Garage Door Controller

Build and

Installation Instructions

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https://github.com/TeamPracticalProjects/Garage\_Door\_Controller/blob/master/Terms\_of\_Use\_License\_and\_Disclaimer.pdf

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# OVERVIEW.

This document provides step-by-step instructions for assembling and installing a Garage Door Controller. Before proceeding with this project, you must read and accept the “*Terms\_of\_Use\_License\_and\_Disclaimer*” document which is located in the root level of this repository.

The following parts are needed to build this project:

* Wireless I/O Board with components needed for the project. See section 2 of this document for details.
* Garage Door Opener Remote Control Unit. Our garage door opener uses remote control unit “Liftmaster 371LM”, available at: <https://smile.amazon.com/gp/product/B075MQCH2P/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1>. Your garage door opener may require a different remote control unit. The remote control unit needs to be modified and mounted in the project enclosure. See sections 3 and 4 of this document for details.
* Ultrasonic Distance Sensor, SR-HC04. These are very commonly found, for example: <https://smile.amazon.com/ELEGOO-HC-SR04-Ultrasonic-Distance-MEGA2560/dp/B01COSN7O6/ref=pd_bxgy_3/137-6812788-8746123?_encoding=UTF8&pd_rd_i=B01COSN7O6&pd_rd_r=cd21824f-1050-44c8-8e2f-b261e16cf05a&pd_rd_w=oLoDZ&pd_rd_wg=nKuOW&pf_rd_p=ce6c479b-ef53-49a6-845b-bbbf35c28dd3&pf_rd_r=F9BXN7BAX9TP8ED9SY81&psc=1&refRID=F9BXN7BAX9TP8ED9SY81>
* Mounting bracket for HC-SR04 sensor. If your sensor did not come with a suitable mounting bracket, you can purchase these: <https://smile.amazon.com/HC-SR04-Cartoon-Ultrasonic-Distance-Mounting/dp/B01FDGU0GY/ref=sxts_sxwds-bia-wc-nc-drs1_0?crid=1HS1W1659L4XW&cv_ct_cx=hc-sr04&dchild=1&keywords=hc-sr04&pd_rd_i=B01FDGU0GY&pd_rd_r=d8101316-87b4-4755-9f9f-a978dcfc9433&pd_rd_w=zuloG&pd_rd_wg=ulQPE&pf_rd_p=43f4b3f0-0b04-46ba-8a08-2e851d035e17&pf_rd_r=2DJESSE197W2F6GX3W0G&psc=1&qid=1595356387&sprefix=HC-SR04%2Caps%2C215&sr=1-1-f3947b35-9c59-4d7a-9603-b751e6eed25b>
* USB “Wall Wart” Power supply. A 5 volt, 1 amp (min) power supply. For example: <https://www.adafruit.com/product/501>
* USB A/B Cable. The length will depend upon where the project is mounted with respect to the nearest convenient AC power source. Here is a 10 foot cable that we used: <https://smile.amazon.com/gp/product/B00NH13DV2/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1>
* Project enclosure. We used the following “pencil box”: <https://smile.amazon.com/Really-Useful-Plastic-Storage-Liter/dp/B003H790JU/ref=sr_1_2?dchild=1&keywords=really+useful+boxes+pencil+box&qid=1595357131&sr=8-2>
* Female-Female Jumper Cables. If these didn’t come with the HC-SR04 ultrasonic sensors, you can purchase these: <https://smile.amazon.com/Really-Useful-Plastic-Storage-Liter/dp/B003H790JU/ref=sr_1_2?dchild=1&keywords=really+useful+boxes+pencil+box&qid=1595357131&sr=8-2>
* Mounting Hardware.
  + 2 ea. ½ inch 4-40 nylon standoffs, female-female, threaded.
  + 4 ea. ¼ inch 4-40 nylon screws.
  + 4 ea. ½ inch 4-40 nylon screws.
  + 6 ea. 1 inch, #6 wood screw.

The following tools and materials are needed to build this project. *Make sure that you know how to use these before undertaking this project*!

* Small tip soldering iron.
* Electrical solder.
* A few feet of #26 solid, insulated wire. It will be helpful to use three different colors – red, black, any other color.
* Wire stripper.
* Diagonal wire cutter.
* Needle nose pliers.
* Various screwdrivers.
* Electric drill, ¼” or larger, with a set of bits 1/32” to ¼” minumin
* Electrical tape.
* Hot glue gun with glue sticks.
* Nibbling tool (optional)
* Set of small files (optional).

Our recommended order of assembly is as follows.

