

TOY HACKING



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STEP BY STEP GUIDE

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TOY HACK:

Hacking a remote controlled toy car so that physically challenged kids can play with it, too.



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① *Choosing the right kind of toy*

Make sure you get a battery powered remote controlled toy car. One like this with thumb toggles is ideal. Bells and whistles optional.

Grab yourself some fresh batteries. If the toy car uses rechargeable batteries, charge them up the night before and unplug during the hacking process.



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② Opening the toy's remote control

Before you can begin to do anything with the remote, you need to open it up.

a. Using a screwdriver, remove all of the screws from the back panel.

Don't throw them all away as you'll need some of them again.

b. Remove the cover.

c. Unscrew the antenna and pull the circuit board out.

Make sure the wires connecting to the battery holder remain intact.

Save the antenna for later!



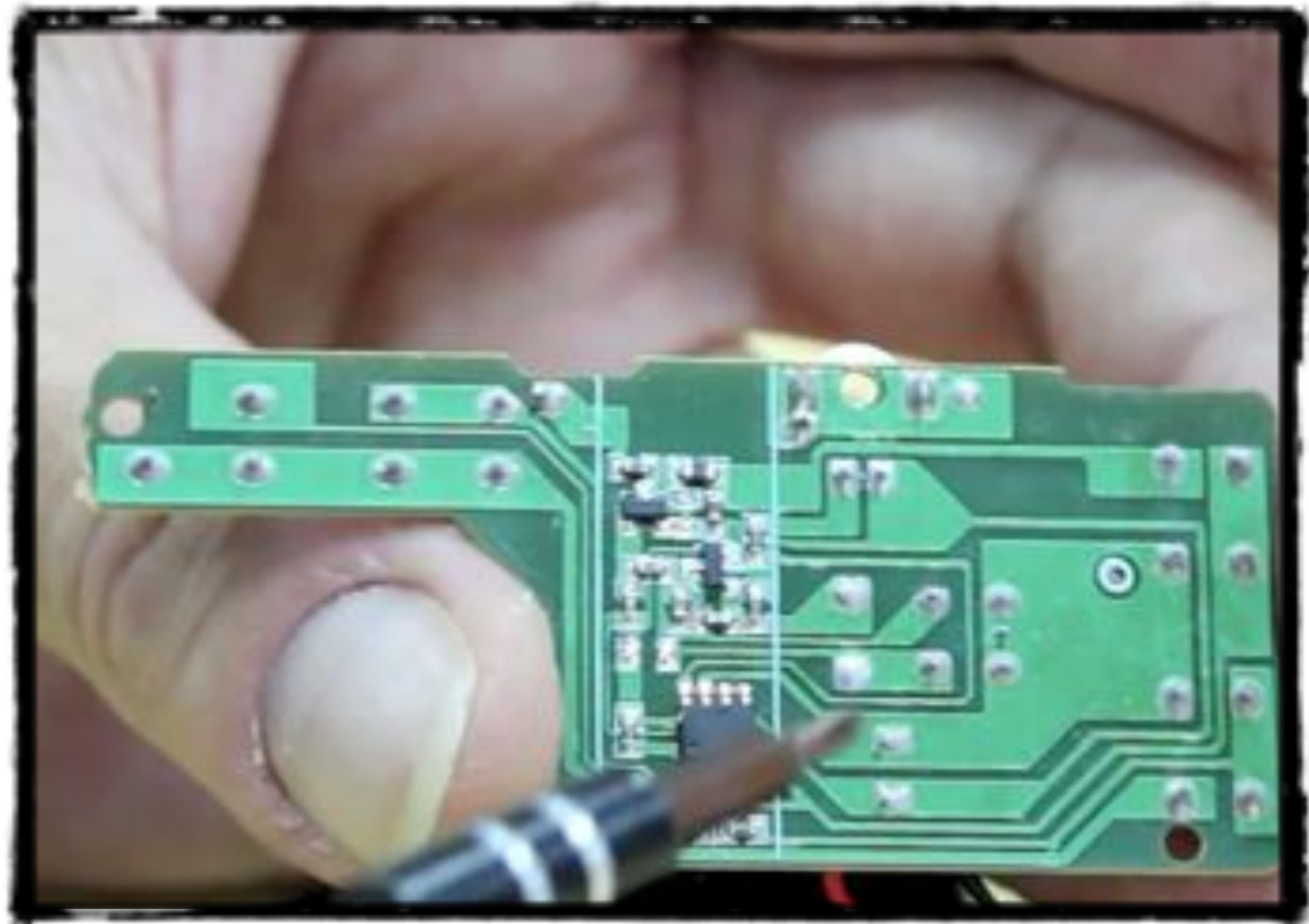
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③ Getting to know the circuitry

Now that you can see the guts of the remote control, let's see how they work!

The circuit board has 4 control points that move the car forwards, backwards, left and right. Each control point has 4 corresponding soldering pads on the back of the circuit board.

Before you can start soldering, you need to determine which pads correspond to which control points. We recommend that you use a multimeter to test which soldering pads form a closed circuit.

