Q.boards

The Q.bo robot needs to interact with its surroundings. Q.bo has some sensors and actuators in order to achieve this goal.

The Q.boards have been designed to aquiere the sensors data and to make it available for the PC that is embedded in Q.bo. The boards also gives the PC the capability to controll the actuators of Q.bo.

In order to control the sensors and motors that comes with Q.bo, three boards have been designed. Their names are Q.board1, Q.board2 and Q.board3. Q.bo has two additional boards whose names are Q.board4 and Q.board5 that serve as an IMU sensor and as the mouth LED matrix respectively.

Q.board1

The Q.board1 is the base control board of Q.bo. Its main functions are the following:

- Control of two DC Motors
- Control of the audio amplifier
- Control of the I²C Bus

In order to achieve this goal the board is equipped with a fast ATmega1280 microcontroller that is compatible with the Arduino IDE.

The motors and sensors are all connected to the ATmega1280 microcontroller.

A motor controller is integrated in the board. This motor controller is able to move two 12V, 2A motors. The recomended motors are the EMG30 motors http://www.robot-electronics.co.uk/htm/emg30.htm

[http://web.archive.org/web/20160705024939/http://www.robot-electronics.co.uk/htm/emg30.htm].

The hall pins of the encoders of the motors (two for each one) are routed to interruption enabled pins in the ATmega1280 microcontroller, so a PID controller is possible with the board.

An I²C bus connector is also present in the board, so several sensors and devices can be attached to it. There are at the moment four types of devices. The SRF10 sensors are used to avoid hitting on the walls. The LCD03 board is used to give some extra information of the status of the robot. The Q.board4 is controlled by the I²C Bus and can be used as an inertial measurement unit to detect falls of the robot and to improve the positioning system.

The ATmega1280 serial bus is connected to a Serial_to_USB converter. Thanks to the Arduino bootloader the board can be programed and controlled easily with the computer.

A program to control the motors and sensors which come with Q.bo is already finished, but it can be modified by anyone who wants to increase or change its functionality.

The board has an integrated audio amplifier. The audio input for this amplifier is a 3-pin connector in the board with the Audio Left, ground and Audio Right signals. These signals must be analog signals.

Source Code: https://github.com/OpenQbo/qbo_arduino
[http://web.archive.org/web/20160705024939/https://github.com/OpenQbo/qbo_arduino]

The schematic of the board is available in the following link: qboard1_v1.pdf

The list of components of the board is available in the following link: qboard1_v1.xls

Q.board2

The Q.board2 is located at the head of Q.bo and its a compatible Arduino Duemilanove board. It has the same connectors for the shields as the original Duemilanove board.

It has an integrated shift register ic (integrated circuit) that controls the mouth leds.

It has 3 electrect microphones inputs routed to 3 analog pins of the ATmega328 microcontroller. These microphone inputs are also routed to an analog multiplexer, so one of the 3 microphone inputs is delivered to the microphone output the board comes with. In Q.bo this output is connected to the PC mic input or to the PC line input.

It has an additional analog input. This additional input is connected in Q.bo to the PC audio output in order to know when the PC is outputting some sound so the mouth can be changed simultaneously, but it can be used for other purposes.

It has 4 servo connectors where the head pan and tilt servos and the eyes servos are connected. The servo power comes from a voltage regulator that takes the power from the power connector in the board.

The logic of the board takes the power from the USB port.

A program to control all these devices is already finished, but it can be modified by anyone who wants to increase its functionality.

Source Code: https://github.com/OpenQbo/qbo_arduino
[http://web.archive.org/web/20160705024939/https://github.com/OpenQbo/qbo_arduino]

The schematic of the board is available in the following link: qboard2_v1.pdf

The list of components of the board is available in the following link: qboard2_v1.xls

Q.board3

This board acts as an energy controller board. Its purpose is to achieve the better energy performance for Q.bo.
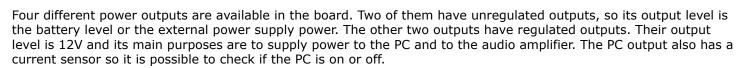
The board makes it possible to completely turn the PC and other Q.bo components power off.

It also gives a battery charging capability to Q.bo.

The board is governed by a stm32f103 32bit Cortex-M3 based microcontroller by STMicroelectronics. It has a switch digital input that serves as a power on/off input, a digital output to light a led and a digital output that acts as the PC on/off switch button.

The board has a connector for the battery and a connector for an external power supply. If no power supply is connected, the board redirects the battery power to the power outputs. If the external power supply is connected, the board switches the output power from the battery to the external power supply and activates the battery charging.

Four different power outputs are available in the board. Two of them have unregulated outputs, so its output level is the battery level or the external power supply power. The other two outputs have regulated outputs. Their output level is 12V and its main purposes are to supply power to the PC and to the audio amplifier. The PC output also has a current sensor so it is possible to check if the PC is on or off.

The maximum power output of the board is 150W.

The board also has an I2C connector. It acts as an I2C device so the battery level and the power state of the board can be read by other microcontrollers.

The board can be programed trough a serial connector easily. It is important to note that due to the high power nature of the board it is not recommended to change the original software designed for the board without the needed knowledge of its operating principle.

Source Code: https://github.com/OpenQbo/qboard3_firmware
[http://web.archive.org/web/20160705024939/https://github.com/OpenQbo/qboard3_firmware]

The schematic of the board is available in the following link: qboard3_v1.pdf

The list of components of the board is available in the following link: qboard3_v1.xls

Q.board4

This board contains the gyroscope and accelerometer sensors, both accesible trough an I²C interface. It also has 3 expansion pins not used by default.

The schematic of the board is available in the following link: qboard4_v1.pdf

The list of components of the board is available in the following link: qboard4_v1.xls

Q.board5

This is the mouth LED matrix board. It contains 20 standard LEDs to form different mouth shapes and a tri-color LED that acts as the Q.bo nose.

The schematic of the board is available in the following link: qboard5_v1.pdf

The list of components of the board is available in the following link: qboard5_v1.xls