* Assemble a Wireless I/O Board with the necessary components for this project – see section 2 of this document.
* Modify the remote control unit for use in this project – see section 3 of this document.
* Drill mounting holes in the remote control unit enclosure – see section 4 of this document.
* Drill/cut the project enclosure and HC-SR-4 mounting bracket – see section 4 of this document.
* Assemble parts in project enclosure bracket – see section 4 of this document.
* Wire up all parts of the project bracket – see section 4 of this document.
* Install Photon firmware and test that the parts work – see section 5 of this document.
* Mount the project in its final location – see section 4 of this document.
* Install the App on your smartphone – see section 6 of this document.

# WIRELESS I/O BOARD ASSEMBLY INSTRUCTIONS.

The *Wireless I/O Board* provides the basic electronics for this project, including the Particle[[1]](#footnote-1) Photon, a relay that is controlled by the Photon, a 3.3 volt power supply for the garage door remote, and supporting circuitry. The *Wireless I/O Board* is a separately documented project of ours and you can find complete details at:

<https://github.com/TeamPracticalProjects/Wireless_IO_Board>

The *Wireless I/O Board* is a general purpose circuit board that provides many different functions and external interfaces. Not all of its functionality is required for this project. You need only assemble the parts that are needed for this project. Specifically:

* 1 ea. Particle Photon
* 2 ea. 12 position female headers (to mount the Photon)
* 1 ea. Type B USB connector.
* 1 ea. 74AHCT125 level converter IC
* 1 ea. 14 pin DIP socket for the 74AHCT125
* 1 ea. 5 volt relay
* 1 ea. 2N2222 transistor
* 2 ea. 1N4004 diode
* 2 ea. Two position terminal block, 3.5 mm
* 1 ea. Three position terminal block, 3.5 mm
* 1 ea. LD1117-3.3v voltage regulator
* 1 ea. 3 position female header for mounting the LD1117
* 7 ea. capacitor, 0.1 uF
* 2 ea. Capacitor, 100 uF
* 6 ea. Resistor, 4.7 Kohms
* 4 ea. Male pin header
* 1 ea. Wireless I/O Board printed circuit board

A detailed parts list with ordering information can be found at:

<https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Hardware/PCB/Wireless_IO_Board_Parts_List.pdf>

Detailed assembly instructions can be found in the document:

<https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Docs/Wireless_IO_Board_Build_Instructions.pdf>

Specifically, refer to the following sections in the aforementioned document:

* Section 2.1, “Core Components”
* Section 2.3, “Relay/Solenoid Control Parts”
* Section 2.4, “Servo Control Parts”. Note: this project does not use a servo. The 3 pin servo control header provides 5 volt power, ground, and the trigger signal for the HC-SR04 ultrasonic sensor (mounted externally to the Wireless I/O Board). In addition, position 2 of the digital I/O terminal bock (section 2.6) does not have a terminal block soldered to it but rather has a male pin header soldered to it that provides Wireless I/O Board connection from the HC-SR04 ultrasonic sensor echo pin.

The completed circuit board for this project should look like figure 2-1, below.

A circuit board

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*Figure 2-1. Wireless I/O Board Assembled for this Project.*

# GARAGE DOOR REMOTE MODIFICATION INSTRUCTIONS.

This section provides detailed instructions for modifying a Liftmaster 371LM garage door opener remote control unit for use in this project. This model remote control is compatible with Liftmaster and Chambertin garage door openers that have a purple learn button. You can purchase a spare remote at:

<https://smile.amazon.com/gp/product/B075MQCH2P/ref=ppx_yo_dt_b_asin_image_o02_s00?ie=UTF8&psc=1>

If your garage door uses a different model remote, the instructions in this section should be useful in guiding your model-specific modifications.

A garage door opener remote unit is needed for this project, as it is the means by which the garage door opener is actually activated. The remote is wireless so no connections to the opener itself are needed. The basic idea is to open up the remote and find the pushbutton switch that activated the circuity and then to solder wires to the switch so that the *Wireless I/O Board* relay contacts operate in parallel with the remote unit’s switch. Additionally, if the remote unit uses a 3 volt battery, the battery may be eliminated and the *Wireless I/O Board* 3.3 volt motor power supply may be used in its place. Eliminating the battery eliminates the need to periodically replace it. Replacing the battery may be inconvenient if the project is mounted up in the garage’s rafters.

Figure 3-1 shows the remote control unit. The unit comes with a visor clip which is not needed and may be discarded.

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*Figure 3-1. Remote Control Unit.*

Open up the remote unit by inserting a small, flat screwdriver in the notch at the side of the unit, see figure 3-2.

