Lesson 2: Soldering

Introduction:
It's time to learn how to solder. So you have met all the components needed to make a DIY Gamer, now it's time to put it together. Soldering is joining the components to the printed circuit board with hot metal using a soldering iron. You will need a steady hand and concentration, but by the end of the session you will have built your own handheld console and will be playing a game on it! How cool is that?

Goals

Learn - to solder safely and how to fix mistakes
Make - the DIY Gamer by soldering, screwing and pushing it together.
Play - snake on it and see if you can get the high score

Activity Checklist

Test your Project

Save your project
Step 1: Learn to solder

Activity Checklist

Watch the how to Solder video

Watch the How to solder video. This is a quick guide to soldering for beginners that will introduce you to the tools, teach you how to solder safely, teach you how to recognize a good and bad solder joint and teach you how to fix it if you make a mistake.

Remember the BASIC SAFETY RULES for soldering

1. Hold the soldering iron like you hold a pen and only hold it by its plastic handle.
2. Never touch hot solder.
3. Always wear safety goggles.
4. Position the soldering iron in a safe and easy to reach place.
5. Always put the soldering iron back in it’s holder when not in use.
6. Hold component legs when cutting them to stop them flying around.

IF YOU DO GET BURNT, immediately put it in cold water for 3 minutes.

Step 2: Make your first soldered joint

Follow these steps to solder your DIY Gamer’s buttons

1. Take out your DIY Gamers’ PCB (Printed Circuit Board) which is pictured to the right. This is what you will be soldering all of your components to in order to build a circuit!
Lesson 2: Soldering

Step 2: Make your first soldered joint

2. Use your blue tak to firmly hold the PCB in place on your desk at an angle. This will make it easier for you to solder the components.

**TOP TIP**
You may have to experiment to find the best angle to have your PCB at for you when soldering. This varies from person to person so just have a play until you feel comfortable.

3. Find the Push Buttons for your Gamer which will be in the Buttons bag. These will be used to control your Gamer and there should be four of them.

4. Next clip the four buttons into place on the illustrated side of your PCB. As seen on the right.
Step 2: Make your first soldered joint

5. Once all four buttons have been clipped into place and are flat against the PCB you are ready to solder. Flip your board over and solder each of the button’s four legs, remember what you learnt from the how to solder video. If you need a reminder ask your volunteer to play it again.

6. Once complete you should have 16 solder joints that look something like this pictured on the right. No apples in sight...!

Test your project

Is your solder joint good enough?

Does it look like an apple or a little hill?
Is there a good bond between the PCB pad and the component leg?
Is there any of the gold pad on the PCB still showing?

If you don’t think it’s up to scratch then simply reheat and use your solder sucker to remove the solder. Then try again!
Follow these steps to solder your Gamer’s LDR

1. Find your LDR (Light Dependent Resistor). This is a clever little component that changes the amount of electricity it allows through depending on how much light it receives. It can be used to do some really cool things with your DIY Gamer later on, but for now just solder it in place...

2. Place your LDR into the area on your PCB that is marked with a similar squiggly line to that on the component.

   **TOP TIP**
   When you insert the LDR you may want to bend the legs out slightly to around 45 degrees. This will hold it securely in place for soldering as it doesn’t clip into place like the buttons did.

3a. Flip your board over, press it firmly into your Blue-tack and solder the two legs of the LDR.

3b. As you will see, the legs of the LDR are much longer than the push buttons so you will have to trim them. Snip them just above the tip of the solder joint.

   **TOP TIP**
   Take care when clipping component legs. To make double sure they don’t end up in someone’s eye hold the tip of the component leg and snip.
Follow these steps to solder your Gamer’s Buzzer

1. Find your Low Profile Buzzer which is pictured right and produces programmable sounds from your Gamer.

2. One thing you’ll notice when you look at your buzzer is that one leg is longer than the other. This indicates that the component has a polarity and needs to go into your PCB a specific way round. The long leg of the buzzer is the positive leg. Which can also be seen on the top with a small + symbol.

   **TOP TIP**
   Whenever there is some sort of asymmetry to a component it is usually trying to tell you that it has a polarity, and has to go a certain way round.

3a. Place your buzzer into the board where it is illustrated with a small musical note symbol. Making sure to match up the positive side (long leg) of the component with the + illustrated on your PCB.

3b. Next solder the component into place and snip off the excess of the leg that is remaining.
Lesson 2: Soldering

Step 5: Solder some more...

Follow these steps to solder your Gamer’s Resistors

1. Take your two resistors which are pictured on the right noticing the coloured bands around the components. These depict their resistance value depending on the order and colour of the bands. Take care, they look very similar.

