Aquabot Control Board Documentation

(Non-driving functions)

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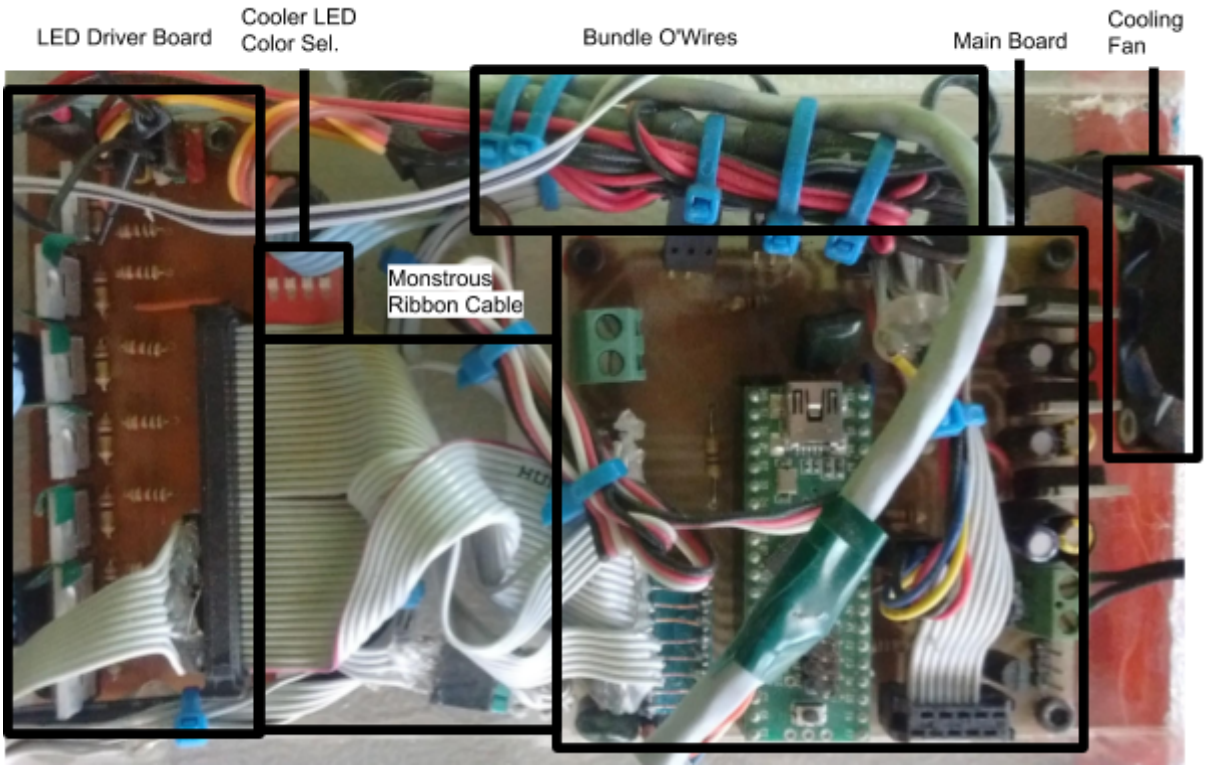
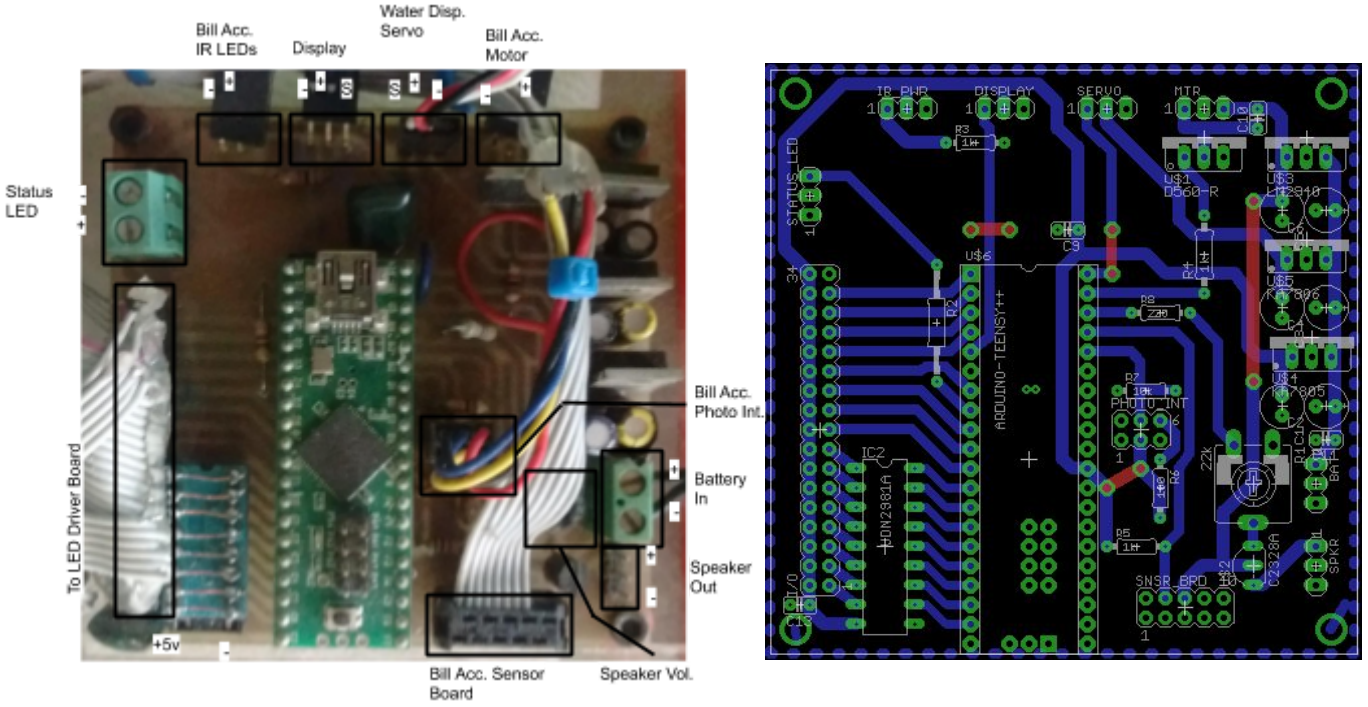
Overview



