# DIY
Gamer
Kit -
Manual

Welcome to the DIY Gamer - Manual

TECHNOLOGY WILL SAVE US.

This is a step-by-step guide to making your own hand-held Gamer. The equipment you should have at your station are wire strippers, cutters, soldering iron, solder sucker, screw driver and Blue-tack.

We hope you enjoy this creative task, learn some new technological skills and apply them to your life in useful ways.
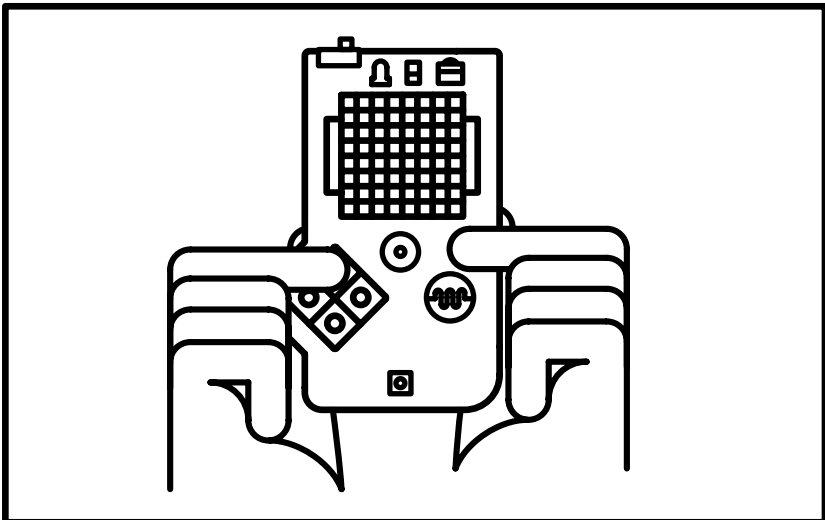
Getting Started

Top Tips

Keep an eye out for the top tips. They are highlighted in a yellow box like this!

Making Time
The kit takes about one and half fun filled hours to solder and build, depending on how speedy you are at soldering!

Useful Appendix
Further information on all the components in this kit can be found in the Appendix at the back of the manual. Learn about their use within the circuit you are building.

Further Resources
Information on how the circuit works alongside different ways to extend your Gamer can be found on our resource page: twsu.co/gamer

Making your DIY Gamer

**Parts:**

1) 1x Acrylic Casing (Front)
2) 1x Acrylic Casing (Back)
3) 1x Gamer Printed Circuit Board (PCB)
4) 2x LED Matrix sockets
5) 4x Header pins
6) 1x 8x8 Common Anode LED Matrix
7) 1x Infrared Receiver
8) 1x Light Dependent Resistor (LDR)
9) 1x Infrared Transmitter
10) 1x Light Emitting Diode (LED)
11) 1x Extra LED (for use with your Arduino)
12) 5x Nuts/ 3x Short Bolts/ 2x Long Bolts/ 3x Short Spacers/ 2x Long Spacers
13) 4x Push Buttons
14) 1x Power Switch
15) 1x Start Button
16) 2x Chips (1x 8 Bit Shift Register & 1x LED Driver)
17) 2x DIL Sockets
18) 1x 1k Ohm Resistor
19) 1x 10k Ohm Resistor
20) 2x 9V Battery Contacts
21) 1x Low Profile Buzzer
22) 1x Arduino Uno Microcontroller

Not Included in Kit:

Blue or White Tack (helpful for soldering)
Soldering Iron
Solder Sucker
Solder
Wire Cutters
Screw Driver (Philips Head)

Check your components to make sure you have all the parts to build your DIY Gamer!
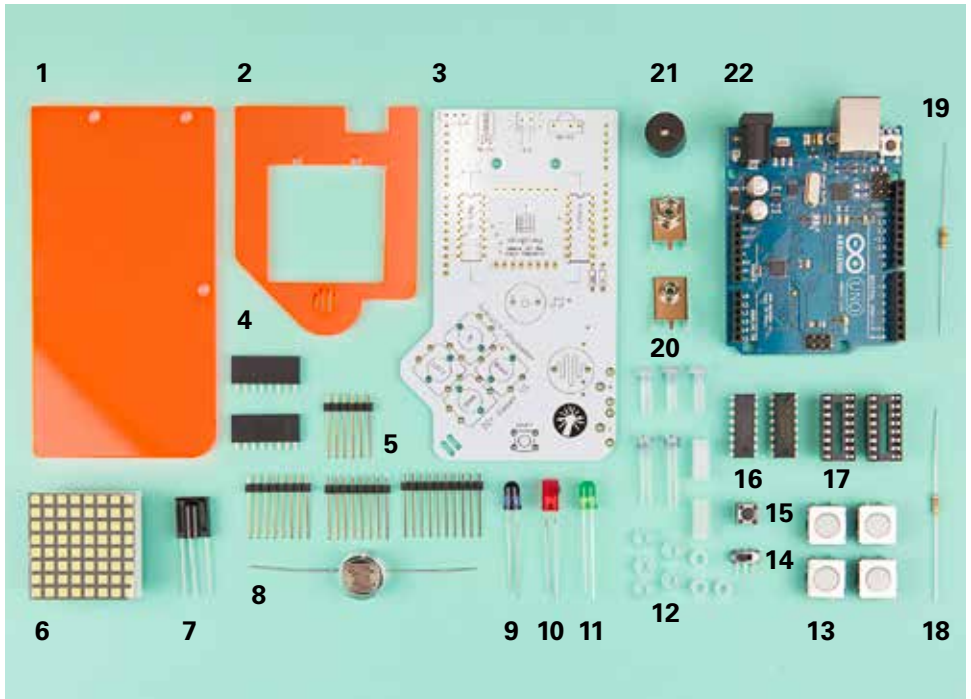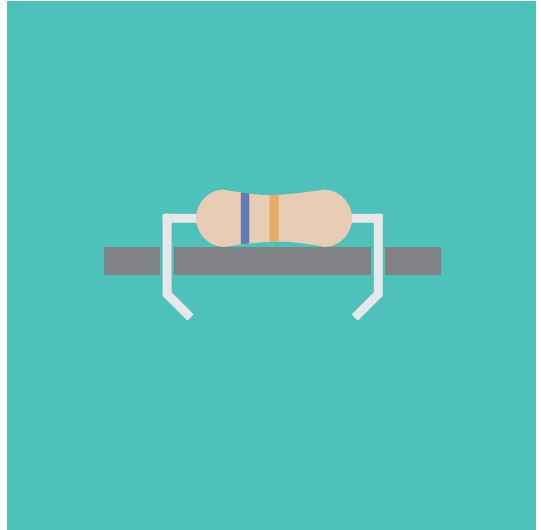
Top Tip
Some components may
look slightly different to
the ones above, don't be
alarmed, this is normal!

SOLDERING 101

STEP 1.

Place the component into the PCB (Printed Circuit Board), make sure it goes in the correct way and it is sitting right against the board. Bend the legs to keep the component in position.
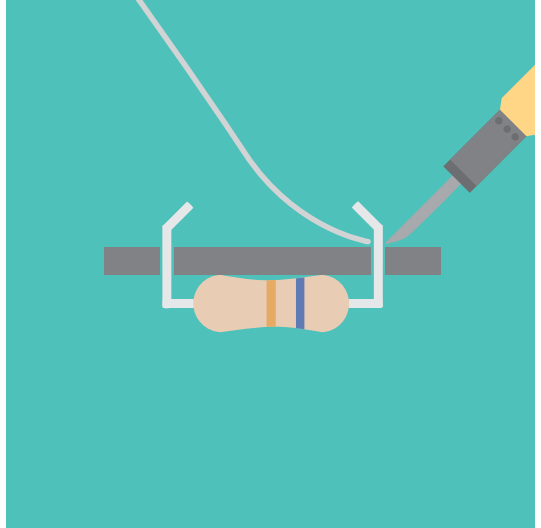
STEP 2.

Turn the PCB around. Place the soldering iron tip at the point on the PCB where the leg of the component meets the solder pad. Heat for about 3-4 seconds.
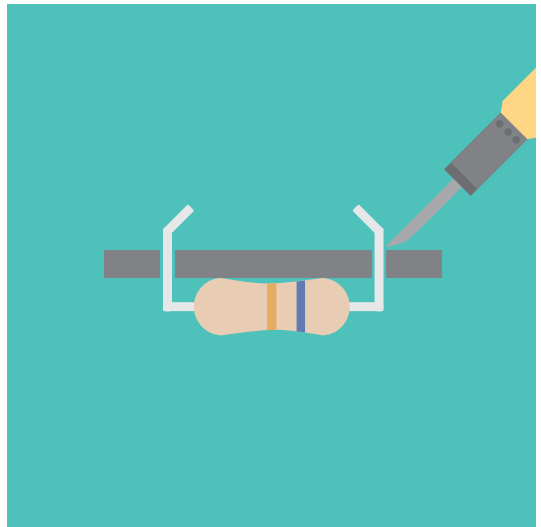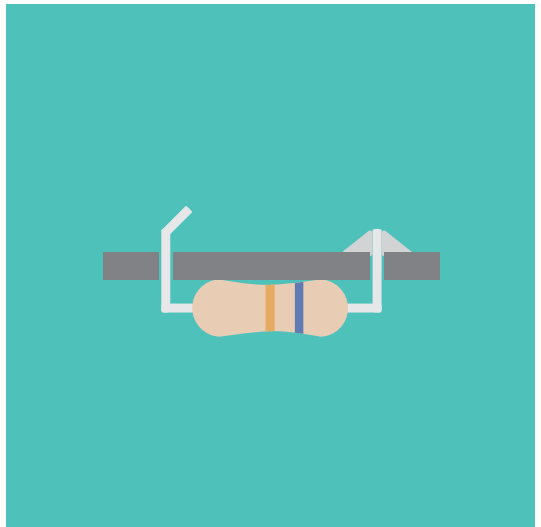
STEP 3.