2. Take the resistor whose bands are brown, black, red and gold. This is your 1k Ohm resistor. In order to fit it into your PCB you need to bend the legs at 90 degrees to form a U shape as shown on the right.

**TOP TIP**
To get a clean fold use a hard surface like your desk to push the tips of the legs inwards.

3a. Place your 1k resistor into your PCB where it is illustrated with a 1k symbol. Your resistor can go in either way around as it has no polarity.

3b. Repeat the bending steps for your 10k resistor. Which is marked with brown, black, orange and gold bands.
4. Place your 10k resistor into your PCB next to your 1k resistor through the holes illustrated with a 10k symbol.

5. You may want to bend the legs of the resistors out slightly before soldering to keep them in place. Then stick down with your Bluetak and solder all four legs into place.

6. Finally snip off the excess of the component legs.

**TOP TIP**
Don’t forget to hold the legs of the component whilst snipping them!
Follow these steps to solder your Gamer’s Start Button

1. The Start Button for your gamer is pictured on the right.

2. Place it on your PCB where its marked with the word ‘start’. Press it down and it should snap in and hold itself in place.

3. Now solder the four legs of the Start Button into place. No snipping necessary!
Step 7: Finish the circuit

Follow these steps to attach the IC’s (Integrated Circuits)

1. Meet the brains of your Gamer. They are Integrated Circuits (IC’s), which means they are tiny circuits in themselves made from silicon. They look very similar but the two do very different things. Between them they work out the what is going to be displayed on the LED matrix screen.

Their full names are the 8 Bit Shift Register and the LED Driver. The 8 Bit Shift Register is like an extension cable and creates more outputs and the LED Driver ensures all the LEDs are the same brightness.

2. Look on top of the two IC’s. There are numbers and letters. Look at your board you’ll see the same numbers repeated below the Dual Inline (DIL) sockets.

On the left hand side is the 8 Bit Shift Register MIC589.

On the right hand side is the LED Driver TLC5916.

3a. Before placing your IC’s into your DIL Sockets you may want to bend the legs inwards slightly so they slot in much more easily.

TOP TIP
Be very careful bending the legs as they are quite fragile. We recommend placing each row of legs on a hard flat surface and gently pressing to bend the legs equally. Like in the image to the right.

3b. Double check you have the IC’s in the correct DIL Socket and press down until they click and are flush in their sockets.
Step 8: Finish the circuit

Follow these steps to attach the LED Matrix (the screen)

1. Take the LED Matrix. You’ll see that it has two rows of pins that we will use to plug into the DIL Sockets. Notice also that Technology Will Save Us is written on one side.

2. Next place your LED Matrix on to your PCB where it is illustrated and named ‘display’.

3. Simply press pins of the LED matrix into the DIL sockets. Making sure that the side with Technology Will Save Us written on it is facing towards the bottom of the Gamer.
Lesson 2: Soldering

Test your project

Does your board look like this?

If not, retrace the previous steps and try to work out what is missing or wrong.

Step 9: Add the finishing touches

Follow these steps to attach your Gamer’s Front Acrylic

1a. Take your front panel and the two longer bolts. Place the bolts through the two small holes in the acrylic.

TOP TIP
To make sure you are putting the bolts through the right side of the panel, check that the notch at the top is on the right hand side when facing you.

1b. Next take the two longer spacers and fit them over the bolt from the back of the acrylic casing.

2a. With the spacers in between the acrylic and PCB, slot the two bolts into the holes at the top of the Gamer PCB. The acrylic should fit perfectly around the display and IR receiver.

2b. Now turn the PCB over whilst holding the acrylic and bolts in place. Take two of the nuts and place them on to the protruding bolts. Then turn the gamer over and use a Philips head screwdriver to give the bolts a final tighten.
Step 9: Add the finishing touches

Follow these steps to finish your DIY Gamer!

1a. Take your back casing with attached Arduino. Then slot your Gamers header pins into the Arduino inputs.

1b. Clip your battery back into place.

The soldering and building of your DIY Gamer is complete! Congratulations!

TOP TIP
If you’re struggling to keep the bolts in place try pushing them into the blue tac whilst adding the nuts.

Test your project

Turn it on, it should be ready to play!

What’s the highest score you can get?

Trouble shooting:

Is it turned on?
Is the battery connected the right way?
Is the battery flat?
Is it pushed into the arduino correctly?
Check your solder joints for overlaps or poor joints?

Well Done!
You have made your hand held gamer, and played some games, so next it’s time to **code** and **invent** and then **play** some more...