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How to Build a Home Arcade

An informal guide for planning, construction and software installation

Does the thought of reliving those awkward, pre-pubescent years of your childhood that were spent at the local arcade give you a full on nerd-gasm? This manual is for you!

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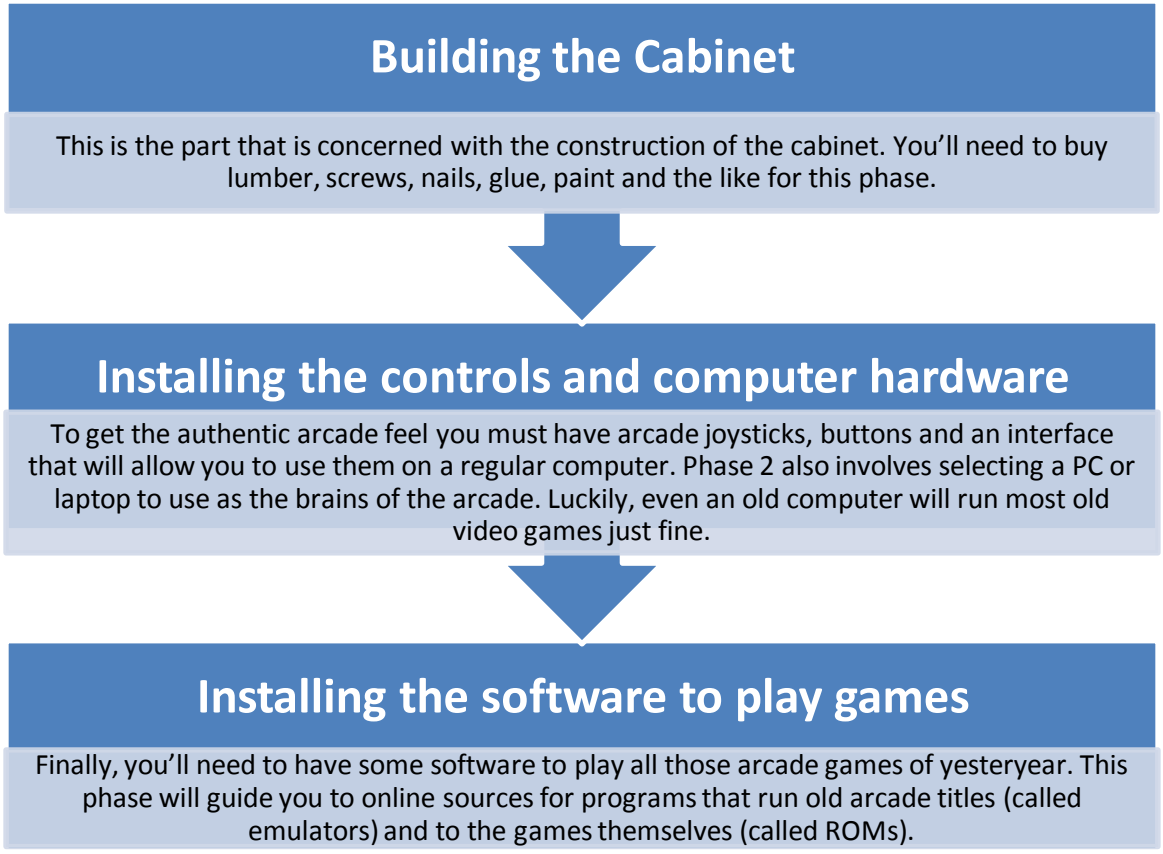
Introduction

1.1 Opening

Building a home arcade is something that most anyone can do but will require patience, precision and perseverance. I'm kidding. Making an arcade is a super experience. The act of building anything with your bare hands is rewarding. The act of building something as geeky as a full-fledged arcade is not only awesome but will reward you with copious amounts of "street cred". Before getting started I'd like to give you an overview of the process and tell you what this manual will and will not cover. The building of the arcade is done in 3 phases:



1.2 Who this manual is for

I'd like to discuss some the things this manual will assume about the reader and what this manual will not cover.