*A picture containing indoor, sitting, table, desk

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*Figure 3-2. Pry open slot in the remote unit.*

The plastic cover pries off by twisting the screwdriver and then moving the screwdriver around the periphery of the unit, twisting it open as you go. The opened up unit looks like figure 3-3.

A close up of a box

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*Figure 3-3. Remote Unit Opened Up.*

Note the battery holder in figure 3-3. If your unit comes with a battery, remove the battery by prying up the top lip that holds the battery in place while pushing the battery out of the holder. The result is shown in figure 3-3.

The modifications that need to be made are depicted in figure 3-4.

A circuit board

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*Figure 3-4. Modification Points on the Remote Unit.*

In this particular unit, we found that the point labeled “Pushbutton active contact” is open when the switch is not depressed and is shorted to ground when the switch is depressed. The sizable copper plane in figure 3-4 is the ground plane.

The pushbutton switch has 4 contacts. The two contacts across the top are shorted together inside the switch, as are the two contacts on the bottom. Depressing the switch shorts the top contacts to the bottom contacts.

We found it easier to access the contact labeled “Alternative pushbutton active contact” in figure 3-4. We found an assessable connection to the remote unit’s ground plane at the pint labeled “Circuit ground (battery -)” in figure 3-4. Any place on the top of the battery holder is the battery + terminal.

In order to modify the remote unit, solder a #26 awg solid copper wire to each of the following points, as shown in figure 3-5:

* Battery + (we suggest a red wire for this)
* Circuit ground (battery -) (we suggest a black wire for this)
* Alternative pushbutton active contact (we suggest any other color wire for this)

The result should look like figure 3-5.

A circuit board

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*Figure 3-5. Modifications to the Remote Unit.*

We suggest that each wire be at least 6 inches long at this time. We will trim the wire for mounting in the project enclosure later.

Lastly, we strongly suggest that you bundle these wires somewhere near where they exit the remote unit and provide a strain relief by hot gluing them to the remote’s circuit board, see figure 3-6. Make sure to leave a little slack in the wires in the circuit board side so that the wires are nt under any tension.

A circuit board

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*Figure 3-6. Hot Glue Strain Relief.*

# ENCLOSURE FABRICATION AND INSTALLATION INSTRUCTIONS.

At this point in the project’s assembly you should have the following steps accomplished:

* A completed *Wireless I/O Board*, per section 2 of this document.
* A modified remote control unit, per section 3 of this document.

In this step, these components are mounted inside a plastic enclosure. We strongly suggest that you do this because:

* The enclosure will help keep dust and dirt away from the unit.
* The enclosure will hard mount the *Wireless I/O Board* and the remote control unit together so that they can be wired together safely and securely.

Note that we chose NOT to mount the ultrasonic sensor inside the project enclosure. This could be done, but the transducers on the unit need to be in free air. We chose to use an off the shelf mounting bracket that is designed for the ultrasonic unit, see figure 4-1.

**

*Figure 4-1. Untrasonic Sensor Mounting Bracket.*

We suggest affixing the ultrasonic sensor to the bracket using hot glue. First, however, note that the bracket mounting holes on the right angle side of the bracket are very small. We suggest drilling the two end holes out so that a #6 wood screw will fit through. This right angle side will mount the bracket to the rafters so that the sensor looks down to where the door track holds the retracted garage door; see figure 4-2.

*A picture containing indoor, sitting, table, small

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*Figure 4-2. How the Project will be Mounted.*

After drilling out the mounting holes on the bracket, and before hot gluing the sensor to the bracket, take four female-female jumper wires and insert one end of each onto the Vcc, Trig, Echo, and Gnd pins on the sensor. Make note of which color wire goes to each of these contacts. We suggest (not mandatory) that you use the following color code for these jumpers:

* Vcc: red wire
* Trig: yellow wire
* Echo: green wire
* Gnd: black wire

Put the sensor aside and let the glue harden.

The next step in the assembly is to prepare to mount the remote control unit in the plastic project box. We recommend doing this by drilling two holes in the back of the remote’s plastic case, as shown in figure 4-3. The location of the holes is not critical; the selected points were easily accessible and don’t interfere with remounting the circuit board into the remote housing. We suggest affixing two nylon ½” 4-40 threaded standoffs (female – female) to the remote housing using ¼” nylon 4-40 screws, see figures 4-3 and 4-4.

A close up of a device

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*Figure 4-3. Modified remote housing, top view.*

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*Figure 4-4. Modified remote housing, bottom view.*

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A close up of electronics

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A picture containing wooden, building, table, wood

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# FIRMWARE INSTALLATION AND TESTING INSTRUCTIONS.

# ANDROID APP INSTALLATION INSTRUCTIONS.

1. <https://www.particle.io> [↑](#footnote-ref-1)