

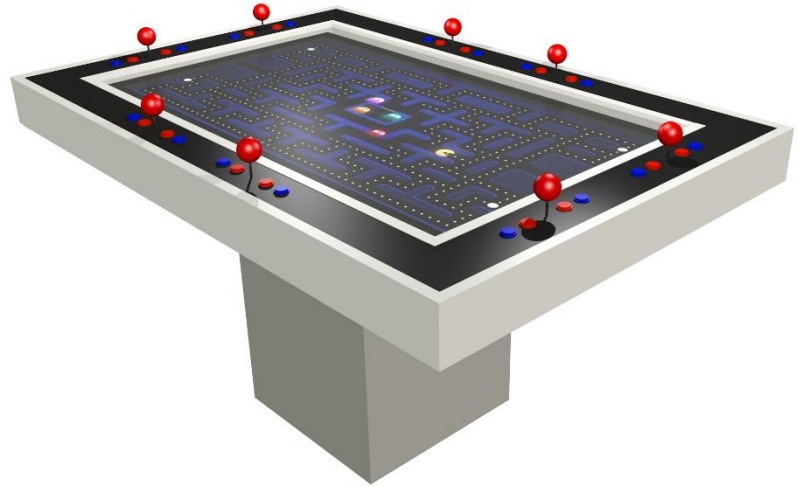
THE DA VINCI GAMING SYSTEM

THE DA VINCI GAMING SYSTEM

A modern gaming system for use in hospitals, hotels and restaurants.

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Document Revision: 0.1



Section 1 – Project Introduction

Project Overview

The Da Vinci Gaming System is a large TV screen laid flat like a table, and turned into a modern arcade games system for up to eight players. Many of the games will be remakes of classic 1980's arcade games, amped up for eight players at a time and others will be brand new titles. The original idea is that these systems could be made and donated to children's hospitals. But because the design and software for this system is free there is really no restriction on using it in any public or commercial venue.

The Da Vinci project does not need funding, it is a volunteer organisation that shares its designs and software with anyone wanting to build one of these tables.

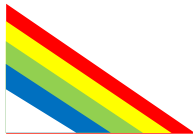
By laying down the basic design rules for a Da Vinci Gaming System table, we are giving game designers and programmers a unique opportunity to let their imaginations run riot and come up with group based games that aren't possible with conventional arcade cabinets.

We also hope to introduce kids to more group based play and show them that it is still possible for the home programmer to develop fun and exciting games without the backing of a large studio.

Thank you for taking the time to look at Da Vinci.

Pete Cotton

Founder



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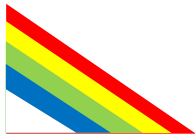
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Introduction

Unfortunately I have had to spend some time recently in the wonderful Alberta Children's Hospital with my daughter. The staff there are truly amazing people and the bravery of the kids is a marvel to behold and very humbling. I feel a desperate need to help in some small way to make their visits less of an ordeal.

For the last few years my father has been carving a wooden rocking horse each winter and donating them to various children's hospitals. They are exquisite and always gratefully received. I wanted to continue his legacy, but I wanted to produce something that played to my strengths (I'm nowhere near as skilled a carpenter as my father, but I am a fair programmer). I really wanted to build a toy that would keep sick kids occupied and their mind off their impending treatment and operations.

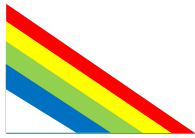


Initially I thought of building a 1980's arcade cabinet for them. I had already built a number of arcade cabinets to entertain my friends. What really surprised me about them though was that my young kids and their friends were just as enthused by these games as the adults were. To this day they probably play more on my current arcade machine than they do on the Xbox. Interestingly, the most popular games are the multiplayer ones such as Gauntlet, Teenage Mutant Ninja Turtles and the Simpsons.

When I built my own arcade machines I used software emulators, but the licensing on the old ROMs is a definite grey area and they almost certainly can't be used in a commercial environment. There are also lots of other issues with fitting different arcade games into a single generic cabinet and most games are only one or two player.