For the construction of the arcade cabinet, you'll need to have a decent understanding of working with wood and power tools. This manual will not cover the operation of such equipment. If you've had a wood shop class in middle school or high school, you should be fine. I will also not give step by step instructions on the types of cuts to make or how to assemble the cut pieces of lumber. These types of things should be fairly straightforward to you. This guide will give you examples of measurements and types of wood that will be good but do not expect the assembly instructions that come with ready-to-assemble furniture.

I also want to stress that this isn't a guide on building one specific model using one design. I would like you to think about the type of features you want in your arcade and design a specific model that suits

you. One of the greatest parts of building your own things is that they are unique. The next time you're at home look around and count the number of things you have that are truly unique. It's shocking. So think about what you want to have. Does your arcade include a keyboard drawer or a door in the front of it to access the computer? Will your control panel have buttons on the side to emulate the bumpers of a pinball machine (they have virtual replicas of hundreds of pinball machines online)? Maybe you will have a coin slot and you'll charge your friends to play. The possibilities are truly endless. Think about what you'd like to have. Visit some arcades, theaters and look online. Make something unique.

This guide also assumes that the reader is a competent computer user. You don't need to be a programmer, but you'll need to know how to install software, plug-in devices to the back of your computer and alter program settings. There's nothing complicated but if dealing with a computer is frightening to you, you may want to have some help from a savvy friend.

Another thing to note about this guide is that playing these games doesn't require a full blown arcade. You can simply set up the software, plug in a controller and have at it. If this describes you, go ahead and jump to phase 3 and skip all the construction.

1.3 Information on the author

In case you're wondering about my level of experience in the realm of building home arcades, here are my credentials: First and foremost is that I have made an arcade cabinet. Prior to its construction I had a shop class in middle school where I made a foot locker out of mahogany. I'm not sure if you're familiar with the show, but I've been an avid viewer of The New Yankee Workshop for years. Norm Abram is a master craftsmen and I've picked up a lot of technique from watching him. Keep in mind that building an arcade is nowhere near the complexity of his projects.

Some of my qualifications for this project are that I am a software programmer. I've been building computers for many years and installed thousands of programs in various operating systems. You know that computer savvy friend or family member that you always bring your PC issues to? I'm that guy.

Excellent! Now that that's out of the way, we can start the construction of your arcade!

Phase 1 - Building the Cabinet

For this type of project you're free to use any kind of wood. You could make your arcade look like it's been carved out of a tree or you could make it look as authentic as possible. You could go all out and use ¾ inch African Bubinga accented with Spruce (high quality and expensive) or you could grab a couple sheets of particle board or MDF (cheap wood that most store bought home furnishings are made out of). If you're planning on painting your cabinet (or don't want to spend a fortune on timber) you should go with particle board or MDF. Particle board is cheaper, but MDF is more sturdy and smoother. I made my cabinet with particle board. Another option, if you want to have a nice looking wood cabinet, is to get particle board and a thin veneer of a nicer wood to paste onto it. This process is for advance wood workers only and is beyond the scope of this guide.

2.1 T-Molding

Something else to consider is whether you want to have T-molding. T-molding is the long plastic strip that covers any edges on the arcade (see Figure 1). Traditional arcade design has pieces of the cabinet that don't line up with adjacent pieces to create a flush edge. The overlapping area is usually covered in T-molding. This is the type of addition that will really make your cabinet look official. If you're planning on using nice wood and a finish, you probably won't need this.