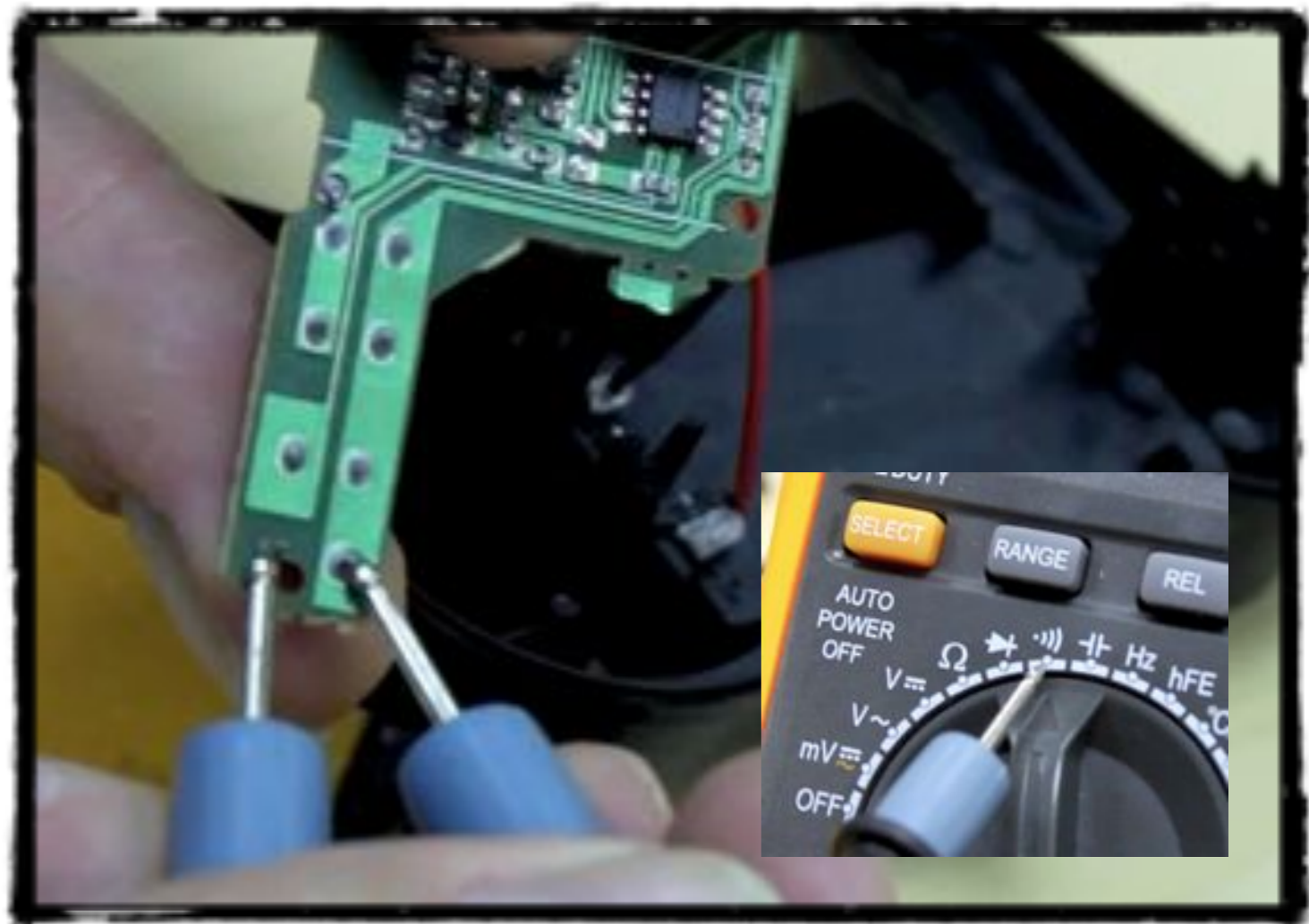


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④ Testing with the multimeter

Multimeters are great little tools that measure voltage, current, and help you tell whether a circuit is closed or not.

- Set the multimeter to the setting pictured in the inset image – now the multimeter will beep when it detects a closed circuit.
- Touch the two multimeter ends to a pair of solder pads while pushing the control button beneath. Having trouble juggling all the parts? Grab a friend to help you out!
- Test all of the pairs of solder pads on the circuit, then match the closed circuits with the corresponding control button on the other side.



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5 Preparing the wires

Before you can solder anything you need to strip the coating off the end of the wires.

- a. Using a pair of wire cutters or wire strippers, cut into the coating of the wire about half a centimeter from the ends. Make sure not to cut through the wire by accident!
- b. Grip the wire by wrapping it around your finger, and with the other hand, pull the wire cutters/strippers to remove the coating.
- c. Twist the expose end of the wire a few times to keep it from fraying too much.
- d. Repeat these steps on both ends of all 8 of the wires.

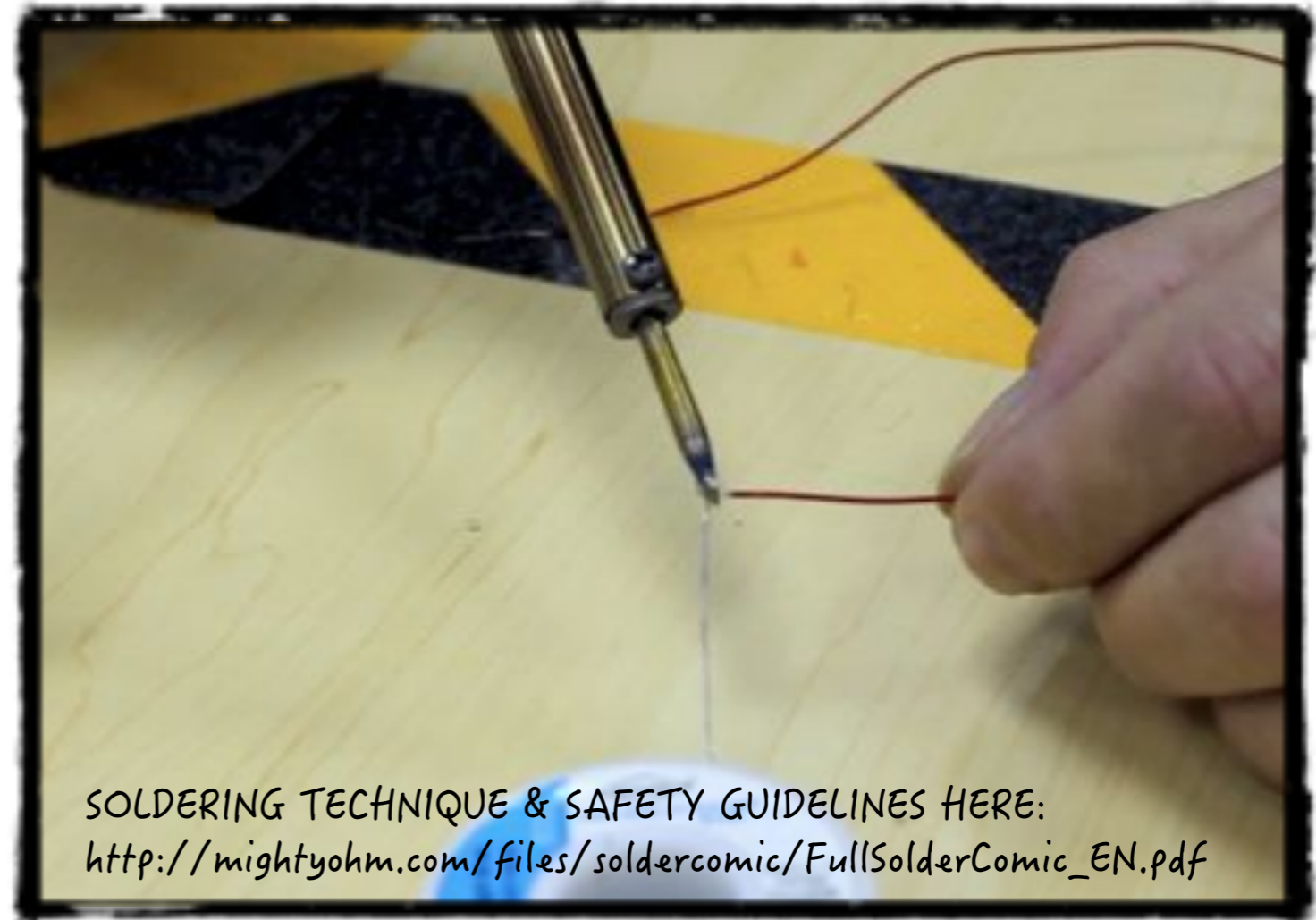


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⑥ Soldering the wires (fun times ahead!)

