robot can send a message.

- **Set message delivery probability**

Environment can set the message delivery probability to simulate message loss in the network.

3.2 Requirements

Register Robot

3.2.1 *Communication model shall support the ability to register robot to the system.

3.2.2 *Communication model shall support the ability to set communication method to each robot after registering. There are two types of communication, broadcast communication and point-to-point communication.

Send broadcast message

- 3.2.3 *Communication model shall support the ability to send broadcast message.
- 3.2.4 *Communication model shall support the ability to receive broadcast message.
- 3.2.5 *Only simulated robot that has broadcast capability shall send or receive broadcast message.
- 3.2.6 *Simulated robots with active send link shall send broadcast message to other robots.
- 3.2.7 *Only simulated robot with active receive link shall receive broadcast communication.
- 3.2.8 Broadcast communication shall support the ability to delay message before sending out.

Send point-to-point message

- 3.2.9 *Communication model shall support the ability to send point-to-point message.
- 3.2.10 *Communication model shall support the ability to receive point-to-point message.
- 3.2.11 *Only simulated robot that has point-to-point capability shall send or receive point-to-point message.
- 3.2.12 *Point-to-point communication shall delivery to only one simulated robot specified by a destination address.
- 3.2.13 *Simulated robots with active send link shall send point-to-point message to only robot with active receive link
- 3.2.14 *Only simulated robot with active receive link shall receive point-to-point message.
- 3.2.15 Point-to-point communication shall support the ability to delay message before sending out.
- 3.2.16 Simulated robots with range restriction shall send and receive messages within range limit.

Set up parameters

- 3.2.17 *Communication model shall support the ability to start up or shutdown all the communication links or each robot. It shall support the ability to activate/deactivate send link only, receive link only or both of them.
- 3.2.18 Communication model shall support the ability to set delay time for each robot or the entire system.
- 3.2.19 Communication model shall support the ability to set range limit for each simulated robot or the entire system.
- 3.2.20 Communication model shall support the ability to set message delivery probability for each robot and for the entire system.

The item with * indicates the critical requirements.