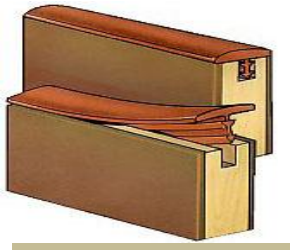


Figure 1- T-Molding

2.2 Hardware

The hardware needed will depend on the type of features you plan on including in your design. You'll most certainly need screws. If you're planning on having a door, then get a handle and some hinges. If your arcade is going to have a keyboard drawer you'll need a set of drawer slides. Maybe you want to roll the cabinet around easily. If so, you'll need some casters. The most basic things you'll need are listed below:

- 3 - 8'x4' sheets of ¾ inch particle board or MDF (Most of the cabinet will be made out of this)
- 2 - 8 foot long 2x4 planks (For structural integrity)
- 1 - 4'x2' sheet of 1/8th inch MDF (Used for the marquee holder and screen bezel)
- #6 and #8 screws
- Paint or stain
- T-molding, if desired
- Any hardware that you require (Door knobs, hinges, etc)

Some tools that will be needed:

- Circular Saw (for all the major cuts)
- Power Drill with a full line of bits (For assembly)
- Jigsaw (for any round edges or inner cuts)

Figure 2- You'll need a few power tools for construction

2.3 Cabinet Template

Included with this manual is a cut sheet that you can use as a base for your design or you could use it as is. This was taken from LuSiD's Arcade Flashback (Lusid, 1999). My control panel is different, but this was the base design for my arcade. You can modify these designs based on personal preference, but the materials list shouldn't change much, if at all.

Some adjustments that you need to check include the size of the TV or monitor you'll be using. You don't want to make your cuts and assemble the cabinet only to find that your TV doesn't fit. You should also consider how your case will have sound. I cut holes in my cabinet, below the marquee, the size of the speakers I'd be using (see Figure 3). You could also use a smaller monitor and have your speakers on the sides of it. Or perhaps you're content with using the speakers from your TV or monitor.

Figure 3- Depending on how you install the speakers you may need to cut some specific slots

2.4 Cutting

After assembling the materials you'll need to begin cutting. After printing out Lusid's cut sheet, and making any desired changes, you need to transfer the cut lines to the sheets of wood. Something to consider here is whether you'll be cutting to leave the line or not. Usually you'll draw a line on the board you're cutting. If you cut past the line (leaving the line visible), the piece of wood will be a tiny bit longer. Since the blades on most saws are 1/8th inch, you'll need to keep in mind how the pieces will fit together. For instance, if you have the base piece and the top piece cut differently, your arcade may be larger at the bottom and smaller up top. Since we're dealing with no more than ¼ inch on a 6 foot tall structure, it may not be noticeable but the wood may be bent too far for comfort. This will be more evident in the control panel construction. A good rule is to cut parallel pieces at the same time so you know whether you're planning on leaving the line or not. You can actually stack 2 pieces of wood on top of each other and have 2 exact pieces.

2.5 Assembly

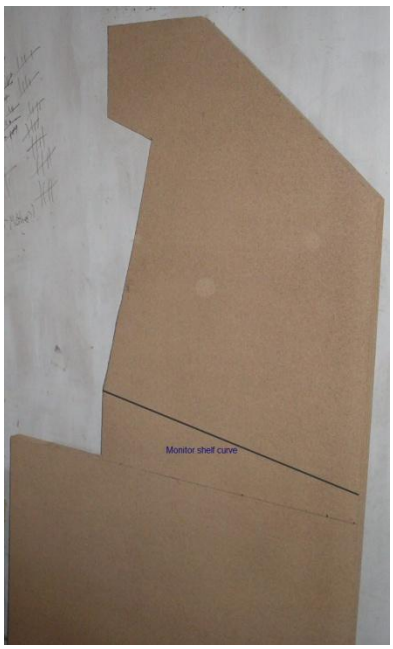


Figure 4- Don't forget to angle the monitor holder as necessary

After cutting all pieces comes the assembly of the cabinet. It will be beneficial to have a helper with this part of the process. It's not always necessary but will ensure things go smoothly.

The first thing you'll want to do is get the cabinet upright. Attach 2x4 strips to the bottom, top and middle of the cabinet sides. These will hold the cabinet base, top and monitor self. Be sure to include any angles for the monitor shelf. Most arcades have the TV face up, towards the player (see Figure 4). After dry fitting them together you can screw them in place. Now attach the back panels. If you are installing a drawer, you can attach the hinges for it. If not, attach the front panel.