Using your other hand, add solder to the heated pad. Add enough solder to cover the pad and the base of the components leg. Remove the solder and leave the iron for another second.

STEP 4.

After soldering both legs, take your side cutters and remove the excess component leg. If you make a mistake, re-heat the join and use a solder sucker to remove the molten solder.

1

The PCB

Take out your 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!

Set up your PCB similarly
to the one pictured on the
right. Using your blue tack
to firmly hold your PCB in
place. This will stop it from
moving when soldering
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
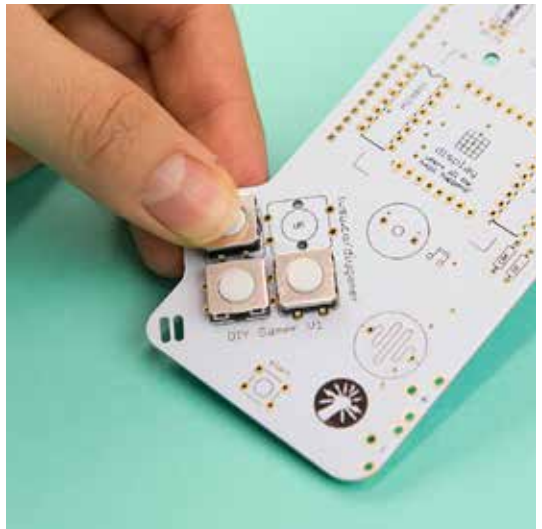person to person so just
have a play until you feel
comfortable.

2

Push Buttons

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.
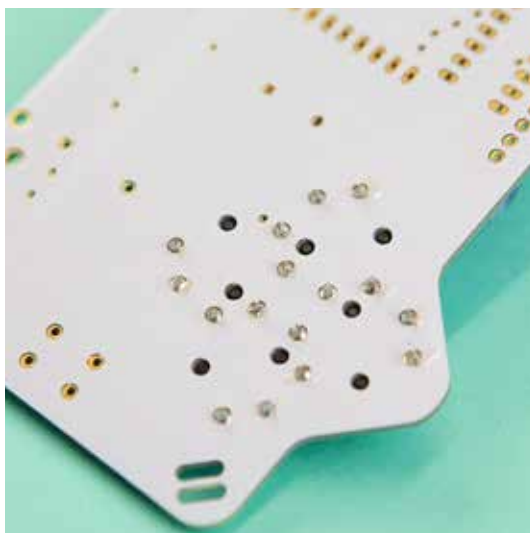

Next clip the four buttons into place on the illustrated side of your PCB. As seen on the right.

Once all four buttons clip into place and are flat against the PCB you are ready to solder. Flip your board over and solder each of the buttons four legs.
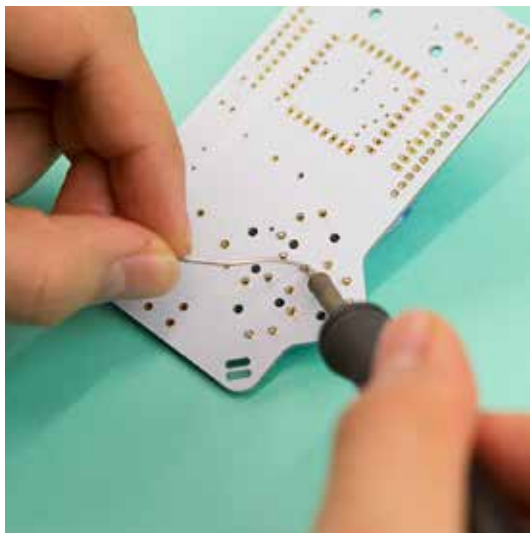
Once complete you should have 16 solder joints that look something like this pictured on the right. No apples in sight…!

The majority of the DIY Gamers components will be placed on the same side of the PCB as the buttons. (The illustrated side) But don't worry it will be very clear when you need to do something different!

3

The LDR

Find your LDR (Light Dependent Resistor) which is pictured on the right. This clever little component that changes resistance with variances in ambient light and can be used to do some really cool things with your gamer later on! But for now lets just solder it...


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.

Flip your board over, press it firmly into your Blue-tack and solder the two legs of the LDR.
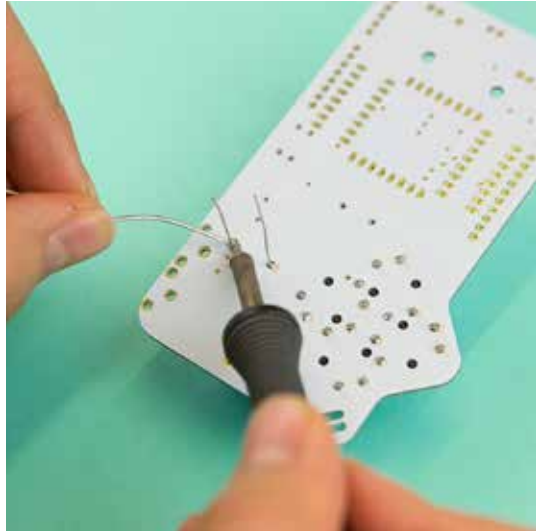
As you will see, the legs of the LDR are much longer than the push buttons so you will have to trim them. Snip them just above the tip of the solder joint.

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.
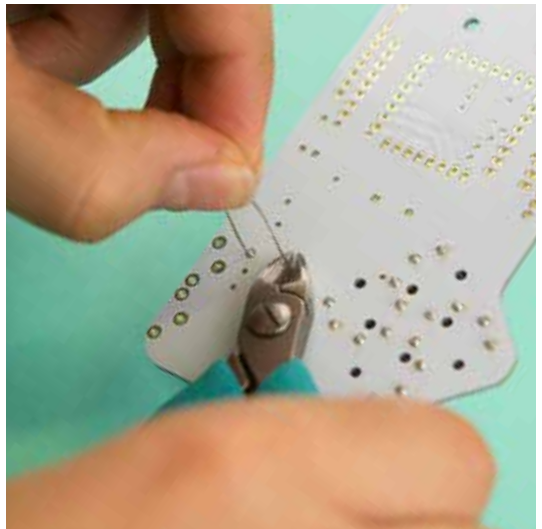
4

The Buzzer

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

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 its is usually trying to tell you that it has a polarity.
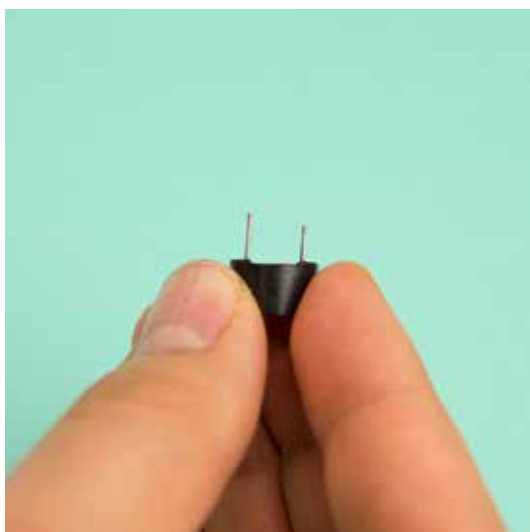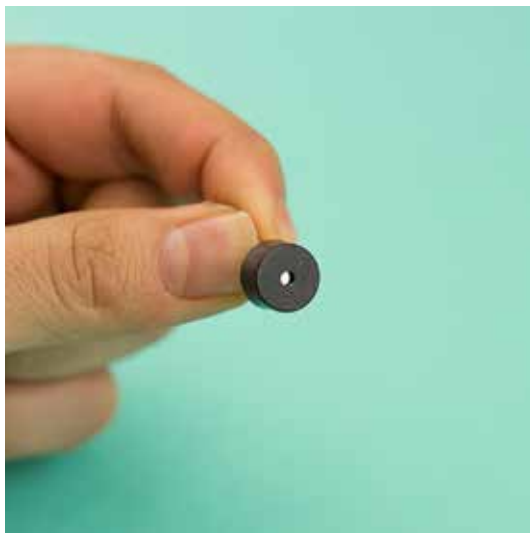
Place your buzzer into the board where it is illustrated with a small musical note symbol. Making sure to match up the positive side (long leg) of the component with the + illustrated on your PCB.