I made the decision then to design a new arcade machine with modern technology that I would write new games for. If we are designing a new arcade machine I wanted it to be something that wouldn't be monopolised by one or two kids, but would allow large group play and encourage sick kids to interact and make friends with others around the game. So the flat table design with eight sets of arcade controls was born. Originally I was thinking of things like an 8 player Pacman machine, but the more I thought about it the more I became excited about the huge number of old games that could benefit from an eight-player reboot.

This document lays down a set of standards that Da Vinci games have to adhere to if they want to be compatible with the eight player Da Vinci Gaming System tables. I am going to use these standards to re-write some of the most iconic games from the 1980's for up to eight players and make them freely available to people who want to build a Da Vinci Gaming System.



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This is a project for enthusiasts trying to help other enthusiasts. I will get the ball rolling by writing the first few games, however we hope that others then use this platform to develop a new generation of home grown arcade games. This can be thought of as the ultimate cartridge games system from the 80's. A modern take on the Atari 2600 or Super Nintendo. It's really easy and reasonably cheap to build and encourages a whole new generation of game designers who missed out on the 80's.

Already a number of people have expressed great interest in the opportunity to design games on a new eight player platform. An unexpected side effect of this project is that it will help to keep interest in some of the classic 80's arcade games alive in to the next generation.

We have deliberately placed very few restrictions on the use of the Da Vinci Gaming System in the hope that it can help spread joy to kids (and adults) everywhere. I would like to see people building these for home entertainment rooms, doctor's waiting rooms, hotels and bars, basically anywhere that children (and adults) need to be entertained.

A Da Vinci table can be made with some pretty straightforward woodworking techniques, but if you are already a skilled woodworker, then there is no limit to the level of craftsmanship that you can apply to your table. For the electronics we are going to use a mid-range computer and a keyboard encoder. The only other electronic components you need are a TV monitor to show the games on and arcade buttons and joysticks, which can be ordered online fairly cheaply. As part of this free document set we include an instruction guide covering how to wire the whole system using just basic skills and tools. It's all low voltage, so there's no danger of electrocuting yourself.

If you lack the required skills you can always rope in friends to help you. I have found that most people are excited by the project when they discover it's potential.

This Document

This is section 1 of a 5 section document that makes up the reference manual. These designs and ideas are free, and they have been split up into their relevant categories to make referencing them easier.

Section 1 – Project Introduction

Section 2 – Cabinet Design

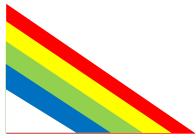
Section 3 – Building Techniques and Wiring Diagrams

Section 4 – Game Design

Section 5 – Game Programming

High Level View of System

Each Da Vinci Gaming System table consists of an LED TV screen (we are using 55" for the prototype) mounted flat like a table, with up to eight arcade control pads mounted around the outside. Each pad will consist of an 8-way digital arcade joystick and two buttons (Fire 1 and Fire 2).



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Player 1 has an additional button, "Select" which is used to pause and change games.



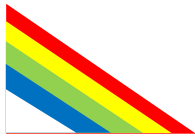
When the system starts up it will boot into the Da Vinci Games Menu which allows player 1 to use their joystick to scroll through the installed games and chose which one to play.

Once a new game has started, other players can join at any time by pressing their fire button. With some games (such as Pacman or Gauntlet variants) the whole screen is the play area. With other games (such as platformers) which require the screen to be facing the player, the screen will automatically divide itself up to give each player a section of the screen.

If a joystick and button set is not used for more than one minute, then after a 30 second warning that player will be assumed to have left and the screen space re-absorbed into the other player screens.

Available Games

At the time of writing there are two completed Da Vinci Games ready to play on the system. These are an 8 player breakout clone and an 8 player bi-plane aerial dogfight game. Each of these games took about a week to write using the free Unity Game Engine Tool. The source code for these games will be released with the final package so that young developers can dissect and adapt them to create their own games, or create entirely new games from scratch.



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Each game is launched separately from the main menu, so they can be programmed in any game creation tool or language. We like Unity because it is free, easy to learn and there are plenty of on-line courses and resources. But there are lots of other suitable tools such as The Unreal Engine, Visual Studio and GameMaker Studio.