By now you should have, for the most part, a fully assembled arcade cabinet. Now it's time to move onto the control panel.

2.6 Marquee

The marquee is an optional step but really brings life to your cabinet. For my arcade I made a design in Photoshop and had Kinko's print it out for me. Nothing really special but when a light shines behind it the effect is fantastic. You could have a company create a real marquee on a slick layer of plastic as well. The choice is up to you.

Figure 5- An arcade marquee

Another option is to have a sheet of plastic or Plexiglas protecting the marquee art. I suggest doing this but it is not necessary.

For the marquee I'd recommend using some of the 1/8th inch MDF as a frame that covers your printout. You'll need a light behind the marquee to have the glowing effect. The entire marquee assembly should consist of the printout sandwiched between 2 layers of Plexiglas and covered by the marquee frame that you make.

To attach the marquee, either screw the entire marquee assembly to the cabinet or use hinges. Hinges will allow you to swing the marquee open to access the light or speakers if you decide to have them placed there. Bear in mind that using hinges may cause light to bleed down onto the control panel. It isn't a bad thing but it does look unprofessional.

2.7 TV Bezel

Phase 2 will discuss your options for the type of monitor you'll use but no matter what you choose, you'll need to have a bezel. The bezel is the object that covers your monitor. It's essentially a frame, like the marquee frame. Another addition is to have a piece of cardboard, plastic or wood that covers any gap between the arcade cabinet and the monitor. You may not want to be able to see into the arcade from this gap. This is another step in making a professional looking arcade.

Figure 6- Centipede bezel

Figure 7- An inner bezel that covers the entire screen

You'll need to know the dimensions of your monitor and how it will fit into the cabinet to complete this part. Use the 1/8th inch MDF to cut a frame for the outer bezel. This will cover the TV or monitors own encasing and any buttons that it has on its face. If you're using a TV and want to use the remote control, be sure to mark where the remote sensor is on the TV so you can drill a hole in the frame.

If your monitor isn't directly touching the frame you'll want to consider adding an inner bezel. The easiest way to do this is with some cardboard. You'll cut pieces out to connect the inner edge of the frame with the outer edge of the monitor screen. The whole purpose is to draw the eye directly onto the screen and to hide the innards of your cabinet.

2.8 Paint

After you've competed the assembly and the dry fit to make sure everything fits together properly you can move onto painting the cabinet.

Most people go with all black. I've seen some cabinets that have exotic designs and personalizations. Another option is to design something on the computer (like the marquee) and actually have it printed onto adhesive paper to create an over sized sticker. You can place it on the cabinet to create some high quality art without being a painter.

The type of paint is also important. I would recommend spray paint. This will give you a really smooth surface. Using traditional indoor paint with a brush will create a texture. This may be preferable to you though.

Stencils can be used to create some really cool abstract designs. Something I did was apply a primer coat (special white paint), then run strips of tape all around the cabinet and add my layer of black paint. This was inspired by Eddie Van Halen's self-made guitar from the 1980s. It was a really easy way to add a design with hardly any extra effort.

Figure 8- Eddie Van Halen's Guitar

You now have a full upright arcade cabinet! But how do you play games on it? How do you hook up arcade controls to a computer? What types of options are there with monitors? For these questions look no further than phase 2.

Phase 2 – Installing the Controls and Computer Hardware

3.1 Control Panel

Figure 9- Control Panel example

The control panel is probably the most important part of the arcade. This is what gives it the rich arcade feel. If you customize anything, customize this. Do you want to include a trackball, a spinner or perhaps an analog flight stick? Do you want to have 4 player capabilities? Look online and visit some arcades to get inspired. Check out some online retailers for arcade controls to see what's available (I've included several online stores that sell arcade parts in the references section). The next phase of this manual delves deeper into how to hook up the arcade controls up to your computer but I'll quickly discuss some options. The two main methods are to dissect a keyboard and use it's controller to solder the wires for the controls or buy a controller that is specifically made for hooking up the controls to the computer.