Now it's time for the fun part: soldering the wires onto the soldering pads!

- a. Turn on the soldering iron (let it heat up) and grab your spool of solder.
- b. Once the iron is nice and hot (you can tell it's hot enough by listening for a hiss as you dab it onto the wet sponge that usually comes with the safety tray), place the solder on the exposed part of wire.
- c. Touch the iron to the solder so that it melts onto the exposed wire, and repeat until the end of the wire is lightly coated.



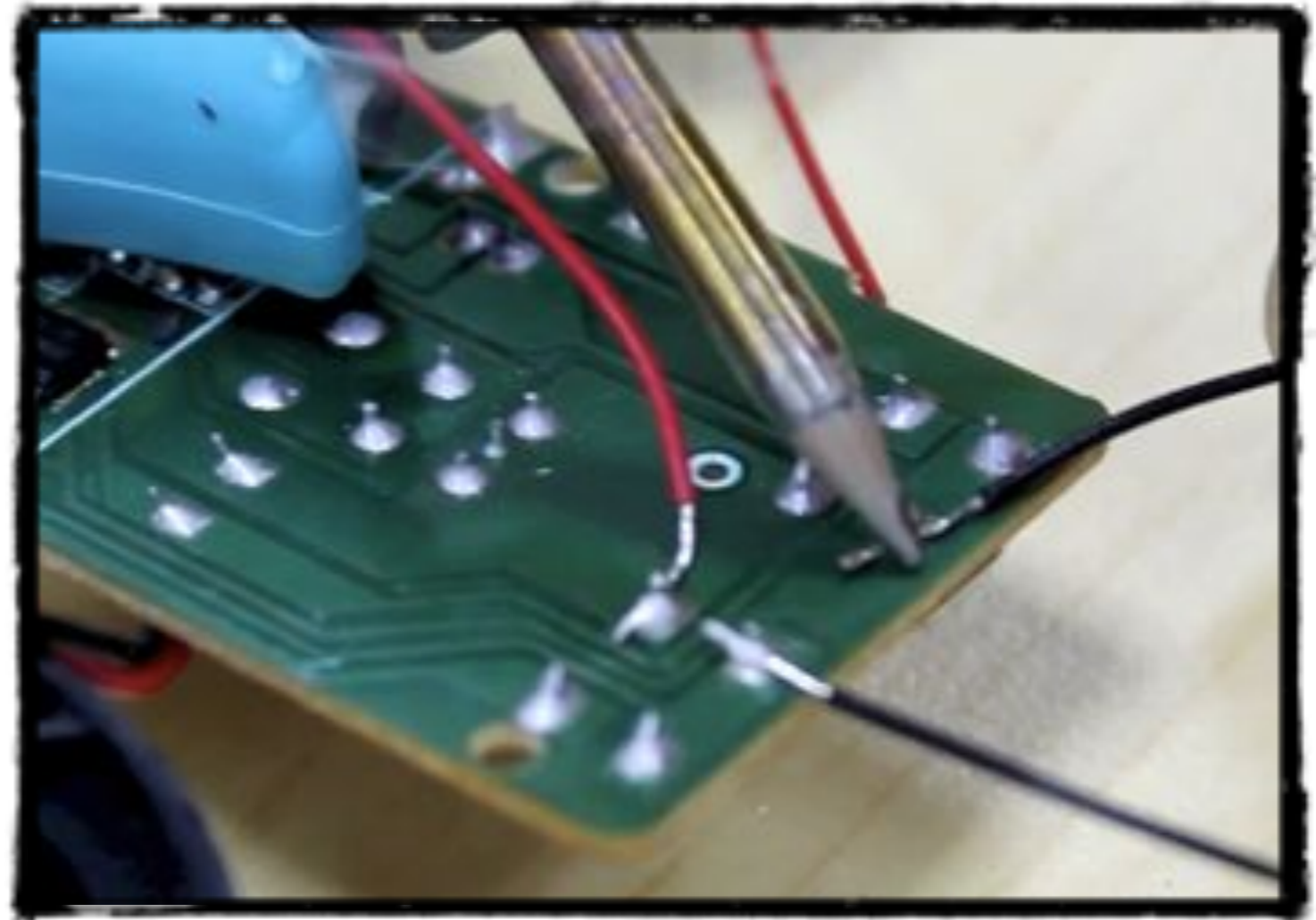
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⑥ **Soldering the wires (fun times ahead!)**

d. Place the solder covered end onto the circuit board soldering pad.

It is helpful to color code the wires so that all of the ones that will connect to the top prong of the button are one color, and the ones connecting to the bottom are a different color.

e. Use the iron to melt the solder from the wire tip onto the circuit pad, so that the two are connected.



