S1 Humanoid Head



Overview

The Meka S1 Humanoid Head is a nine degree-of-freedom robotic active vision head. Designed for a wide range of expressive postures, it is the ideal platform for researchers interested in human-robot interaction and social robotics. The S1 system features high resolution FireWire cameras in each eye, integrated DSP controllers, zero-backlash Harmonic Drive gearheads in the neck, and the Meka M3 real-time control system.

The S1 head includes a 3 DOF active vision camera system capable of quick saccades, smooth pursuit, and vergence. The 4 DOF neck and two independent eyelids allow for a wide range of expressive emotional display such as happy, surprised, sad, and sleepy. Optional 4 DOF ears with RGB Led displays provide additional opportunities for emotional displays.

Total DOF	9+
Interface	M3 EtherCAT
Power	24V@6A peak
Weight	7.6 Kg
Angular resolution	.022 degree
Camera	1328x1048 at 23 FPS

Preliminary specifications. Subject to change.

Meka can tailor the S1 design to your needs with the addition of customized head shells and additional degrees-of-freedom. S1 system is plug-and-play compatible with the Meka M3 control software and the A2 manipulators.

Electrical Properties

The S1 head requires 24VDC@ 6A peak for motor power. This is exposed through an Amp PowerLock connector (54483-2). The digital EtherCAT bus requires 9-15V@1200mA over a standard FireWire cable. All required electrical connections are brought out from the Meka A2 manipulator if present. When used without the A2 system, an external M3 EtherCAT hub and M3 Power Board is required.



Mechanical Properties

The S1 head size is scaled to 150% of a small adult. This oversized appearance enhances the youthful playfulness feel of the head. Smaller head packaging is also available. The head weighs 7.6Kg and bolts directly to the Meka T2 Torso or the lab bench. The overall size is shown below.



The 9 DOF of the head have the kinematic structure shown above and the joint ranges shown below.

joint ID	joint name	theta_max	theta_min
JO	Lower neck tilt	30	-45
J1	Lower neck pan	70	-70
J2	Upper neck tilt	17	-25



J3	Upper neck roll	30	-30
J4	Eye tilt	28	-30
J5	Right eye pan	35	-35
J6	Left eye pan	35	-35
J7	Right eyelid	29	-10
J8	Left eyelid	29	-10

Sensing

All sensing is done with the embedded DSPs at 1Khz. Joint position is measured at each joint using a 14bit ContElec Vert-X 13 absolute encoder.

Each actuator also provides sensing of the motor current, the motor temperature, and the amplifier temperature. These values are monitored in the manipulator firmware for over-current and over-temperature safety conditions.

Control and Software

The head is shipped with the following controllers ready to run:

- Smooth trajectory joint angle control
- Animation sequence controller

The head has embedded DSP controllers which relay data on the EtherCAT bus at 1Khz. The on-board M3 EtherCAT hub interfaces to a PC or laptop using a standard CAT5 Ethernet cable. The off-board real-time control PC (RTPC) runs Ubuntu Linux, RTAI, and the M3 control system.

The M3 control system provides:

- A plug-in based real-time C++ control architecture allowing for easy design of custom controllers.
- A calibrated (SI) view on all sensors and actuators
- Integrated Orocos KDL kinematics and dynamics functionality
- Smooth Spline and Minimum Jerk joint trajectory control
- Inverse kinematics and dynamics control
- A XML-RPC and TCP/IP server for scripting by external Python clients
- A Python API for controlling the A2 posture and forces.
- Support for the Willow Garage Robotics Operating System (ROS) and its ODE based physical simulator.
- Open-source GPL licensing.

The M3 API can be found here: https://mekabot-dev.com/m3doc/html/index.html

Options

- Expressive 2 DOF ears with programmable RGB LED display.
- Custom head shells
- Lab bench mounting chassis
- Enclosed bulk power-supply



Sales

Contact <u>info@mekabot.com</u> for current pricing. Purchase includes:

- Meka S1 Head
- Meka M3 Power Board and Remote E-Stop
- Meka M3 EtherCAT hub
- Meka M3 control software and S1 head calibration files.
- Preconfigured Dell Core Duo RTPC
- On-site installation
- One year, no-cost unlimited support including parts, travel, phone and email.