Next solder the component into place and snip off any excess of the leg that is remaining.
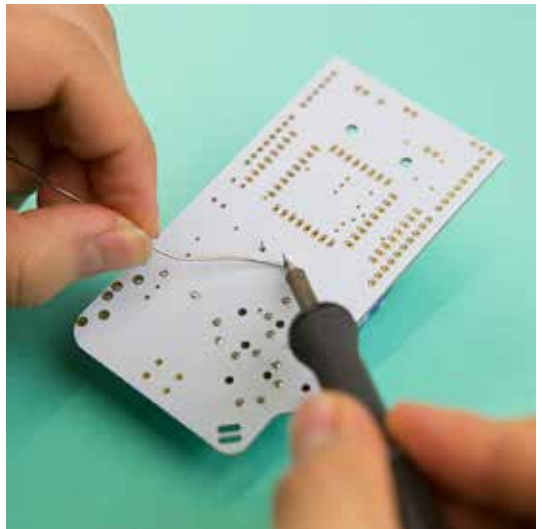
5

LED Matrix Sockets

These sockets are basically what your LED Matrix or 'display' plugs into. You should have two of these which are pictured on the right.
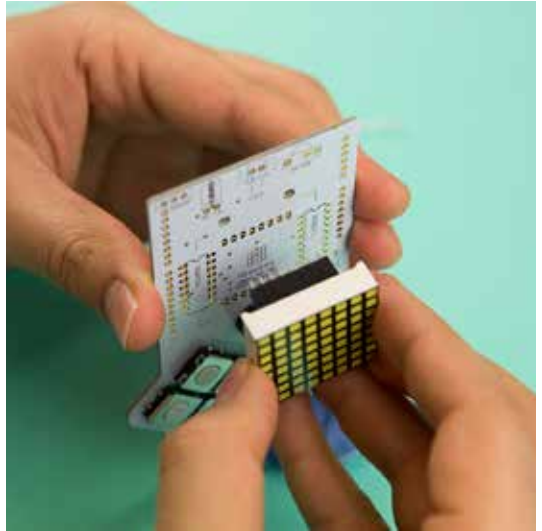
To make sure that the screen fits perfectly into the sockets and can be attached and removed with ease we are going to plug the sockets into the display before soldering. So plug both sockets into the top and bottom of your display as pictured on the right.
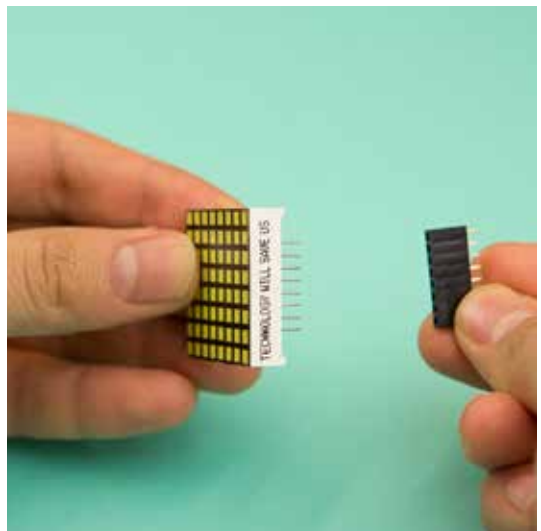
Next place your matrix sockets and LED Matrix on to your PCB where it is illustrated and named 'display'.

All that's left to do for the Matrix Sockets is to solder the two rows of connections into place. No snipping of legs is needed as they are nice and short.

Top Tip

Once soldered you can remove the display as many times as you like. You might want to remove it at this stage so that it doesn't get in the way or damaged in the rest of the steps to building your Gamer.
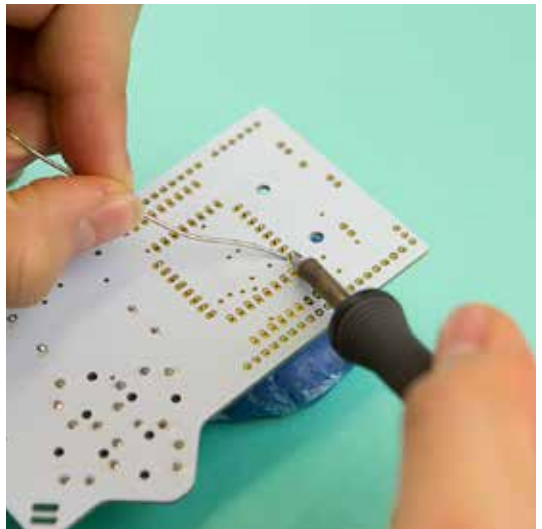
6

DIL Sockets

Your DIY Gamer has two chips in its circuit, these are the brains of the operation and so need protecting. The DIL sockets are what the chips plug into in order to protect them from heat when soldering and also means they can be replaced quickly and easily.


You will notice the DIL Sockets have a small curved notch at one end of the component. When placing the two DIL Socket into your PCB (illustrated either side of the display) make sure the notch of the component matches the illustration.
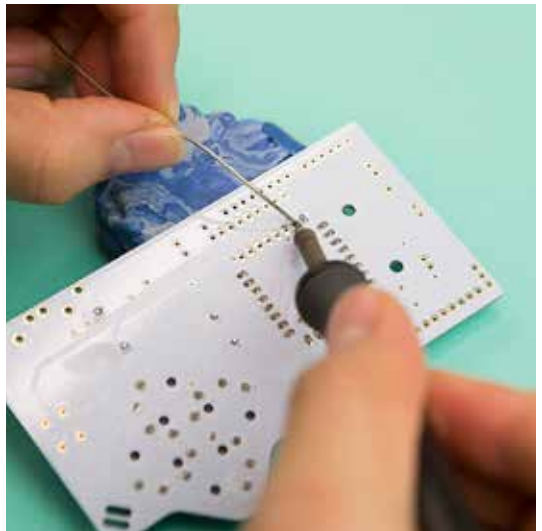

Top Tip

Make sure the notch in the DIL Sockets are facing the top of the Gamer!
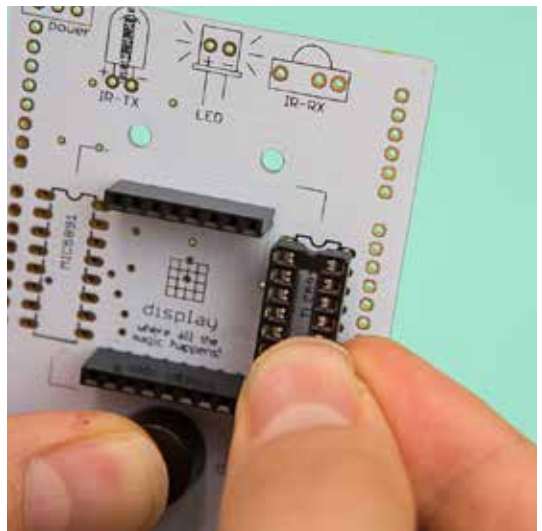
Make sure the two sockets are sitting flat against your PCB.
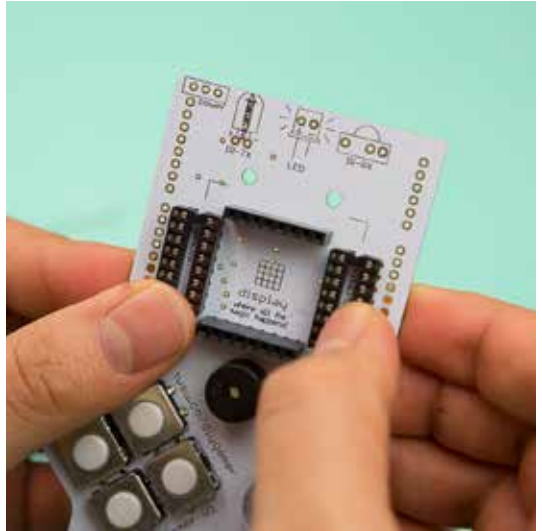
Flip your board over, stick it down and solder the four rows of the DIL Socket pins to your PCB.
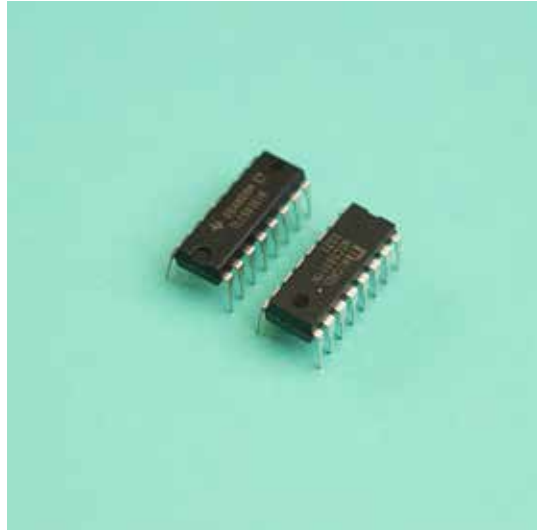
7

IC (Integrated circuit)

Meet the brains of your
Gamer. They look very
similar but the two do very
different things. One is an
8 Bit Shift Register and the
other is an LED Driver.