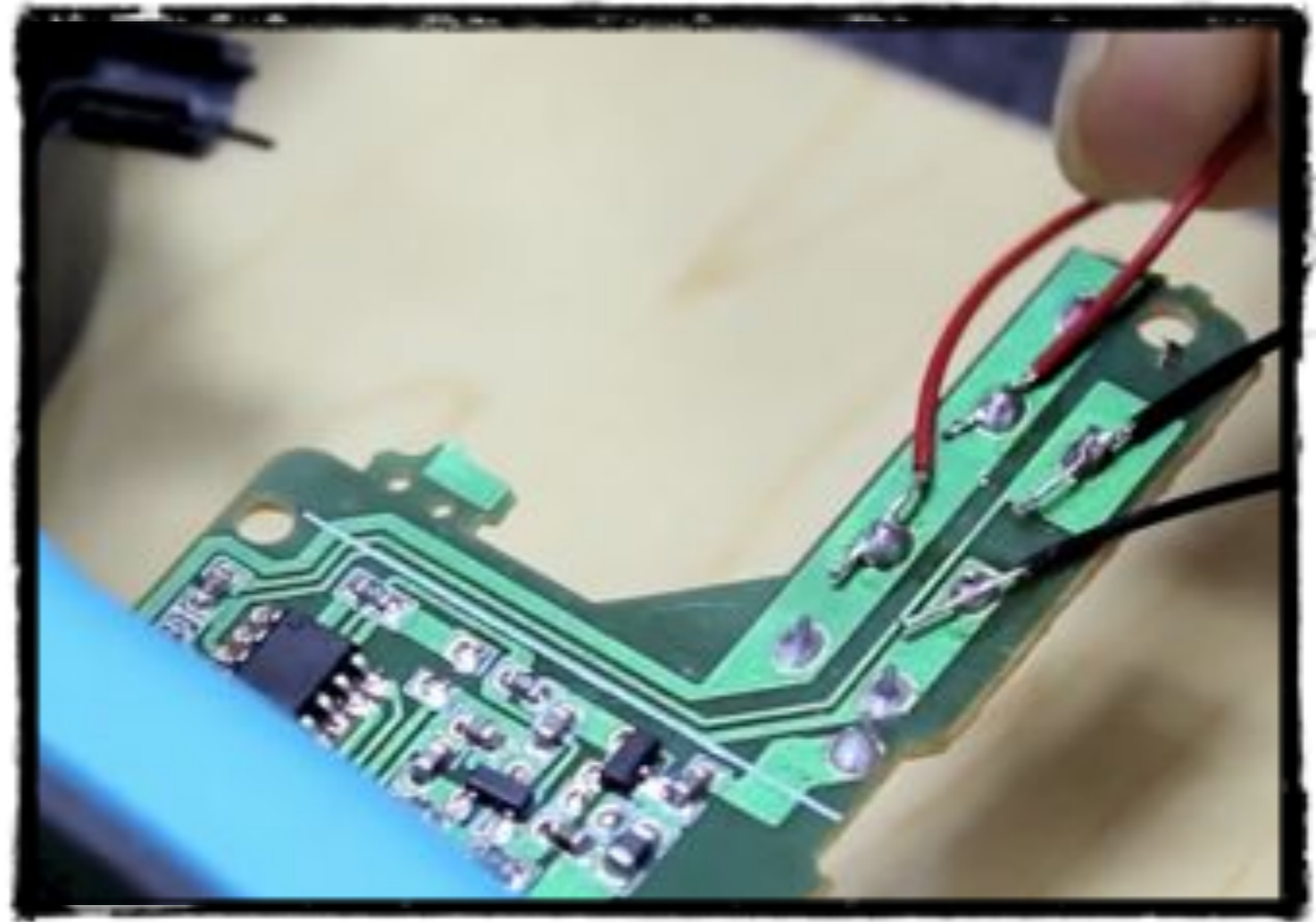
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⑥ **Soldering the wires (fun times ahead!)**

To keep track of which wires are connected to which buttons, it is useful to wrap a small bit of tape around them and label them with a marker.

f. Now, repeat these steps with the 7 remaining pieces of wire so that all of the control points have two connected wires.

You'll want to make sure you position and solder each wire so that it's only touching the one soldering pad and not the metal parts of any other wires, soldering pads or other parts of the circuit board.



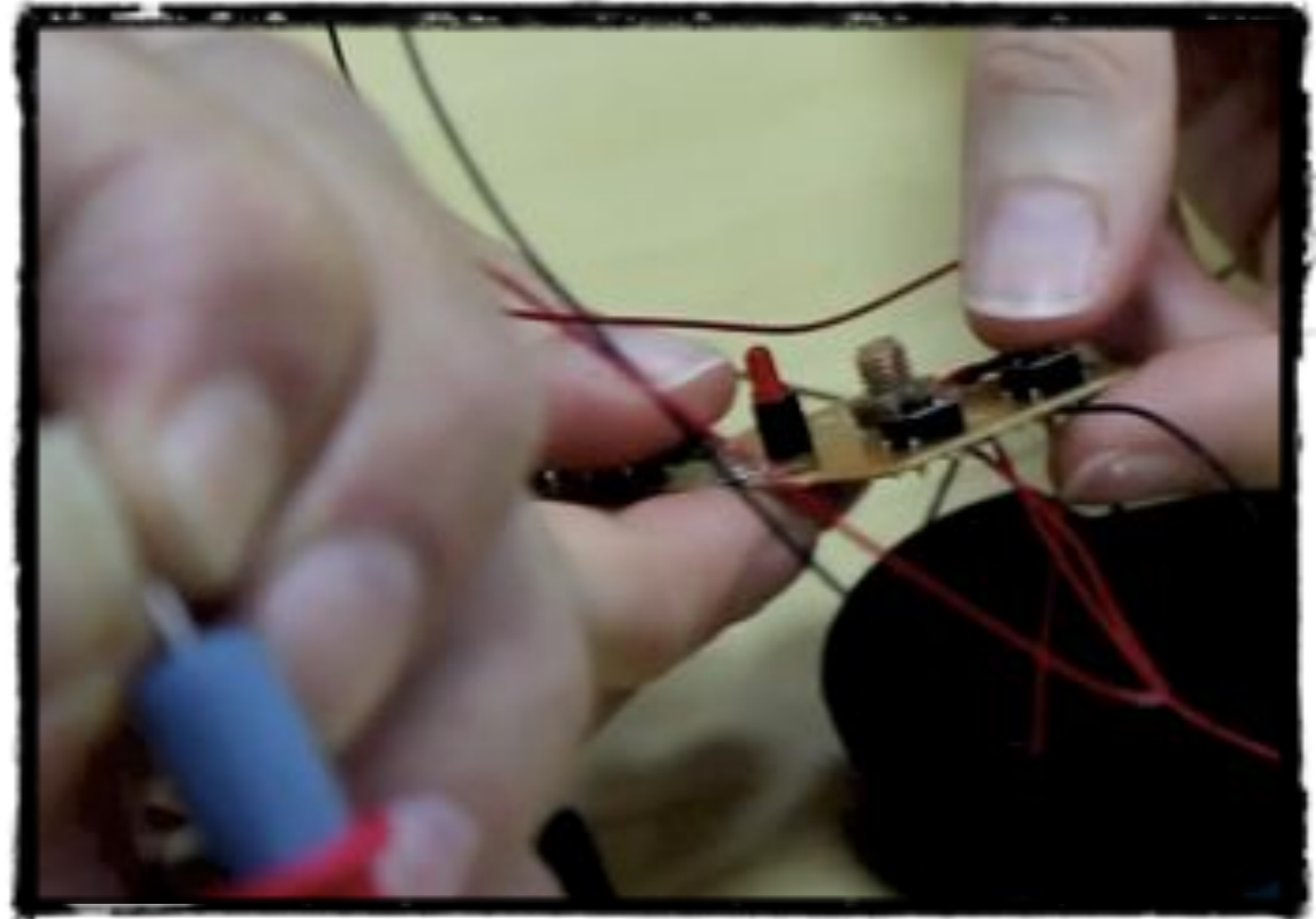
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Testing your soldering handiwork