For the arcade sticks and buttons, you'll need a 1 inch drill bit. I've included a layout for a typical 6-button design. You can use that to mark holes for your buttons and joysticks.

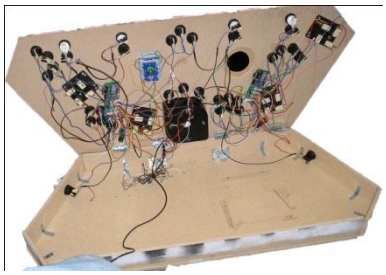


Figure 10- The innards of a control panel

Lusid's control panel has a slope to it. I've tried that and I prefer to have my control panel parallel to the ground. The only issue with that is that everyone and their mother will most likely rest their drink on it. Just like with the main cabinet, you need to make your cuts and assemble the pieces. This can be done on your own. No helper required.

I highly recommend attaching the top of your control panel with hinges so that it can be opened easily. There are a few reasons for this. First, spending 4 hours wiring all your controls and screwing the panel shut is really aggravating when you find out that you miss-wired something. Making these changes on

the fly is very helpful. Second, I've gotten tons of questions on how everything works on my arcade and it's great to be able to flip the top up and show them.

After the assembly, you can get a feel for what playing will be like. I'd recommend making paper cut outs of your control scheme items (2 players, 6 buttons each, 1 trackball and a spinner, etc) and lay them on top of the control panel. This will ensure everything will fit and be comfortable. You'll also want to have some buttons set aside for non gaming actions such as coin insert (in emulators, your computer will literally “think” it's an old arcade and will require coins to be inserted to play. This action can be mapped to a keyboard key or arcade button), player start, escape, pause, tab (used for modifying game settings).

Now you can attach the control panel to the cabinet. You can also add a keyboard drawer or any other modifications you desire.

3.2 Arcade controls

There are two ways to use arcade controls on your personal computer. One is easy and the other is hard. The hard way involves taking apart a standard keyboard and detaching the board’s controller. The controller is the device that reads what key you pressed on the keyboard and sends that info to the computer. You can actually tap into that device and solder on your own wires which will be attached to your arcade controls. If you love tinkering with things, you may enjoy this.

Figure 11- Arcade joysticks

The easy way involves buying a special controller that was designed with the sole purpose of interfacing arcade button switches with a PC. This was how I did it. The company X-Arcade specializes in making arcade peripherals that the average consumer can install and use. They even have pre-built control panels for sale (X-Arcade).

I bought my arcade parts and added them to my own, specially designed, control panel. You can purchase the sticks, buttons and controller interface card for about $90. The interface card uses USB so installing is as easy as can be. Your computer treats all your arcade controls as if they were a keyboard. I highly recommend this way.

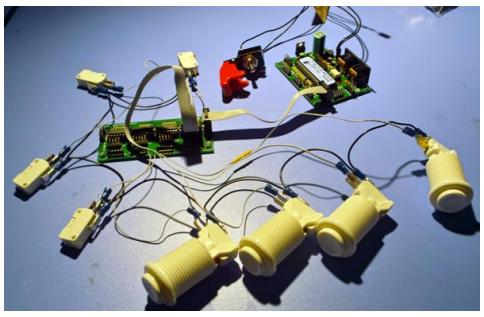


Figure 12- Arcade buttons hooked up to a controller

X-Arcade has most of the controls that apply to arcade games. They even have trackballs for games like Missile Command and Centipede. If you have a need for more specialized arcade parts, you can go to Happ Controls (Happ Controls). Some games really shine with a joystick that can only move in 4 directions (Pac-Man, Dig Dug, all the classics). Perhaps you want to add a spinner wheel to your control panel because you love Arkanoid. Maybe you require a 3 player and 4 player start button. Happ Controls will have what you need. Most buttons and joysticks will use a standard switch (including coin doors) that work with

the controller interface from X-Arcade but things like spinners may not work on a computer out of the box. Some are made for that purpose but make sure before buying.