You'll notice that on top of
the two IC's there are a
series of numbers and
letters. These are how you
differentiate which is which.
If you look at your board
you'll see these numbers
repeated below the DIL
sockets. The one beginning
with MIC is your 8 Bit shift
register and so goes on the
left hand side where MIC
is illustrated on your PCB.
The other beginning with
TLC is your LED Driver and
goes into the right hand DIL
Socket with TLC illustrated
on your PCB.
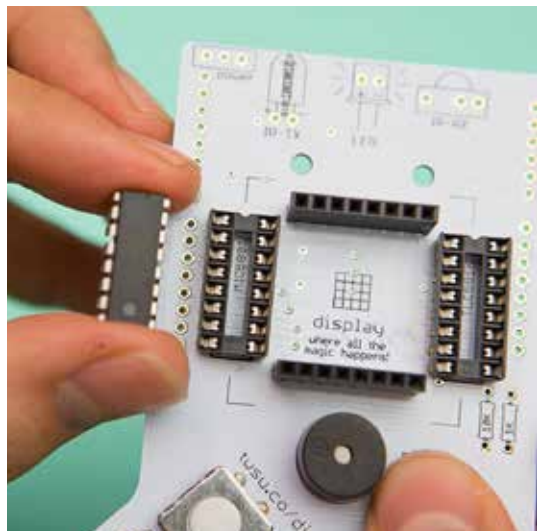
Before placing your IC's into your DIL Sockets you may want to bend the legs inwards slightly so they slot in much more easily.

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.

Double check you have the IC's in the correct DIL Socket and press down until they click and are flush in their sockets.
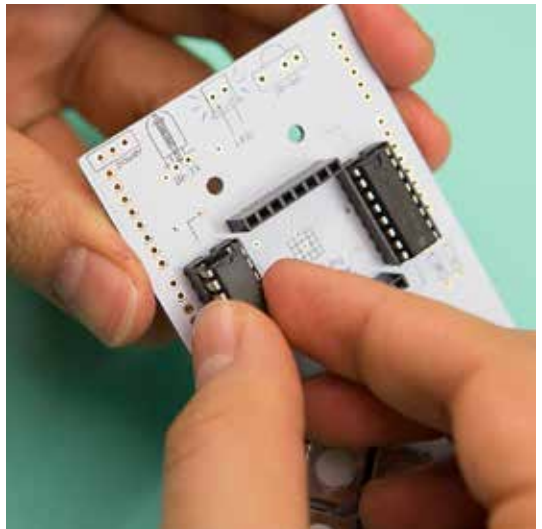
8

Resistors

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 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 45 degrees to form a U shape as shown on the right.
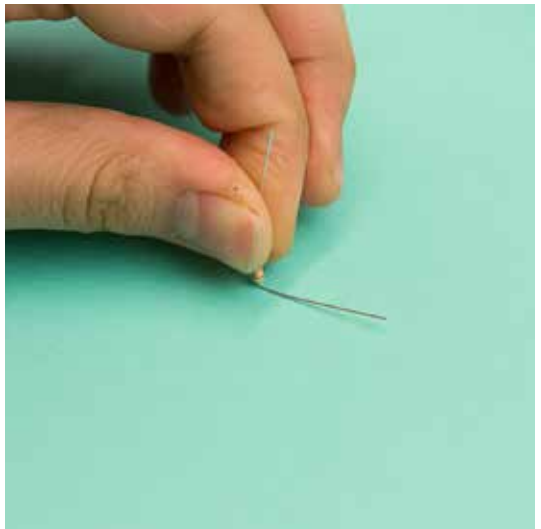
Top Tip

To get a clean fold use a hard surface like your desk to push the tips of the legs inwards.
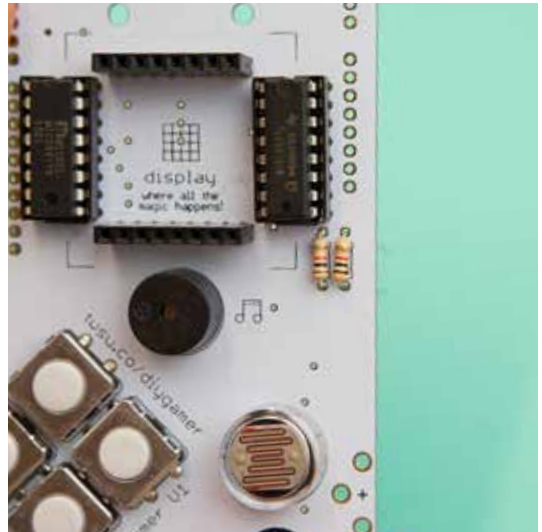
Place your 1k resistor into your PCB where it is illustrated with a 1k symbol. Your resistor can go in either way around as it has no polarity.


Repeat the bending steps for your 10k resistor. Which is marked with brown, black , orange and gold bands.

Place your 10k resistor into your PCB next to your 1k resistor through the holes illustrated with a 10k symbol.

You may want to bend the legs of the resisters out slightly before soldering to keep them in place. Then stick down with your Blue-tak and solder all four legs into place.
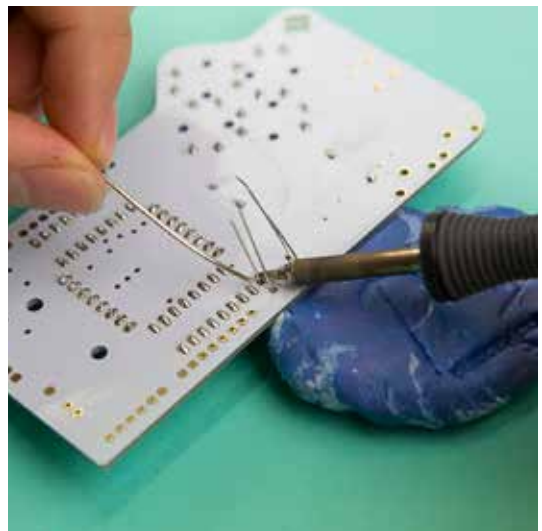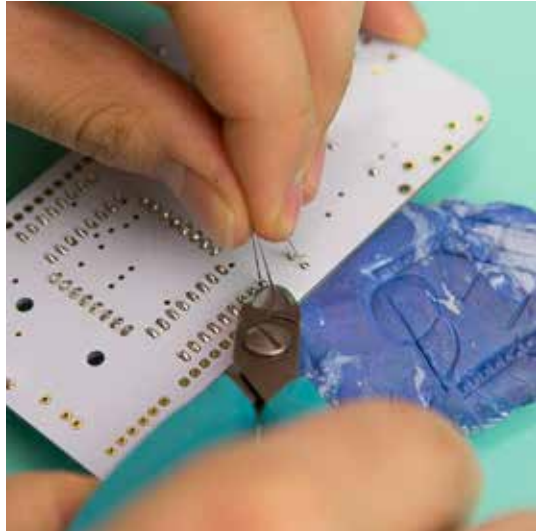
Finally snip off the excess of the component legs.

Top Tip

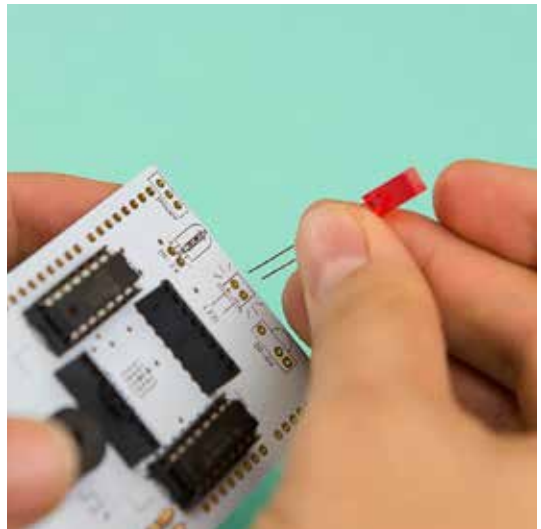Don't forget to hold the legs of the component whilst snipping them!

9

LED

Find your LED (Light Emitting Diode) which is pictured on the right. Its different to your Arduino LED as its rectangular.

You'll notice that your LED has two legs, one of which is longer than the other. From earlier in this guide you'll remember that this asymmetry is telling us the polarity of the component and which way round to place it in the PCB. Match the longer leg with the + symbol illustrated on the top of the PCB, surrounded by an illustration of the square LED.

Bend the legs of the
component at 45 degrees
to hold it in place. Then
solder both legs and snip of
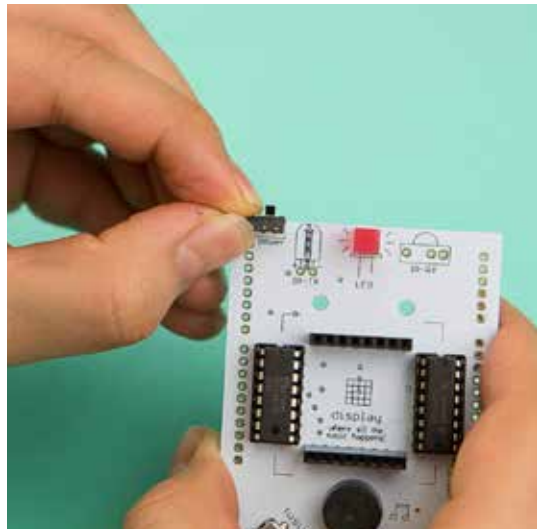the excess.
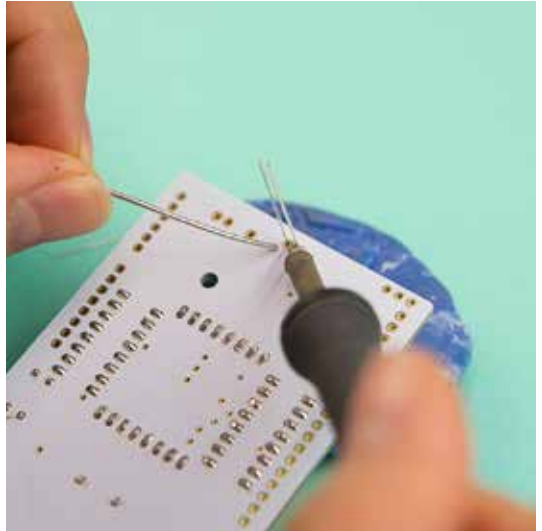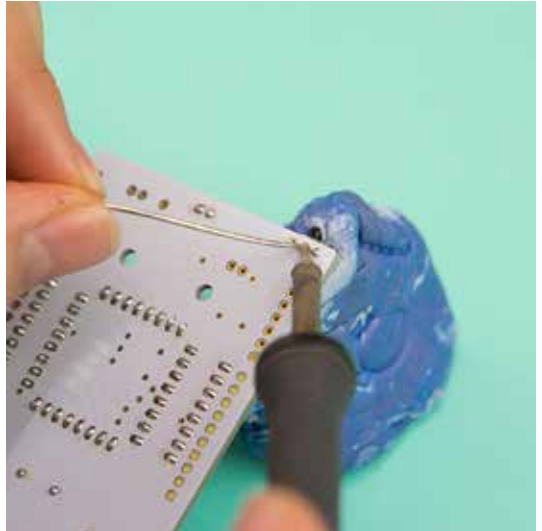
10