As much confidence as you might have in your soldering abilities, it's always a good idea to check the connection between your wires.

- a. Hold the two ends of the multimeter to the unsoldered ends of the wires you just soldered and push the button. Unless you are a pro or have an extra arm, you may want to have someone else help with this part.
- b. If it does not beep, then check to see if a wire is loose or if you have any exposed metal parts from one wire touching the metal part of another wire or soldering pad.



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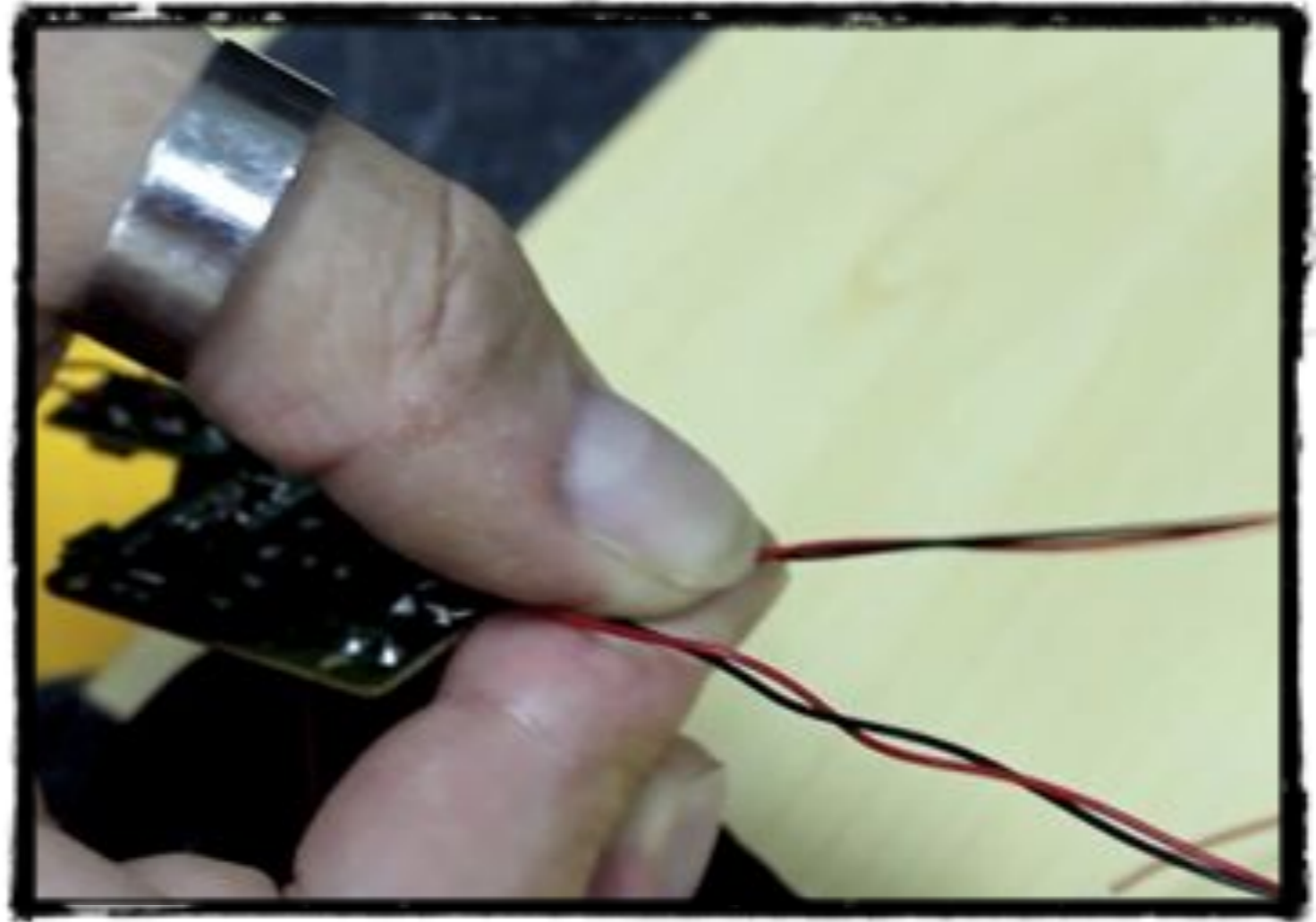
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⑧ *Neaten things up*

Now that you know your circuit is functional, it's time to put everything together into something a little more visually pleasing.

- a. Once you have determined that you have successfully created a closed circuit, twist the paired wires of each control point together to prevent them from getting tangled later on.