There is one more type of controller to mention: Light Guns. These will be rare for your home arcade setup. Arc Labs has 1 or 2 models of light guns that work on the PC. Some require that a computer monitor is used (TVs may not work). Also there are a few select arcade shooter games that won't work with light guns. Terminator 2: Judgment Day had the appearance of a light gun game but the Ozzies that you use are actually attached to analog balls, much like how trackballs and old mice work. Therefore, light guns won't work on the old T2 game.

Figure 13- A button switch

If you buy a controller from X-Arcade hooking up the buttons and joysticks is a snap. Each button uses a standard switch. Joysticks will use the same switch, only there are 4 of them for each joystick. Every switch has 2 or 3 metal tabs that protrude out. Each switch needs to have 2 wires hooked up to it: one that carries a current and a ground. You can attach the wires to any of the metal stubs (it actually doesn't matter which). The wires then plug into the X-Arcade controller circuit board. The circuit board will connect to your PC with a USB cable. The computer will treat it exactly like a keyboard. There is a way to manually setup what keyboard key is assigned to each button/switch. See X-Arcade's manual for how to do that.

3.3 Monitors

Different types of monitors can be used with your arcade. The difference is significant and will be determined by the degree of authenticity you desire; how easy you'd like your setup to be; and how clear you want the picture.

Figure 14- Arcade Monitor

If authenticity is key, you can buy genuine arcade monitors. They are almost exactly like CRT TVs but are made for arcades. They very rarely have cases and are extremely heavy, not to mention dangerous. Since the back of the monitor is exposed, the wiring is present. I've read about stories of arcade builders that have made trips to the hospital because they weren't careful. Your computer will have to have a special video card to be able to use one of these. If this is the route you choose, you'll have to find the installation instructions somewhere else.

Figure 15- Video card with an S-Video output

An old CRT TV is much cheaper and easier to acquire. It also requires a video card, though. Most new cards don't have the needed S-Video jack in the back though. You'd have to look at older models. Something else to think about is that you're still using a computer. The text prior to game playing will be almost indiscernible. The TV will need to have an S-Video input or a composite video in. Any computer video card that has an S-Video connection will include an adapter for composite.

The best option is to get an HDTV or computer monitor. PC monitors are usually more expensive, so HDTVs have a great quality to cost ratio. HDTVs also have VGA, DVI and/or HDMI inputs on them too. This makes setting up a computer a breeze.

3.4 PC

To run emulators and play old video games, your computer has to meet some very strict requirements. It must have been made sometime after the year 2001. This is one of the best things about having an arcade is that any computer can run these games. Just for good measure I will give you my recommended PC specifications:

- 1GHz Processor
- 512 MB RAM

You can use any operating system. I use Windows because it's very simple and has a lot of gaming programs. Linux will have almost as many and I'm sure Macintosh has some good software available as well.

As mentioned in the Monitor section above, you may need a video card. If you're using an HDTV or computer monitor, you won't need one. If you're using a CRT TV or an arcade monitor, you'll need a video card with an S-Video output.

Phase 3 – Installing and Configuring Software

If you are so inclined, the previous phases can be disregarded if you have a PC and simply want to play some old video games. You could use your keyboard and mouse or buy a PC gamepad for $15 dollars and start with this phase.

Figure 16- Gamepad for the PC

For this final section we'll discuss the programs used to play all the old games (called ROMS) on your PC using special programs (called emulators).

4.1 Emulators

Emulators are programs that will make your computer work exactly like another kind of machine. There are emulators available for old arcade machines and home consoles such as NES and Genesis. There are even emulators for cash machines and calculators.

Figure 17- MAME logo

The main emulator for arcade games is called MAME, which stands for Multiple Arcade Machine Emulator (MAME Official Website). Since there are thousands of different types of computer architectures that were made specifically for each arcade game, MAME does the job of emulating all of them within one program. It's really an amazing piece of software.