Power Switch

Take your Power Switch pictured on the right. This will be used to turn your gamer on and off.

Place your switch into your PCB where it is marked power in the top left. Make sure that the small black toggle of the switch is facing outwards so you can use it!

Now solder your switch
into place. No need to snip
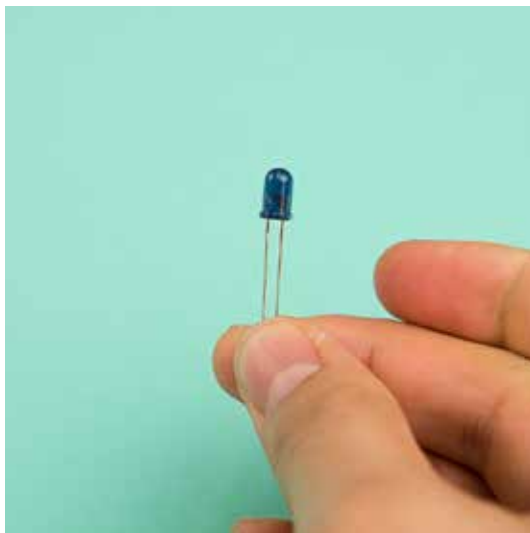as the switches legs are
already small.

11

Infrared Transmitter

Your (blue) Infrared Transmitter pictured on the right is one of the two components that allows your gamer to have multi-player functionality via infrared! The transmitter sends information from your gamer and the receiver picks up information sent from another gamer or other infrared device.


The Infrared Transmitter has polarity so find the longer leg of the component and place it into your PCB, matching it with the + symbol. The space for the transmitter is marked on your PCB with the letters IR-TX at the top of your PCB.
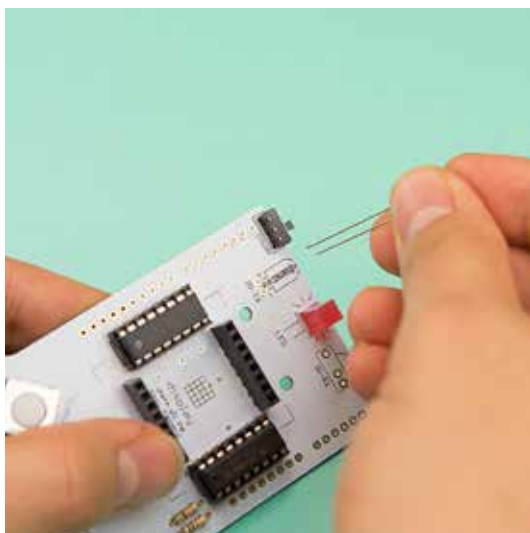
Before soldering we need our Transmitter to be facing forwards so it can send information in a forwards direction. In order to do this bend the transmitter at 90 degrees so that it sits flat on the board as pictured on the right.
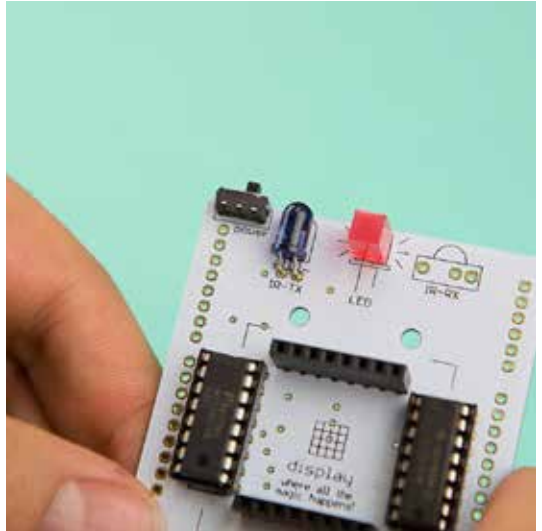
Once bent we can solder in the Infrared Transmitter and snip off the excess leg material.
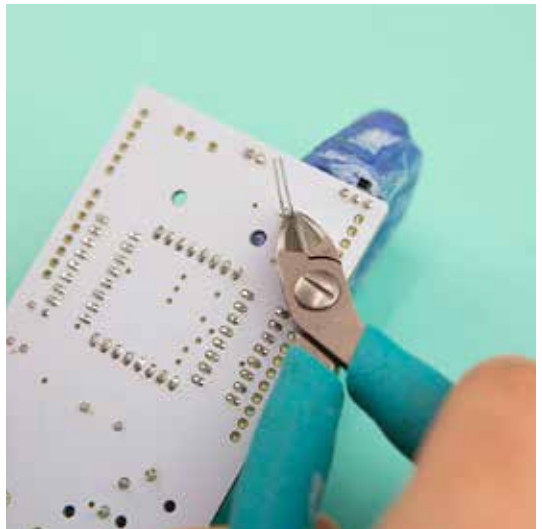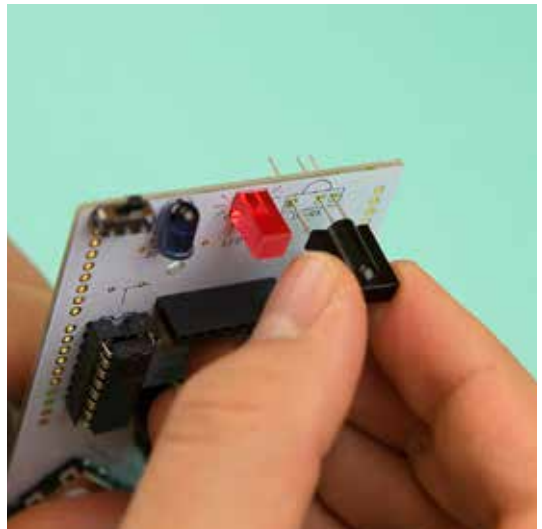
12

Infrared Receiver

Now for the other half of the multi-player components, the Infrared Receiver. Notice one face of the receiver has a rounded profile.
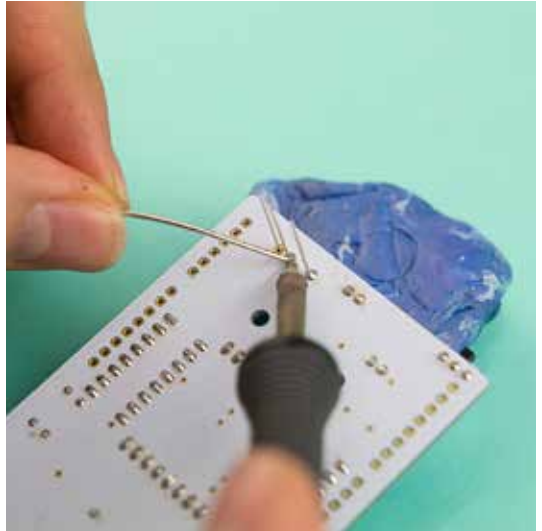

Place the Infrared Receiver into the position your PCB marked IR-RX. Make sure that the curved profile of the component faces outwards away from the PCB, in line with the illustration on the board.