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⑧ *Neaten things up*

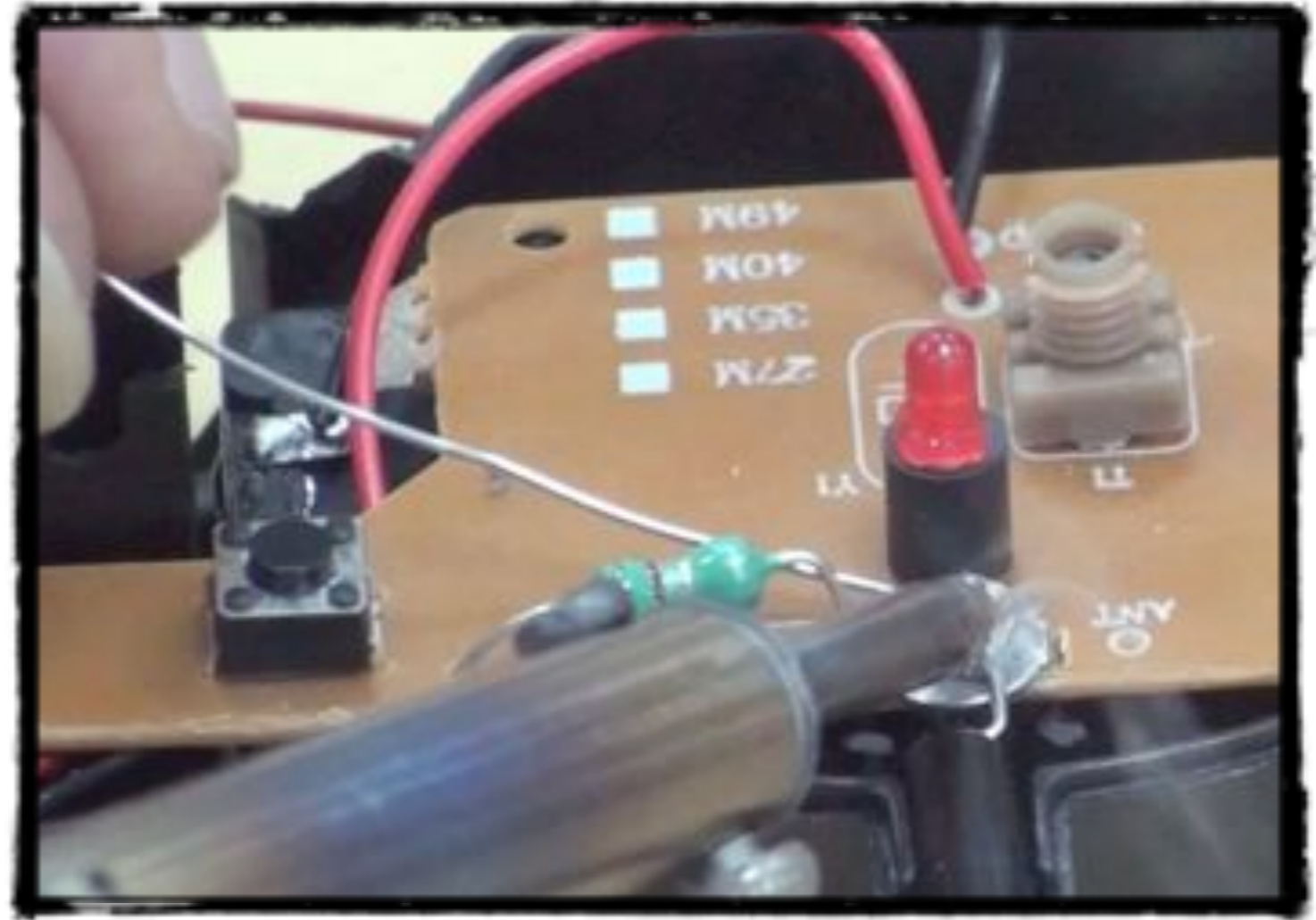
b. Flip the circuit back around and place it back in its nook in the remote so that all of the wires splay out from the bottom.



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⑧ *Neaten things up*

c. Put the antenna (which you remembered to save, right?) back into its place on the circuit board, and solder it back on.

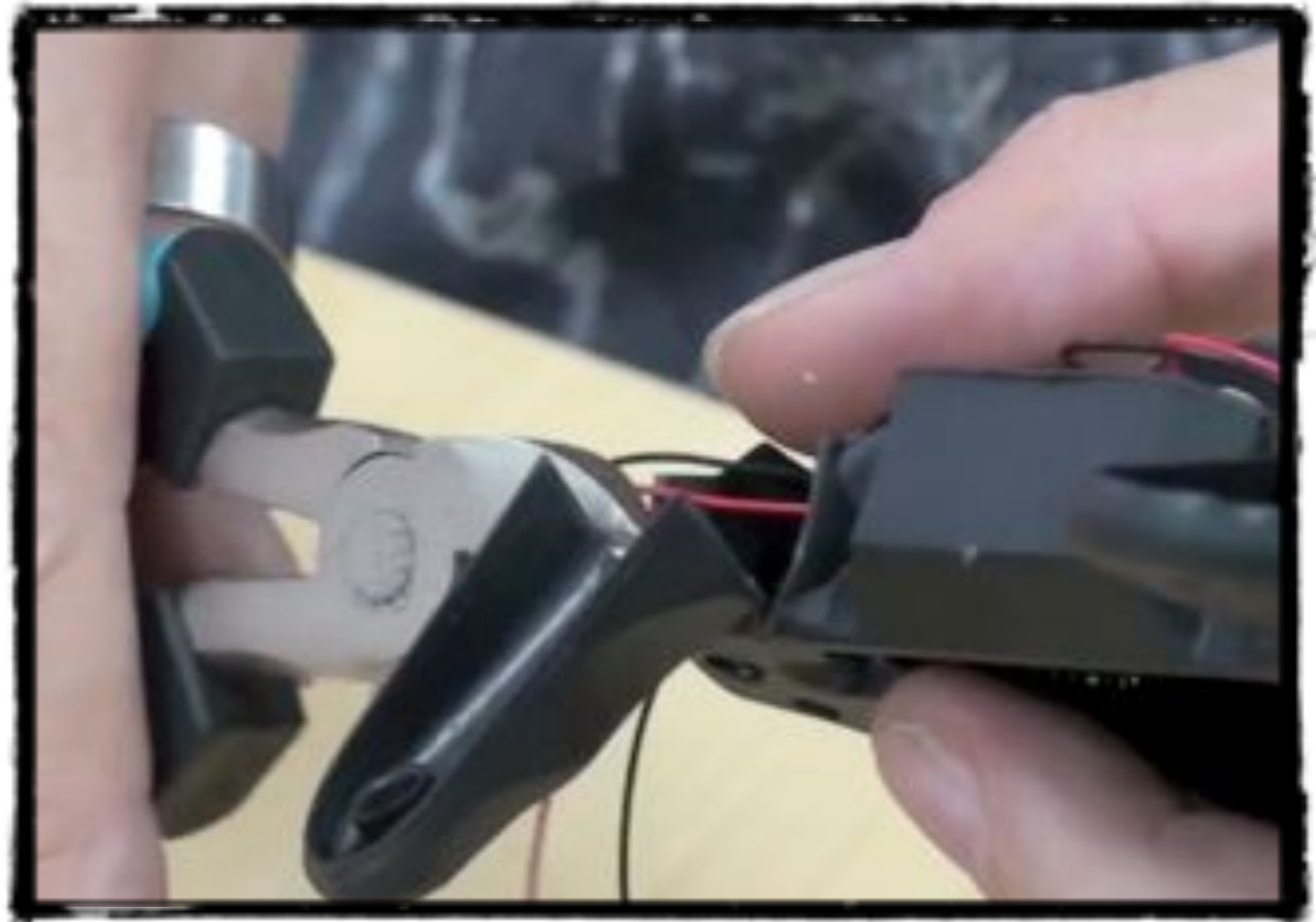


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⑧ *Neaten things up*

d. Use the wire cutters to cut off the excess plastic from the controller, so that it will fit into the new remote control box.

