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Technical specifications of the R1 platform

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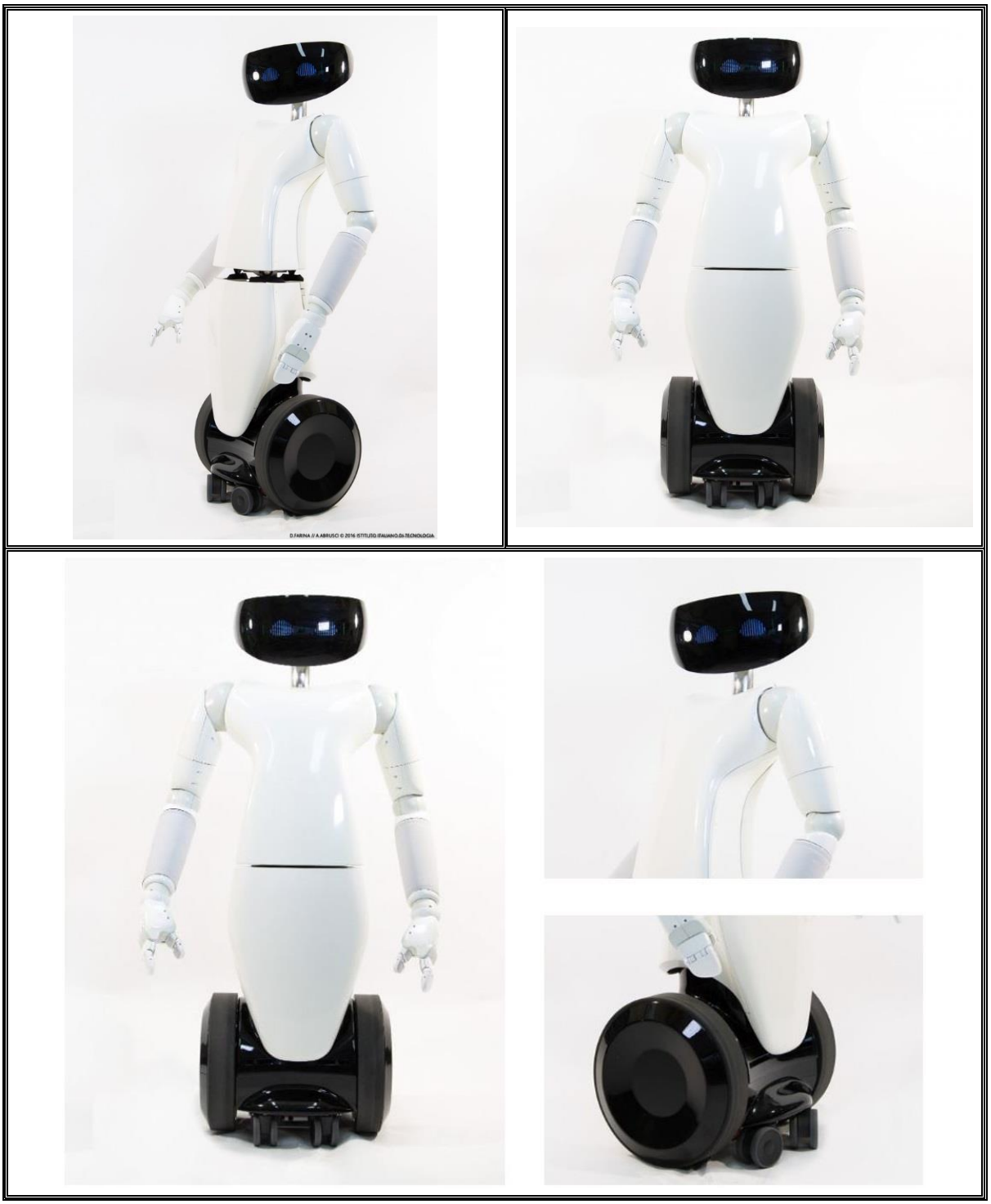
1 CHANGE LOG

Revision	Date	Changes
1.0	05/08/2019	First revision

2 INTRODUCTION

The main features of R1 robotic platform prototype are briefly sketched out hereafter. It is worth noting that pictures, and related description, are based on the previous release, the so-called R1 mark 1, since R1 mark 2 has not yet been manufactured at the time when this document is drafted.