Turn your PCB over, stick it down with your Blue-tac, solder the three component legs and then snip off the excess material.
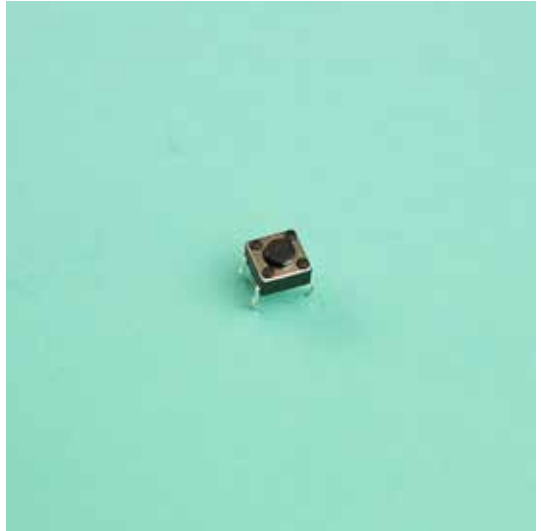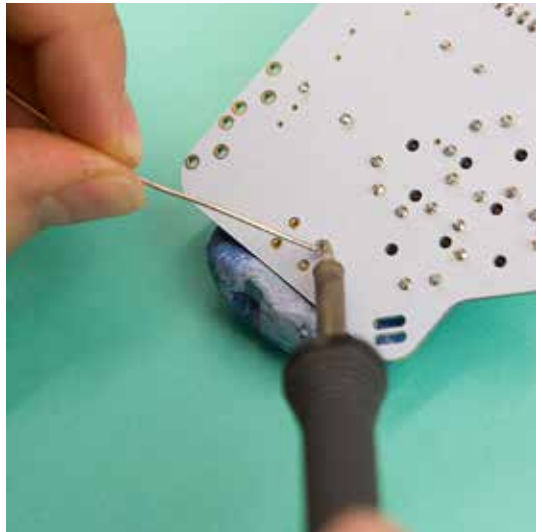
13

Start Button

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

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.
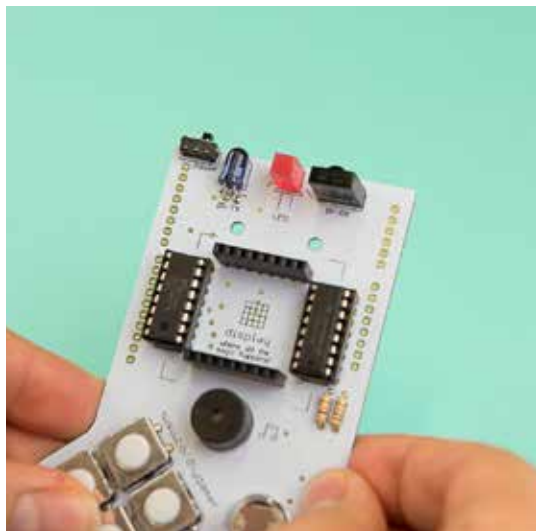
Now solder the four legs of the Start Button into place. No snipping necessary!

Circuit check! Is your board looking like the one pictured on the right?

Top Tip

If its not, don't worry! Retrace the previous steps to try and work out what's missing or gone wrong. Then either add anything you've missed or use your soldering iron and solder-sucker to remove components.

14

Battery Clips

Your gamer wouldn't be much of a portable hand-held if it had to be plugged in would it! So its powered by a 9v battery. The battery is not included but the clips to attach it are and can be seen on the right. The clip with a hexagonal connector is the positive(+) side and the one with a smaller circular connector is the negative(-) side.

To make it much easier to solder the battery clips, attach them to the heads of the battery and match up the + and - of the battery to the + and - illustrated on the top of the PCB.

The battery clips are one of the few components that need to be on the side of the board that is not illustrated. So push the pins of the battery clips into the holes from the side you have up until now been soldering on. See the image on the right. Solder the outer two legs of each battery clip from this side of the board.

Top Tip

Make sure to push in the clips so the pins poke right through the opposite side of the board. This may be a bit tough, but carefully apply force until they go through.

Now turn the board over and solder all six heads of the battery clips into place. Now remove your battery from the clips.

Top Tip

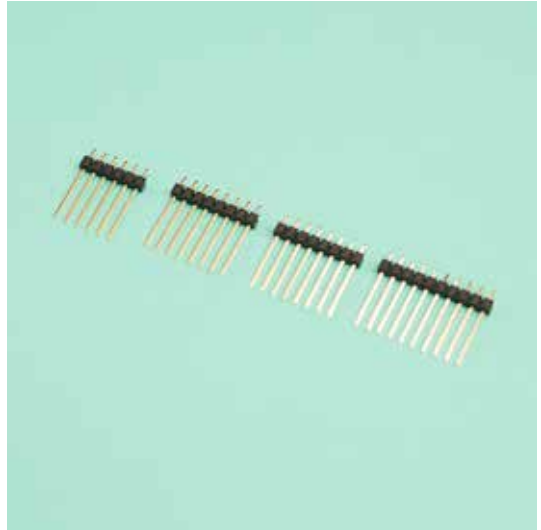Try to cover each hole with an even mound of solder to get a good connection.
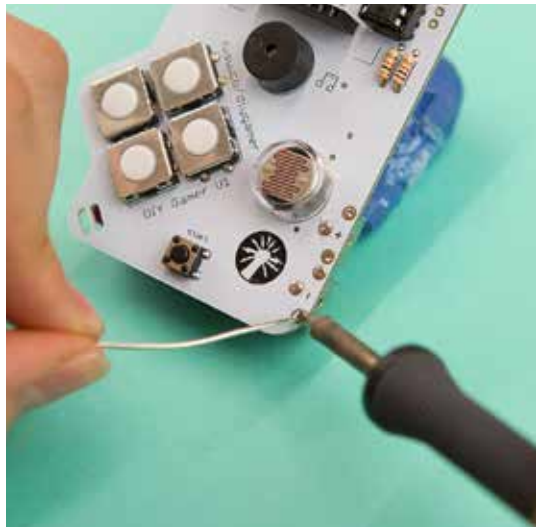
15

Header Pins

The header pins in your gamer are used to connect your PCB to the Arduino board and can be seen on the right. Notice there are four sets of pins and three different sizes each with a longer and shorter side.

Take your Arduino board and place the longer end of the header pins into the rows of black holes. They should fit perfectly into the holes with no spare holes or extra pins.

Top Tip

If there are extra pins or spare holes you may have the wrong header pin set in the wrong set of holes. Switch them all round until all the pins are matched up with a hole.
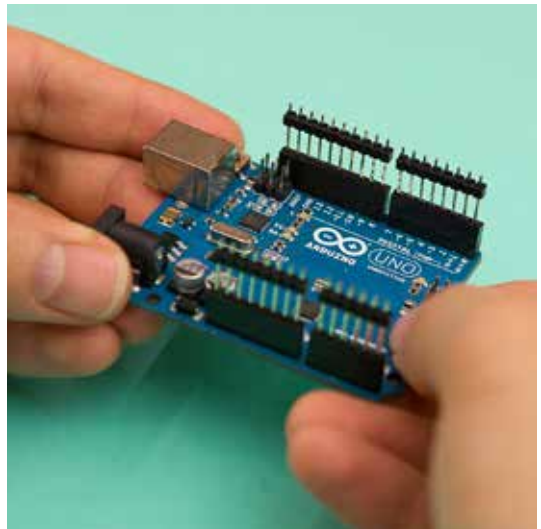
Now place your PCB onto the Arduino and Header Pins with the component side of the PCB facing upwards. The short side of the pins should fit perfectly through series of holes on the outside of the PCB.

Top Tip

You might want to prop up the other end of the PCB where the battery will go so you have an even surface to solder on to.

Now you just need to solder all of the pins to the PCB. You'll be soldering on the side of the board that has illustrations on it!

You have now completed the electronics of your Gamer! Test if it works! Plug in your display with the writing on its side facing the bottom of the Gamer, plug in the battery and turn on the power switch. If it works you'll be able to play the pre-loaded games. If not, check the previous steps to work out what's wrong.

16

Acrylic Casing (front)

By this stage your Gamer should be working in terms of electronics. Now its time to add the Gamers acrylic casing which can be seen on the right. A front and back panel.

Shown on the right are the fixing that are used to attach the panel to the Arduino and PCB. You should have 5x Nuts, 2x Long bolts, 2x Long spacers, 3x Short bolts and 3x Short spacers.
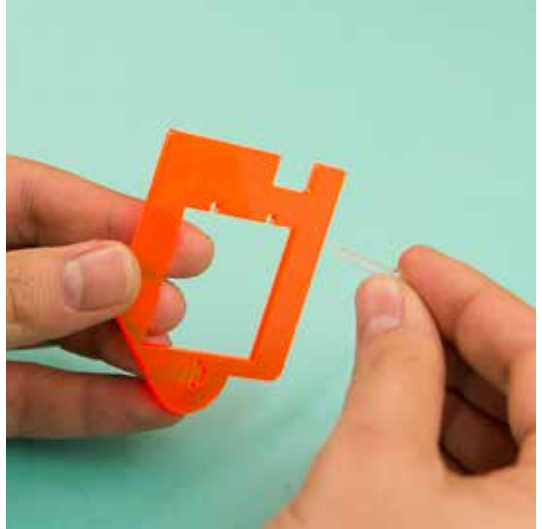
Take your front panel and the two longer bolts. Place the bolts through the two small holes in the acrylic.
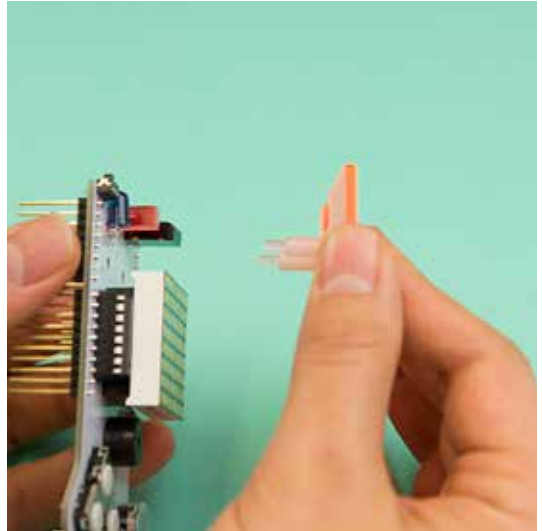
Top Tip

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.