Make sure not to cut any wires or cut into the battery holder parts!



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9 The buttons

The large push buttons are the most colorful and fun-looking part of the new remote.

- a. You should have 4 buttons, and the remote control wooden box panel with 4 holes in it. In our video and toy hack kits, we include a pre-cut box which is made according to the size of the push buttons we have here in Shanghai. You might have a new, improved version of this or be using one of your own design.
- b. Untwist the plastic ring from each of the buttons. Place the buttons through each one of the 4 holes on the panel, making sure to alternate the colors.



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9 The buttons

- d. Screw the plastic ring back onto the button from behind to fasten it to the wood panel.
- e. Take the three pronged and two pronged button pieces and fit them together. Again, your buttons might be different to ours.
- f. Clip these pieces into the rest of the button, making sure that all of the ends are lined up in the same direction, which makes it easier for the soldering which comes next.
- g. Using a pencil or a pen, mark which direction each button controls on both the front and back sides of the wooden panel.



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10 *Soldering the buttons*

Now that your button panel is looking nice and snazzy, it's time to attach it to the circuit board wires.

- a. Push one wire up through the small hole in the top prong and one wire up through the hole in one of the side prongs.
- b. Touch the solder to the first wire and melt it using the soldering iron so that the wire attaches to the prong.
- c. Repeat this step with the other 7 wires – the circuit board and the wires should now be fully connected.



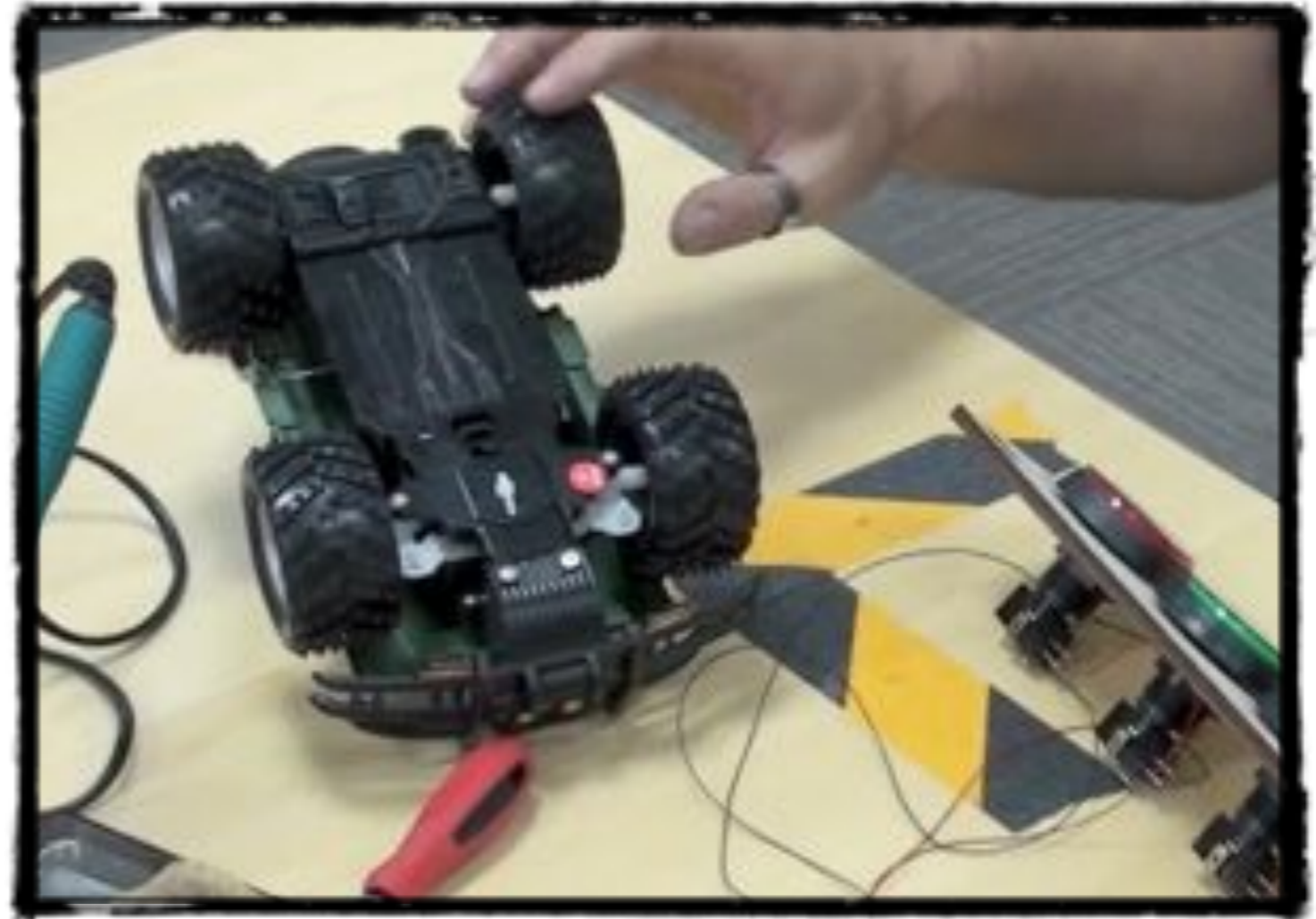
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10 *Soldering the buttons*

d. Test the integrity of your handiwork by turning the car on its back so that the wheels stick up, and press each of the control buttons to see if the wheels move.

If the wheels do not move the way they are supposed to, check your connections for loose wires, dodgy soldering, or misaligned button components, then try again.

Make sure your car has fresh batteries in it!