The Aquabot has a control box dedicated to non-driving functions. It controls the dispenser, LEDs, LCD, keypad, and bill acceptor. It is separate from the driving functions so that a problem in the water dispensing code does not interfere with driving, potentially harming someone. There is a Teensy++ 2.0 on the board that acts as the brain, as well as circuitry to interface with peripherals. At first, there was only the Main Board, and the LED Driver Board was added later to control the LEDs, keypad, and other accessories.

Main Board



The Main Board controls all of the non-driving functions. It houses the Teensy 2.0++, voltage regulators, bill acceptor circuitry, in addition to connectors to the bill acceptor, water dispenser servo, power, and display.

Voltage Regulators and Power Input

The Main Board contains the following regulators:

Output Voltage	Part Number	Battery Voltage	Powers
5v	LM7805	7-25v	Teensy 2.0++, display, bill acceptor circuitry, etc
6v	LM7806	7-25v	Water dispenser servo
12v	LM2940 -12	6-26v	Bill acceptor motor

The maximum input range for power input is 7-25v to keep all of the regulators satisfied. This normally gets wired directly to the Aquabot battery. Power comes in the smaller screw terminal connectors near the rear of the electronics box. The polarity of the power **must** be correct to avoid permanently damaging all of the electronics. The positive should be closer to the voltage regulators, and the negative farther away.

Bill Acceptor Connectors and Circuitry

The Main Board has all of the connections for the bill acceptor to function.

Bill Acceptor Sensor Board

The sensor board of the bill acceptor connects to the large, 2x5 header pin block at the bottom of the board. This is currently only used for the IR detectors on the sensor board to detect a bill being inserted, but there are other signals coming from the sensor board that are currently unused. This connector is keyed and will only plug in one way. Do not try to force it on any other way.

Bill Acceptor Photo Interrupter

The photo interruptor on the bill acceptor that is on the lever that trips when the bill exits the bill acceptor is connected to the 2x3 header pin block near the center of the board. This connector is keyed and will only plug in one way.

Bill Acceptor IR LEDs

The Infrared LEDs that are used to shine on the IR detectors on the sensor board to detect a bill being inserted connect to the 1x3 header pins on the upper left of the board. Ground is on the right pin, and +5v is on the left. Ground is connected through a 1kΩ resistor. This connector is keyed, but it will plug in the other way. Be sure that this is pluged in the right way.

Bill Acceptor Motor

The motor that runs the bill acceptor connects to the 1x3 header pins on the upper right of the board. Ground is on the left, and +12v is on the right. The ground connection is switched by a MOSFET, controlled by the Teensy 2.0++ to control the motor. This connector is keyed, but it will plug in the other way. Be sure that this is pluged in the right way.

Speaker Out

The Main Board has a simple transistor audio amplifier connected to one of the digital pins on the Teensy 2.0++. The speaker connects to the 1x3 header pins on the lower right of the board. The two signal pins are on the outside of the connector. This setup is limited to simple beeps, and cannot make any substantial sounds. The polarity of the speaker does not matter when plugging it in. There is a small trimmer potentiometer used to adjust the speaker volume.

Display

The display connects to the 1x3 header pins on the top middle of the board. The display is a 20x4 character LCD with a Serial Backpack. This allows controlling the display with the

hardware serial pins on the Teensy 2.0++. Only the TX pin on the Teensy 2.0++ is connected to the display. The RX pin is unconnected. +5v is in the center of the connector, with ground on the left and signal on the right. A standard servo cable is used to connect to the display.