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

If you still have your Arduino attached you'll need to remove it from your PCB at this stage. 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.
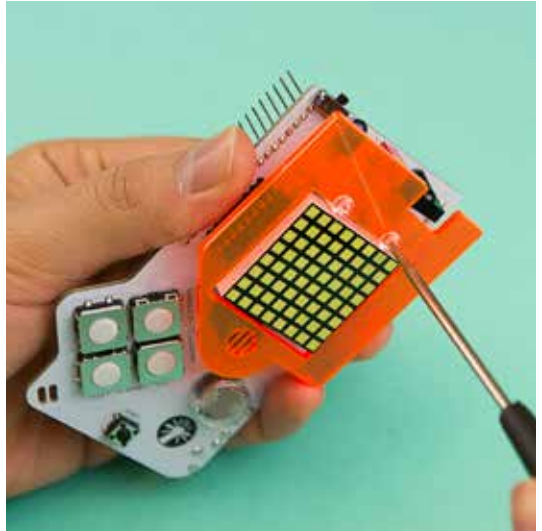

Now turn the PCB over whilst holding the Acrylic and bolts in place. Take two of the nuts and place them on to the protruding bolts.
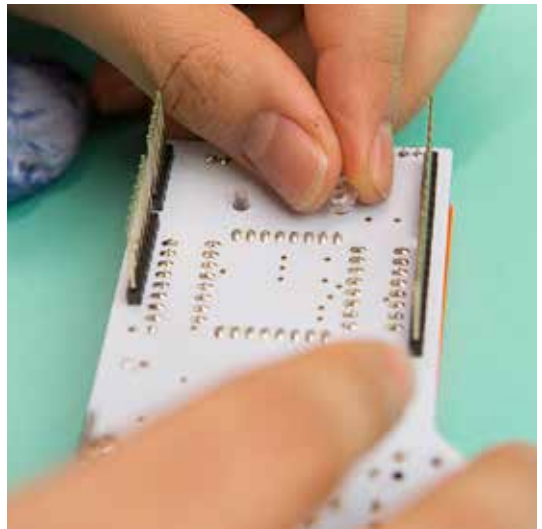
Use a Philips head screwdriver to tighten the bolts until the acrylic is secure.

Top Tip

You will need to hold the nut in place when you tighten the bolts. Otherwise they will just spin around!
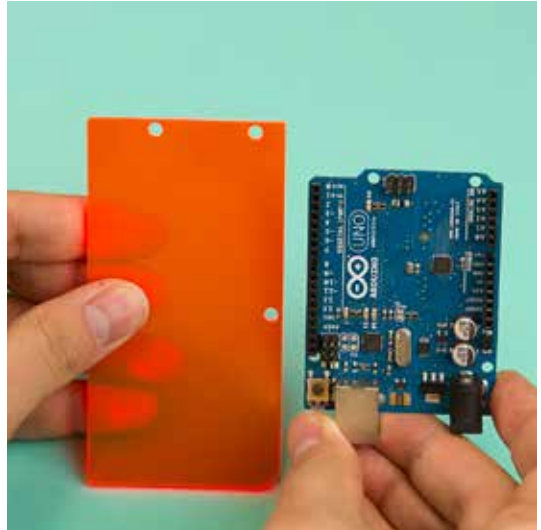
# 17

Acrylic Casing (back)

Take the back piece of your acrylic casing which can be seen on the right. This piece attaches to your Arduino.

If you hold out your acrylic case in front of you, you should see that one corner is slightly more rounded than the other three. This corner should be on the bottom right. The Arduino sits on this side of the acrylic with the components on the Arduino facing up.
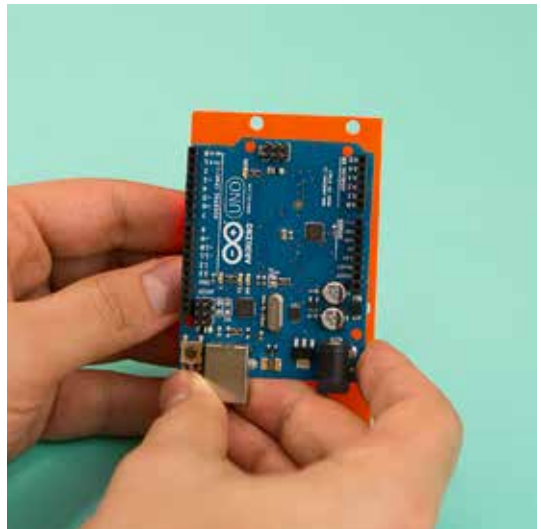
Now you know which way round the acrylic goes, slide the three smaller bolts through from the back of the casing. Then just as we did for the front casing add a small spacer to each of the bolts.
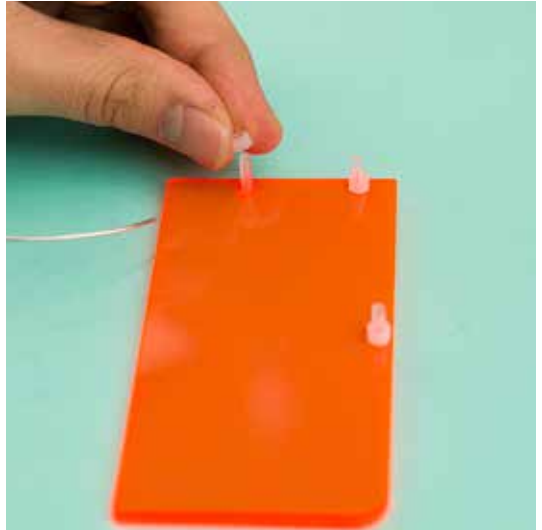
Next place your Arduino on to the bolts which should line up with the holes in the Arduino PCB. Finally add a nut to each bolt and tighten with your screwdriver.
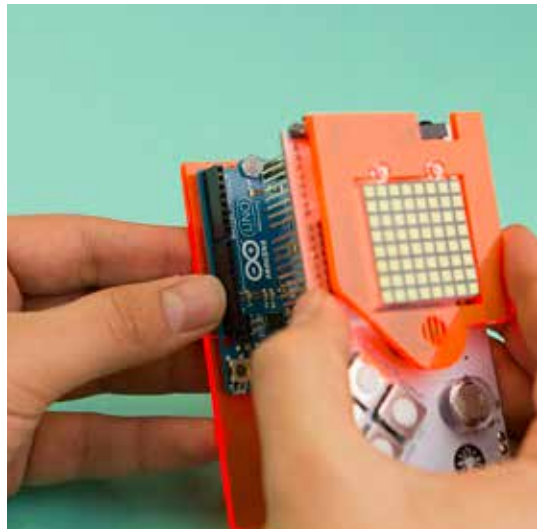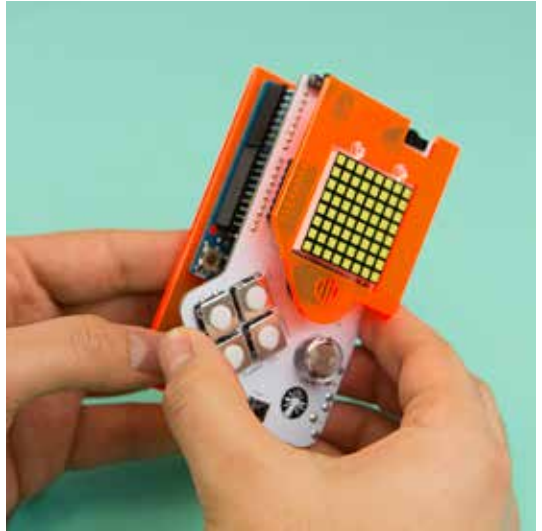
18

Final Assembly
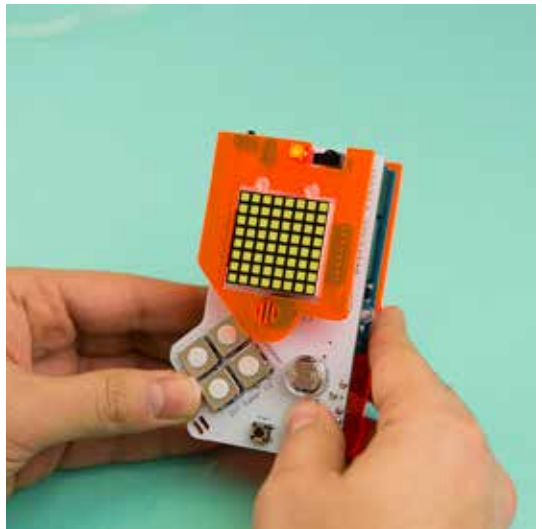
Take your back casing with attached Arduino.

Then slot your Gamers header pins into the Arduino inputs .

Clip your battery back into place.

The soldering and building of your DIY Gamer is complete! Congratulations! Turn on the switch and play some of the pre-loaded games such as snake!

Congratulations!

You have finished the soldering and building of your DIY Gamer Kit. But your Gamer journey has only just begun! You've MADE and probably had a PLAY so next its time to CODE and INVENT! Then play some more...