Location, Location, Location

The fact that Da Vinci Gaming Systems can double as tables makes them suitable for drawing customers into a number of different commercial venues. Because they can be custom made for each client their physical appearance can be created to match the décor of the location. This makes them appropriate for non-traditional arcade locations such as coffee shops, waiting rooms, fast food vendors etc.

While an old bar might prefer a nice varnished oak finish, a coffee shop might go for a cleaner white look. For a kid friendly restaurant, the machine could be built with bright colours and exciting graphics. It's up to the cabinet creator how they want to build it.

The commercial version of the Da Vinci software also has the option to display menus and advertisements when there is no active game. The games themselves might even be adapted to match the location or venue characters.

Approved Games

Anyone can program and install a game for their Da Vinci System, however we will also operate a volunteer database of approved games that have been vetted for malicious code and that have been assigned an age appropriate warning. This allows non-technical hospital or restaurant staff to log into the Da Vinci Gaming System and download new games for their system (via the Internet), safe in the knowledge that they will be age appropriate and virus free. This system will seamlessly install the games and they will now appear in the game menu.

Optional external controllers

Each player game pad consisting of one joystick and two buttons (Fire 1, Fire 2) requires 7 wires (6 signal wires and one common return). For systems that are being installed in hospitals there is an optional plan of wiring up an external RJ-45 socket for each player game pad (this is the standard Ethernet socket available in most hardware stores). These connections are wired in parallel with the switches for that player. This allows players with physical handicaps to have their own individual controllers which they plug in to the table at any player station and start to participate. Again, we hope that the user community really comes together on this one and starts designing controllers for people with varying levels of motor control.

Screen Split

Games designed for the Da Vinci Gaming System fall into two categories, full screen or split screen, with the split screen sub-divided into either a 4-way or 8-way split.

Full Screen

Full screen games have all players sharing a top down view of the entire playing field.



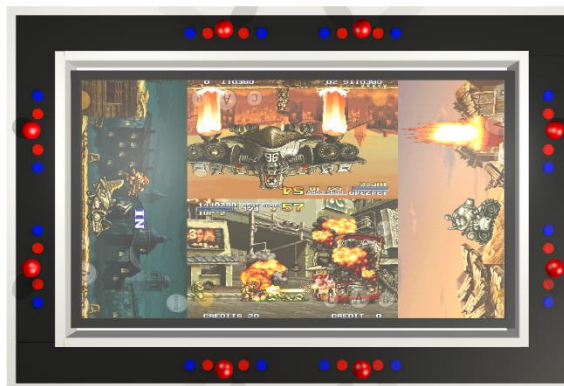
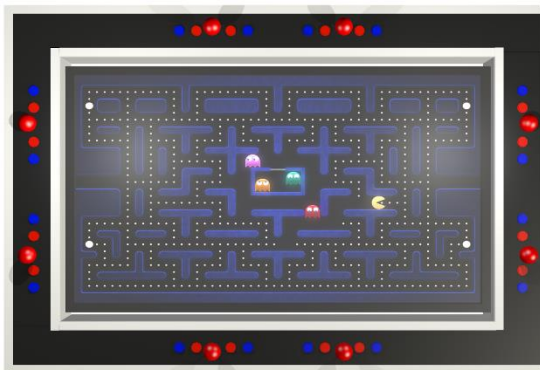
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Games such as pong, pacman, gauntlet, tower defense etc. all fit into this category. Players might be able to roam all over the screen or they might be restricted to a specific area in front of them, but ultimately the playfield is rendered as one big image.

4- Way Split Screen

Split screen games are more complex and form one of the standards for the Da Vinci Gaming System so that they are all handled the same way and the players come to know what to expect from a multiplayer experience.

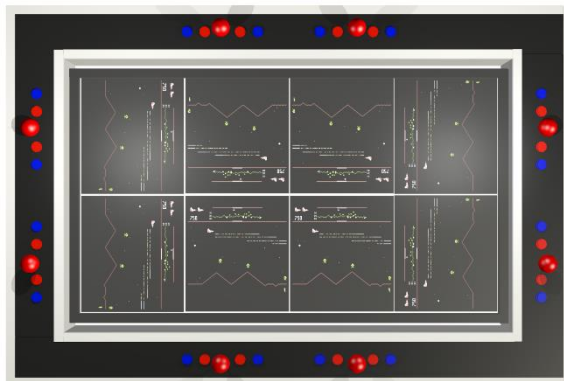
The first split layout is a 4-way split, which allows four teams of two players, with each team sharing a side by side view of the action.