Status LED

There is a large screw terminal in the upper right of the board that connects to the built-in LED on the Teensy 2.0++. It has a 470Ω resistor in series with the connector on the board. Positive is on the bottom, and negative is on the top.

Connector to LED Driver Board

The LED Driver Board connects to the Main Board by a large, 2x40 male header pin block. This was originally added to the Main Board as an expansion port, before the LED Driver Board was needed. As a part of this port, there was a socket for a UDN2981A driver chip. This was added so that higher current devices, such as lights and small motors, could be driven directly from the board with no additional circuitry. This chip was decided on because it is available from the original board for the bill acceptor. When the LED Driver Board was added, this chip was not needed, and so a jumper was put in its socket. However, there are still the +5v and ground pins available on the socket. The entire column of pins toward the outer edge of the board are all +5v, and the signal pins are on the inside.

LED Driver Board

The LED Driver Board was added a year after the Main Board to support the addition of LED strips to the Aquabot, along with the keypad and cooler LEDs. This was also when all of the electronics got moved to a box separate from the money box. This board contains transistors to drive each of the RGB channels in two sets of LED strips. It also has a seventh transistor to drive a single color of cooler LEDs, switched by a cooler switch.

LED RJ11 Connectors

On the outside of the box, there are three RJ11 connectors for the LED strips. RJ11 connectors were chosen because they are 4-way, and latch. The latching ensures that they will not become unplugged while the Aquabot drives around.

Power Connector

The power connector is a 3x1 header pin on the top left of the LED Drive Board. It takes in battery voltage to power the LED strips and cooler LEDs. Ground is on the left, and battery voltage is on the right. It is important to make sure the polarity is correct to avoid permanently damaging the LED Driver Board and the LED Board.

RGB LED Drivers

The LED Driver Board contains transistors to drive two independent RGB LED stips. One of these strips is around the outside of the Aquabot, while the other is around the opening where the water is dispensed. The LED strips connect to the two 4x1 header pins on the left side on the board, toward the display. The driver transistors can handle near 100A of current, although additional cooling may be required before 100A is reached.

Cooler LED Strip

The cooler LED strip can be connected to the yellow 3x1 header pins at the top of the LED Driver Board. This output is switched with an additional transistor, controlled by the cooler switch. Currently, this output is run to a separate Cooler LED Color Select Board, which has a 4-way DIP switch to allow selecting the color of the cooler LEDs.

Cooler Switch

The cooler switch plugs into the blue 1x3 header pins. This switch controls the cooler LED strip transistor. Connect the two outer pins of the connector together to turn it on. Currently, there is a jumper on the connector to leave the LED on all the time.

Keypad

The keypad connects to the 1x11 header pins near the Main Board connector. The keypad is a 5x4 matrix, and is used to operate the menus on the display. It is important to plug it in the correct way to ensure proper keypad operation.

Cooler Temperature Sensor

Connects to one of the analog pins on the Teensy

Main Board Connector

The Main Board connects to the LED Driver Board through the 2x40 header pin block. Due to inadequate planning during the designing of the LED Driver Board, the pinout did not match the pinout of the connector on the Main Board, and so the cable between them had to account for the discrepancy. The outer column of pins is +5v, and the inner is the signals.

The Box

The box that houses the Main Board and the LED Driver Board is made from clear acrylic to allow fairgoers to see the inner workings of the box.

Cooling Fan

The cooling fan is a 40x40x10mm 12v fan. It is wired directly to the power in, and is on whenever there is power. It is there to avoid creating a greenhouse when the Aquabot is out in the hot sun all day.

Front Panel

The Front Panel houses the display and the keypad. It unscrews from the box using four M3 screws. The screws thread directly into the acrylic of the box, so it is imperative not to overtighten the screws to avoid stripping out the threads. Some of the threads are already partially stripped out.

Display

The display is a 20x4 character LCD with a Serial Backpack. This allows controlling the display with the hardware serial pins on the Teensy 2.0++. The display is transflective, meaning that it has a backlight and will reflect back light that shines on it. This makes it visible in the sunlight. The display is entirely inside the box, without a cutout, to protect it from water and allow operating the Aquabot in light rain.

Keypad

The keypad is a 5x4 matrix, and is used to operate the menus on the display. It is stuck to the front of the display panel with its adhesive backing.

Power Wire

There is a power with with ground and battery voltage that runs from the drive electronics box to the control box. There is a XT60 connector in the middle to allow removing the cooler without disturbing the power wire.

Drive Board Communications Wire

There is an RJ45 cable with no connectors that runs between the control box and the drive electronics box. Currently unused, this was added to allow the Main Board to talk to the Driving Board or the Aquabot Locator. It has eight conductors that can be used for any purpose. This has been removed in 2017