For those of you who want to test your skills and learn more check out: **http://twsu.co/gamer**

You will find many more creations and hacks to explore the world of coding, animation and gaming!
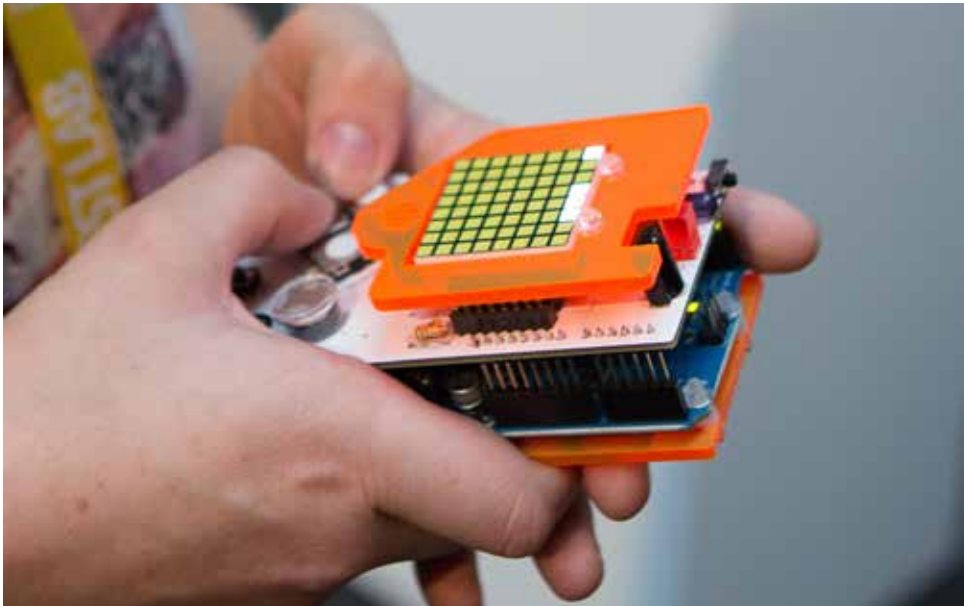
CODE + INVENT

Begin to learn to code with your Arduino micro controller that has a fantastic support community and is a great way to learn how to code physical objects. The first thing you need to do is download the Arduino software (its free from their site) then take a look at our Intro to Arduino video online. Find your extra LED included in the kit and introduce yourself to the wonderful world of Arduino.

Once you have looked into the awesomeness that is Arduino you can now get to grips with the custom software library we have built for you. This will help you use the Gamer's most common features and make it as easy as possible to get you programming straight away. Check out our custom built Gamer Animator and Painter software which will help you to create code without having to write it! Then using the library features, our library cheat sheets and your imagination start bringing in the different controls to create your own games.
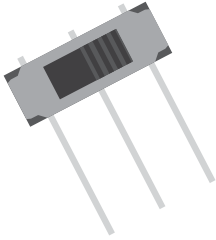
Now experiment, invent, play and share your creations.
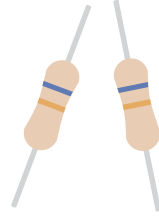
Find all these resources at: **http://technologywillsaveus.org/ resources/diy-gamer/**
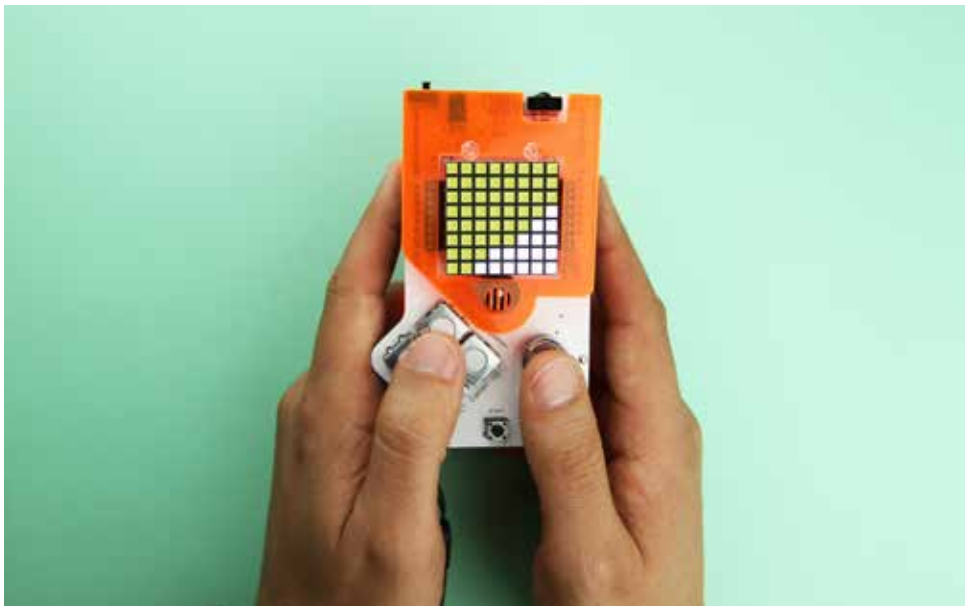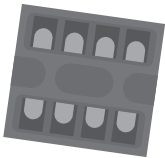
Component Appendix

Switch -

A basic switch. It allows current to flow in one direction when it is switched on by completing the circuit. When switched off it breaks the circuit stopping the flow of current.
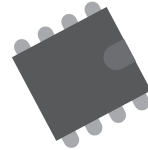
Resistors -

Resistors are used in a circuit to restrict the flow of electrical current and stop things from blowing up! The resistors in measured in Ohms.

DIL Socket -

A DIL (Dual in Line) Socket holds the Integrated Circuit (IC) to the PCB. It protects the IC from being damaged during soldering.
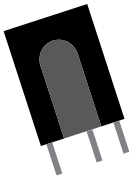
Integrated Circuit (IC) -

An Integrated Circuit also know as an IC is a whole circuit itself but very very small and made of Silicon. The chip in this circuit is a 555 timer chip one of the commonly used chips in the world made up of 25 transistors, 2 diodes and 15 resistors.
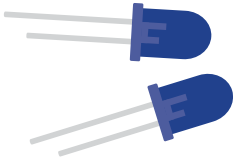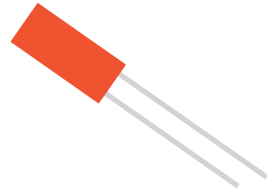
Infrared Transmitter -

The infrared transmitter is similar to your LED but it translates and sends information in wavelengths that are longer than visible light. In the case of your gamer it is used to send information wirelessly in pulses.

LED (Light Emitting Diode) -

A light-emitting diode is your basic electronic light. Its also a Diode - which means it only allows current to flow in one direction. That is why the legs are different lengths.

Infrared Receiver -

The infrared receiver picks up the pulses of infrared information that you transmitter emits. It then translates this information into a usable format that your gamer can read.
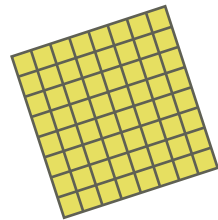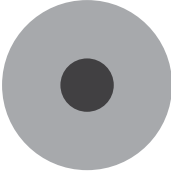
LED Matrix -

An LED Matrix is an 8x8 grid made up of rows and columns of LEDs. In this format each LED can be controlled individually. In the context of your gamer, 1 LED equates to one pixel.
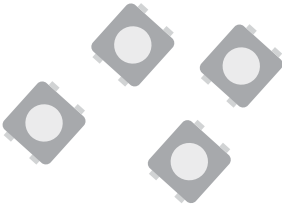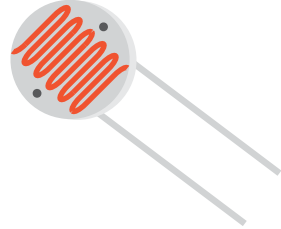
Component Appendix

Buzzer -

The buzzer allows you to create sounds with your gamer. It makes a sound when a constant voltage is applied to it. The pitch of this can be varied by also changing the voltage.
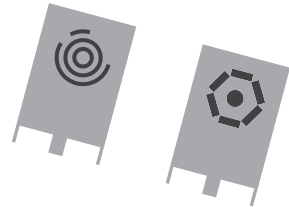

LDR -

An LDR is a resistor whose resistance decreases with increasing light levels.

Push Buttons -

A push button is basically a spring- loaded switch. So when pressed it completes the circuit and allows current to flow in one direction. And when released the springs break the circuit stopping the flow of current.
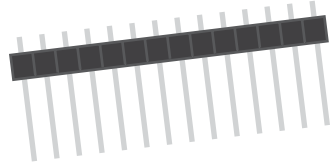

Battery Clip -

The battery clip allows a 9 volt battery to power the circuit. The battery can only connect in one direction with the hexagonal clip head being positive and the circular clip head being negative.

Start Button -

Your start button works under the same principles as your push buttons. The only difference is its casing.

Header Pins -

Header pins are basically wires, but a bit more solid! In your gamer they transfer information from your PCB to your Arduino.

Thank You!

Technology Will Save Us exists to educate and inspire people to make, tinker and experiment creatively with technology as a way of unleashing new possibilities.

Devices, gadgets and computers are all a part of our everyday life and yet most people know so little about what these things are made of, let alone how to fix them or create new uses for them. We believe that the opportunity for technology to play a richer, more creative role in our lives has yet to be explored.

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