8-Way Split Screen

The 8-Way Split Screen gives each player their own individual view of the action. With both the 4-way and 8-way split screen views, inactive screen space (due to missing players) is re-assigned to existing players to increase their screen size.

Although a standard Da Vinci table has spots for eight players, there is nothing to stop you building a table for fewer players. The split screen logic will assign the unused space as required.





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The reason we can make the system work with a wide variety of layouts is that internally we split the single screen into 8 separate view screens that can be grouped together to provide each user with a view.

First the table is split into four “Play Areas” which account for the four sides of the table.

There can be none, one or two players in each Play Area. If any player is active in a Play Area then the appropriate available screens will be assigned to that Play Area.

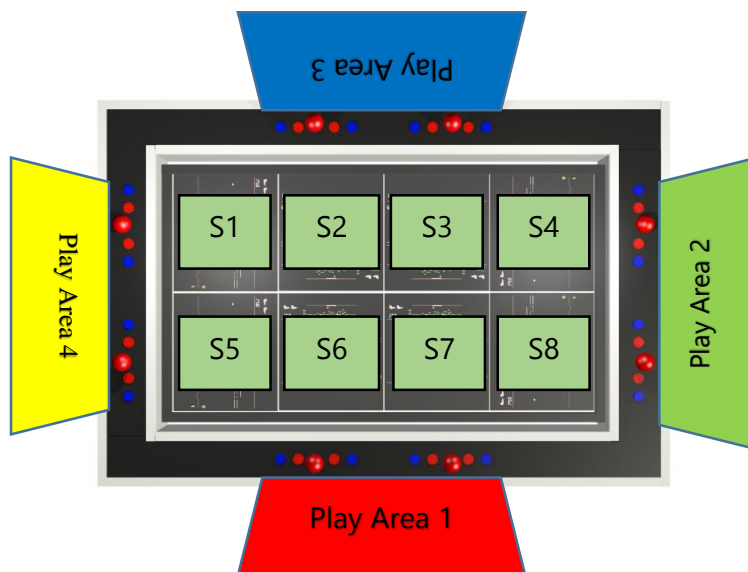
For some games the screens will be shared between the two players, in other games if two players are present then they will get individual screens.

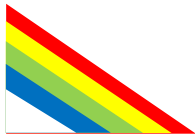
This means that a single player will get the full screen to play on. When a second player joins the screen may be split into two halves. As more players join the screen will become sub-divided to provide each player with their own piece of the play field.

The free developer kit has examples of this code in action and the logic is described in detail in Section 5 – Game programming.

The official Da Vinci Gaming System specification supports two resolutions, 1080p (which is 1920x1080 pixels) and 4K (3840x2160 pixels) and games will be tested at these resolutions. However people may decide to use TVs with other resolutions so any games written for the software should be able to adapt to any resolution.

It should be noted that a typical 1980s arcade game has a resolution of 224x228 pixels, so even if we split a 1080p screen into eight, each player would get a 480x540 play area (5 times the resolution) and on a 4K screen this increases to 960x1080.



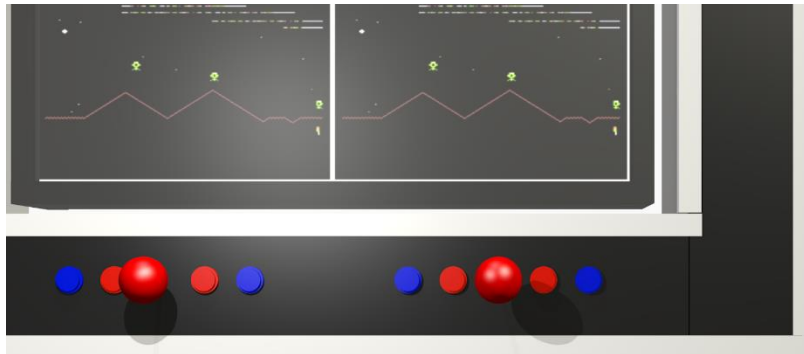


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Standard Player Controls

Each of the eight players gets an 8-way arcade digital joystick and two fire buttons. The 8-way joystick has four switches in it (Up, Down, Left and Right) with the diagonals being registered when two switches are pressed at the same time.