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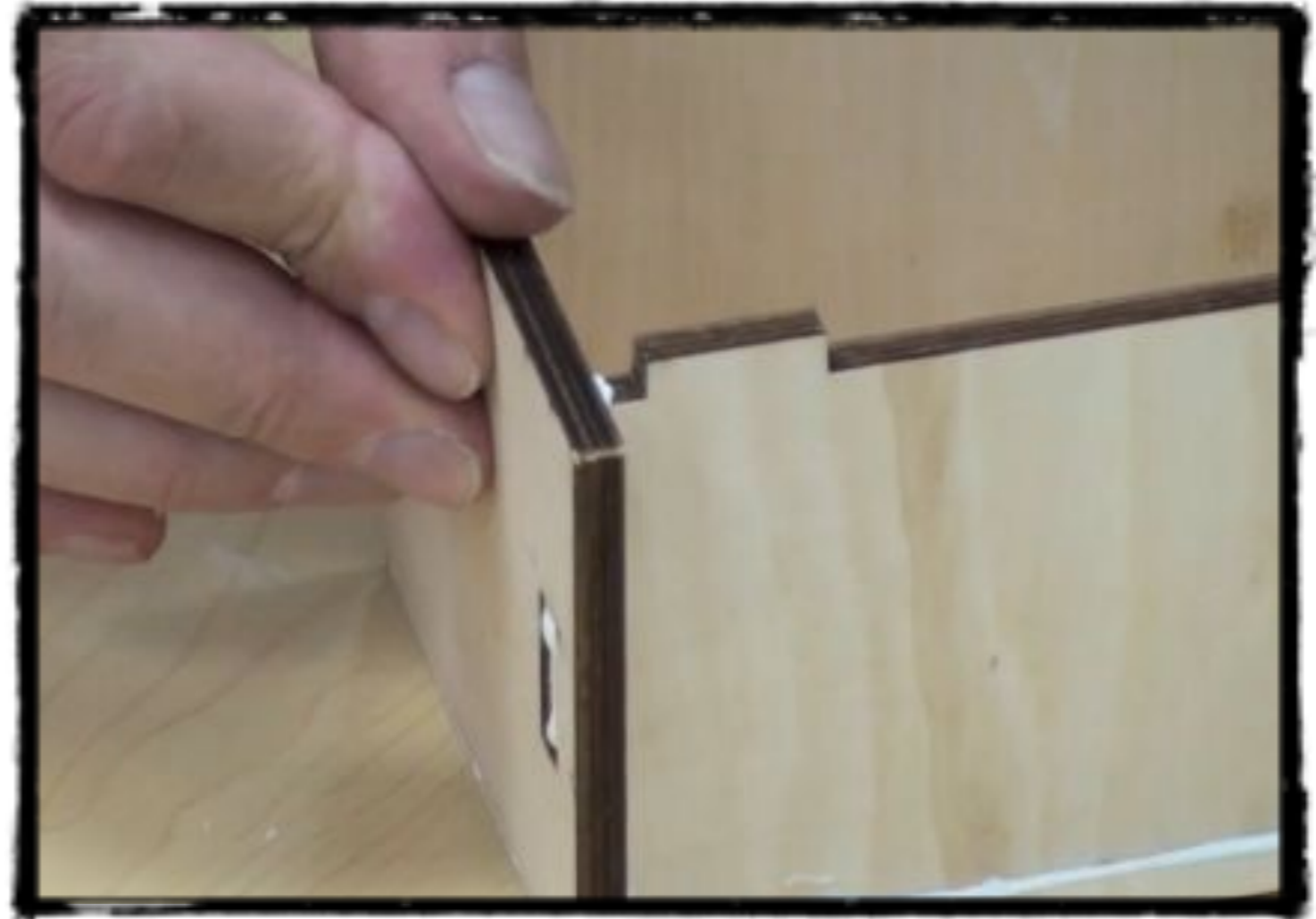
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Assembling the remote control box

Now that you have assembled the guts of the controller, it's time to create the wooden control box to put it all in. Lay the bottom piece flat on the table.

- Dab non-toxic wood glue all around the bottom edge of the long side panel.
- Fit the side piece into the corresponding side of the bottom panel so that the glue creates a seal between them.
- Repeat with the remaining two wood panels, leaving out one of the short side panels so that you can place the controller inside.



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Assembling the remote control box

d. Place the button-lined panel on top of the control box without gluing it first.

If you glue it shut now, you are going to have a bad time trying to fix any loose wires later!



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Assembling the remote control box

- e. Place the antenna of the circuit board through the small hole at the end of the remote so that it sticks out of the top.
- f. Once the antenna is in place, put the rest of the circuit and battery pack into the control box, placing the batteries in last. If you still have it, put the battery holder lid back on now.

Cut off more extraneous plastic with wire cutters if the batteries bit is still too big to fit inside the box.



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12 *Testing out the remote*

You are so close to being done! But before you can seal everything up, you should probably test again to see if the remote actually works.

- a. Place the toy car on its back so that the wheels face upwards. Press the buttons one at a time and watch to see how the wheels spin or turn.*
- b. If the wheels do not move in the correct way, a wire or two may have come loose while you were putting everything together.*



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12 *Testing out the remote*

- c. Take off the top panel.
- d. Fix any loose wires. Check the component pieces of the push buttons are properly connected as well.
- e. Test again. All ok?



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13 *Finishing up*

It is finally time to put the finishing touches on your newly hacked remote!

- a. Dab some wood glue onto the corners of the top part of the control box panel.*
- b. Carefully glue on the top panel. Making sure everything is back neatly inside the box.*



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13 *Finishing up*

c. Fit the last short panel into place so that the glue creates a seal

It would be a good idea to double check to make sure that the box is not loose or wobbly.

d. For extra stability, use small pieces of electrical tape to fix the final end panel onto the rest of the box. This should be the end with the closest access to the batteries inside.



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13 *Finishing up*

Now the only thing left to do is take your newly hacked remote control car for a proper spin by making it race across the floor!

This image is showing you how the car could be played by a kid without any hands at all.



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14 *What next?*

We encourage you to donate your hacked toy to a local charity that cares for physically challenged children.

This remote controller can be played by children who lack fine motor control of their hands.

Here in Shanghai, we have donated our hacked toys to children with cerebral palsy.



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14 What next?

We are developing and testing new and improved designs of the toy hack remote control box.

If you have form and functionality improvements that you would like to share, please either email them to us directly or post a link to them on the Instructables page:

info@nestworkschina.org

THANK YOU! HAPPY HACKING!



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