You can also download emulators for any home console ever made. If you have fond memories of playing on a Commedore64, there's an emulator for it. There are even emulators for calculators! All of Atari's, Nintendo's and Sega's systems are easily accessible. The following list contains my favorite emulators for various systems. All of which can be found at the Emulator Zone (Lefteris_D).

A lot of emulators are open source and you can download the source code for them. Most emulator sites will have downloads pages that include both binary files and source code files. You want the binary files. Those are the ones read and executed by your computer.

4.2 ROMS

ROMs are the term used to refer to a game that runs on an emulator. It stands for Read Only Memory. They are also commonly referred to as images. There are some legal issues with ROMs. A lot of old arcade games fall into the category of abandon-ware. This type of software isn't sold anywhere and usually the team that created it has no means by which to collect money from its sales. This makes them legal to obtain and use. Be careful, though. If a game is still available to purchase, the ROM for it could be considered illegal to own. Many console ROMs fall into the abandon-ware category as well. Nintendo does not. If you want to download any ROM used for a Nintendo game, you will be, according to them, stealing.

For ROMs of games other than Nintendo's, I have one site to recommend to you: Pleasuredome (Pleasure Dome). This is a bit torrent site that has a massive amount of ROMs for more systems than you could want. They have entire sets for various platforms and the bit torrents can be upwards of 100GB in size. If you are unfamiliar with what bit torrent is, here's a great tutorial on how to use this peer-to-peer (P2P) networking technology: http://www.utorrent.com/help/guides/beginners-guide

If you're just looking for a few select games, you can probably find them at Cool Rom (Cool Rom).

4.3 Installation of Emulators

Different emulators install in different ways. Most will just need to be extracted from the zip file you downloaded them in and you're ready to play. Others have install wizards like most Windows programs. Each emulator will most likely come with a readme file for instructions on how to install.

Setting up a file structure to keep everything in order will be helpful. I recommend using a schema similar to the picture on the right. The only folders that are necessary are the emulator (or system name) with a ROM folder inside it. The other folders are only needed for Front Ends (more on that later).

4.4 Configuration of Emulators

This part will require a good amount of time depending on how many emulators you have. For every emulator you have you'll have to go through a few steps:

1. Assign the control scheme
2. Place your download ROMs into their folder
3. Configure graphics and audio options

Every emulator will have an options menu. Usually they look just like any other Windows program with a "File", "Edit" and "Options" menu. MAME is different. To configure the controls you just need to find the control setup options. From there, you can assign the game actions to your arcade controls. Do this by pressing the <tab> key while running MAME. You can use the arrow keys, <enter> and <esc> to navigate through its control scheme set up.

You'll also want to throw all the ROMs for each video game system into its respected emulator ROM folder.

Finally, you need to configure the video and audio options for each emulator. Like the controls, an option menu will exist for it. You can tell it what resolution to use, whether it should start in full screen mode and some emulators have video filters that can make older games look better than they used to.

Most of the audio options should be fine, but you may need to tweak them as well.

MAME configures differently from other emulators. After downloading it and extracting it, run the MAME.exe file. This will launch MAME. From there use the arrow keys to move up and down and select the configure option. This will open up all the control settings. If you need to adjust video, audio or other things you'll have to open up a command prompt, navigate to the directory you installed MAME to and run this command: `mame –createconfig`. If you're not familiar with using the command prompt in Windows, here's a nice little tutorial:

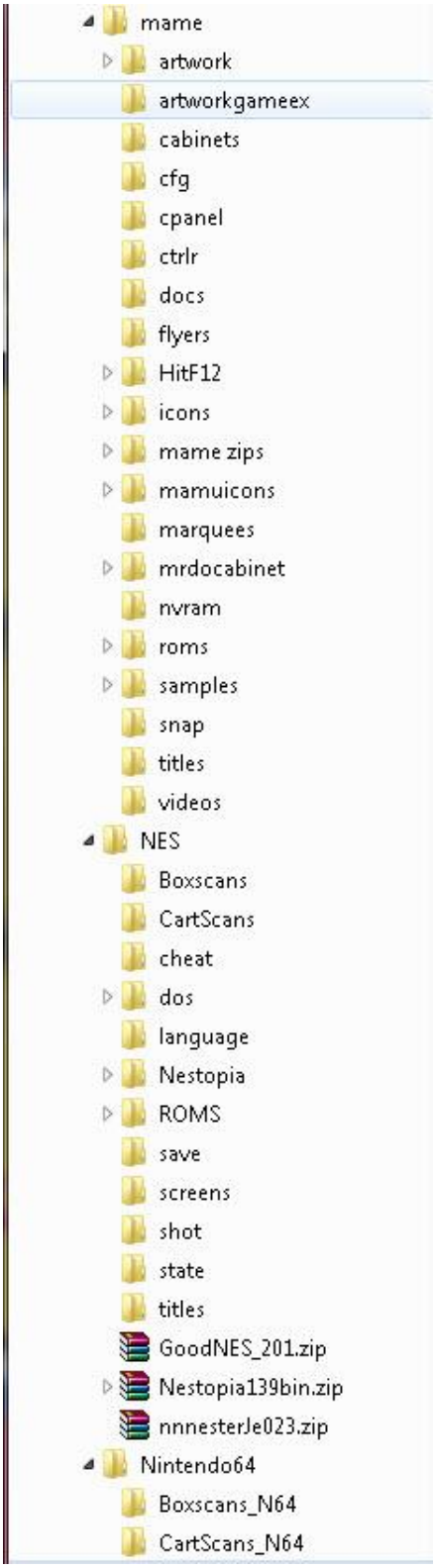


Figure 18- Folder structure of emulators

http://www.bleepingcomputer.com/tutorials/tutorial76.html

This will create a file called “MAME.ini”. You can edit this file using notepad. Only tamper with settings that you understand. You can check out the documentation online at MAME’s website for more info.

4.5 Front Ends

If emulators are the engine of an arcade, front ends are the body. These programs create a slick user interface for you to choose what game you want to play. It will launch your emulators for you and start the ROM that you select. Many front ends will also play music and video files on your computer. Most will be free, as well. For a streamlined experience you’ll need one of these.

Figure 19- The GameEx front end

There are many front ends out there and I’d recommend trying several of them to see which one you like the most. I run GameEx (Speirs). It has a great interface, works with all the emulators I have and can be customized a great deal. GameEx is free but has a donation splash screen when it starts. Some of the more advanced features are blocked in the free version as well. Most people will not require those extra features, though.

Download and install GameEx. Afterwards you can run the configuration wizard to tell it where to find your emulators and ROMs. A really cool feature of front ends is that you can download pictures of arcades, control panels, flyers, box art and cartridge art for all the ROMs available and have them displayed next to a game title. Most emulators will even have small video clips for every game. You can get these pictures in sets at Pleasuredome. Be sure to tell GameEx where those picture files are when configuring it.

5. Wrap-Up

There you have it. You now have a fully functional home arcade! I hope you enjoy years of free play and nostalgia. At this point I highly recommend looking online and checking out the emulation scene. There are thousands of people out there with years of experience that will be happy to help you along in your ongoing quest to enjoy the best games of yesteryear.

I hope you enjoyed this guide and I really hope you enjoy your home arcade!

Figure 20- My home arcade

Glossary

Bezel – The outer frame of the monitor you'll be using in your arcade cabinet. This hides the space between the monitor and the cabinet.

Control Panel – The entire unit that houses the arcade controls.

Emulator – A type of computer program that, in this case, allows you to play old games on a modern PC.

Image (Image File) – Another name for ROM.

MAME – Stands for Multiple Arcade Machine Emulator. This single program emulates hundreds of different types of arcade machines. This is the software that makes playing arcade games at home possible.

Marquee – A semi-translucent sign at the top of a cabinet that usually states the title of an arcade game.

ROM – Stands for Read Only Memory. This is a file that contains all the software of an arcade game. They run on emulators.

T-Molding – The molding that covers the exposed edges of an arcade cabinet.

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