The standard layout for each game pad is to have the 8-way joystick in the middle and then two pairs of fire buttons which are duplicated on the left and right, one set for left handed players and the other set for right hand players.



Design Considerations

We foresee three different types of Da Vinci Gaming Systems

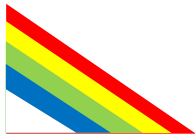
Hospital/Waiting Rooms/Family Shelters

Hotel/Bar/Restaurant/Coffee Shop

Home use

Of course, we're sure there are plenty of other scenarios, but feel free to adapt the guidelines in these documents to your particular intended use.

Each of these locations has specific design requirements that need to be taken into account, such as stability and access to moving parts. These are covered in depth in Section 2 – Cabinet Design.



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Game Ideas

Here are some ideas for games that could be rebooted for eight players on the Da Vinci Gaming System.

Some things to consider when designing 8 player games.

It's usually best to avoid situations where players get knocked out of the game and are left waiting for other players to finish.

The screen can get very busy. If players can roam all over the screen consider drawing a thin line from their controller to their character on the screen to help them find their location.

Is there an opportunity for players to form teams/alliances or maybe they are all on the same side fighting a greater evil?

Pacman

A huge screen map with all 8 players running around chomping dots. Each player gets 3 lives, once their lives are up they become a ghost and can chase down the remaining players.

Combat – Tank

The classic tank game from the Atari VCS days. Each player controls a tank in a large top down maze. Points are awarded for shooting the other players.

Combat – Dogfight

One big play area, showing a top down view of a bi-plane dogfight. Shadow on the ground shows the relative height of each plane, so can swoop and climb. Upgrades can be picked up for more power or better guns for a few seconds.

Tower Defense

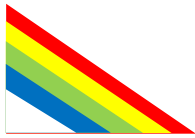
Each player is responsible for buying and placing defense components within their area of the play area. Enemies march out and around a pre-set path to a central goal. More players spawn more enemy units.

Defender

Each player gets their own screen, though all eight players are in the same game world and can see each other if they get close enough. Players are co-operating to stop the humans from being abducted. Game is over for everyone when the last human is gone.

Frogger

Each player tries to get the most number of frogs from their base into the island in the middle of the screen within a time limit.



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BattleZone

The screen is split into eight independent views, and players drive their tanks around the game world attempting to get shots on other players. When your tank is destroyed you re-spawn back at your base. At the end of a specified time the player with the most points wins.

Space Invaders/Galaxians/Galaga

It may sound old, but a team defense against the invaders could be made pretty awesome with a bit of imagination.

Gauntlet

This would be a lot of work, but an eight player version of gauntlet is just what the world has been waiting for.

Platform

Splitting the screen into four and having teams of one or two players each working together for a common goal or as opposing teams. There are so many genres to choose from Spy vs Spy, Elevator Action, Black Dragon and Gyzor spring to mind.

Racing Boat/Plane/Car

Top down central race track with small local screens in-front of each player as they race around courses.

Beach Head

Players must use their fixed gun emplacements to fend off enemy invaders.

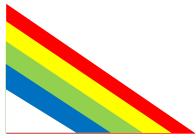
Asteroids

Players must defend their local area of the screen as the asteroids drift across the game area.



Our approach (writing new games for our newly designed arcade machine) avoids any legal issues with ownership of rights and code. This allows us to give the software and design specifications away freely. In order to keep on the right side of the original copyright owners we will also have to respect trade names and existing art work. So when you are designing your new games please do not re-use graphics or audio that you do not own the rights to.

The program and designs are free. That means it can be used at home, in hospitals, doctors waiting rooms, bars, coffee shops, restaurants etc.



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And finally.....The Agamemnon Project

When coming up with the design for the Da Vinci Gaming System it was very tempting to add just one more hardware feature or extra buttons. However we wanted to create an entry level system that was cheap to build and simple enough for children to not be daunted by it. Even simple design decisions such as a third fire button were heavily analysed and ultimately rejected.