2.1 HARDWARE OVERVIEW

2.1.1 Size, height, weight

2.1.1.1 Height

The robot is 1.2m tall. The robot torso is equipped with a mechanism that allows it to vary its height from a minimum of 1.15m to a maximum of 1.35m.

2.1.1.2 Small footprint

The footprint of the robot is a rectangle 400mm wide and 350mm long. The support area of the robot is widened with three 75mm pivoting castor wheels.

2.1.1.3 Weight

The robot weighs 51kg in total (including batteries).

2.1.2 Safety

The robot is designed for safe human-robot interaction. All arm joints are equipped with a very simple overload protection device that acts as a safety clutch that provides inherent safety.

On top of this, the robot is equipped with active force-torque control. The robot exploits the data measured by two six-axis force torque sensors in its arms, to generate safe and compliant motions.

The robot has an emergency stop button operating in conformance with the ISO13482 standard.

Furthermore, the robot has completely closed covers with no pinch points.

2.1.3 Mobility

The robot moves by means of two driving wheels. Its maximum speed is limited to 0.6m/s in software.

2.1.4 Manipulation

The robot has two eight-degree of freedom (DOF) arms. The target payload of the robot arm is 1kg with arms stretched reaching at a 0.6m distance from the robot body. Higher payloads are obtainable at shorter distances.

The robot has a special torso mechanism, which allows it to adapt its height to the height of the surface on which it is possibly manipulating. The height of the robot can vary by 200mm.

The robot hand was designed to allow opening of different types of doors (doors with handles, doors with push bars, etc.).

2.1.5 Hands

The robot has two four-DOF, two degrees of actuation (DOA) hands. The hands are equipped with distributed pressure sensors, joint angle encoders and series elastic actuators to allow monitoring of the gripping force. The tip force of the hands is approximately 20N.

2.1.6 Sensors

2.1.6.1 Joints and body

The robot configuration is measured and controlled by means of joint position encoders.

Most motor control boards sport embedded accelerometers and gyroscopes, which allow to monitor the state of the robot and to identify the occurrence of unplanned impacts.

The hands of the robot are equipped with IIT's proprietary pressure-sensitive skin technology.

The robot has two six-axis force-torque sensors installed in its arms to measure and control physical interaction.

2.1.6.2 Head

The robot has a two-DOF head that is equipped with sensors and devices for HRI.

The robot mounts an XtionPro Live RGBD sensor, for depth sensing. Higher performance depth sensors are being tested and may be provided in a number of optional variations.

The video system is based on the Leopard Imaging OV580 twin camera module and allows for multiple configurable video resolutions and sampling rates.

The head also integrates two microphones, a loudspeaker and a special, custom designed, programmable RGB LED matrix.

2.1.6.3 Mobile robot base

The robot base is equipped with a Robopeak RPLidar laser sensor.

2.1.7 Computation

The robot has two Nano-ITX i7 computing units and a MYIR Xilinx based Z-turn board.

2.1.8 Wi-Fi connection

The robot is equipped with the EA-AC87 ASUS 5 GHz Wireless-AC 1800 access point.

2.1.9 Battery

The robot is equipped with an on-board battery on its base. The robot is designed to allow for three hours of operation. The robot has two power buses, at 24V and 12V respectively, plus an additional low voltage bus for the computing units.

2.2 SOFTWARE

2.2.1.1 Open source

The robot is shipped with Open Source APIs for YARP, a lightweight middleware employed on the iCub platform. Interface to ROS is possible via dedicated protocols.

2.2.1.2 Capabilities

The software APIs allows the R1 platform to exploit a wide range of advanced libraries for service robotics (from the Open Source communities) for navigation, manipulation, and perception.

2.2.1.3 Simulation

Developers can benefit from the powerful simulation and visualization tools, which are freely available. Among these the Gazebo and RViz environments, have been set up and are actively being used for the development of the robot hardware and software.

2.3 TRANSPORTATION

IIT has designed a professional travel case to safely and easily pack and ship the R1. The professional travel case may be purchased at any time by requesting it to IIT at least 2 months before the intended date of utilisation.