In the end we came up with a compromise. The basic Da Vinci Gaming System is the standard that will be used for the time being. However we will also release designs for the Agamemnon Gaming System which is a backwards compatible arcade cabinet with substantially more features (and more cost). All Da Vinci Games will run on the Agamemnon, but designers wishing to utilise the more advanced hardware will have a standard platform to work to.

The main differences with the Agamemnon are listed below.

Players have analog joysticks instead of digital ones. This allows players in sports games such as Hockey, Football or even Speedball to fire the ball at any angle. Flight combat simulators become more viable and even platformers get significantly more controllable.

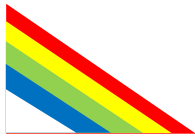
Each player has a private Raspberry Pi driven 5" screen which cannot be seen by the other players. This allows information such as scan data, playing cards or resources to be displayed privately to the player.

More buttons for each player, some dedicated to the 5" screen allowing players to step through menu options (maybe raising shields on their starship, or arming torpedoes) without the others being able to see what they are up to.

The standard screen resolution is 4K (3840x2160 pixels)

Players can identify themselves on the machine by plugging in a USB memory stick or phone which will automatically register their name (for the high score table) and allow them earn rewards on certain games (upgraded ship capabilities, more powerful spells etc.)

Cabinets will be permanently connected to the Internet and will be able to access game servers for online gaming against other teams.



Section 2 – Cabinet Design

Design Considerations

We foresee three different types of Da Vinci Gaming Systems

Hospital/Children/Disabled Access

Hotel/Bar/Restaurant

Home use

Of course, we're sure there are plenty of other scenarios, but feel free to adapt the following advice to your particular intended use.

Hospital/Children/Disabled Access

This is the design where you have to be most careful. Assume that children will be crawling underneath and sticking their fingers into fans, pressing any buttons under there etc.

All fans should be covered with screw on covers and you should not be able to access any wiring or reset buttons without either a key or screwdriver. The lock does not need to be anything fancy, a simple padlock on a latch will usually suffice in keeping prying fingers out.

The Da Vinci Gaming System has the option of limiting the audio volume of the games, this should probably be set fairly low to save annoying other people.

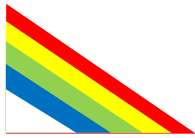
Test the stability of the system by having someone sit on each of the edges/corners of the system. This system should be almost impossible to topple over with normal force. This is easily accomplished by securely attaching the feet to a wooden base which is equal to the size of the top of the unit.

The screen should be covered by laminated glass. Laminated glass is two sheets of tempered glass (which breaks into dull pieces) with a layer of vinyl between them, so that in the event of a breakage the glass is all contained. The edges of the glass (and all sharp edges) should be protected by wood or plastic to prevent injuries if someone trips and hits their head on the unit.

The design of the system should be such that a drink spilled on the glass or control panels drains down to the floor (and not onto the screen or the electronics). This is easily achieved with careful placement of the electronics within the unit and by drilling drainage holes at appropriate points.

If you have any stick on labels they will be peeled off. Instead consider covering any labels with a screw on plexiglass cover or even have the labels made out of metal or plastic and screwed on.

The optional RJ-45 external controller port should be fitted to each of the arcade panels to allow people with disabilities to connect their own controllers and join the fun.



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Surfaces for Hospitals should be no-porous to resist cross contamination and will be wiped down regularly with disinfectant. Because of this unvarnished wood is not suitable, though plastic coated wood or heavily varnished wood should both work fine. Also wood and metal are very acceptable.

It might be worth giving some thought to making the play area (controls and screens) height adjustable. There are a number of commercial height adjustable tables that can be purchased without the table top. These could be used to adjust the height of the table to accommodate people in wheel chairs. If you do make a height adjustable table, ensure that the height can only be adjusted by an adult (by locking the controls inside the cabinet or removing the manual winding handle). This is to prevent children becoming trapped underneath the table.

Most computers have the option for the display to be mirrored to a second monitor. It might be useful to make this second port available so that a second monitor can be plugged into it. This provides another avenue for people in wheelchairs who might not be able to come in close enough to the table.

The ability to pause and exit the game should be restricted to only one player. Experience has shown that some children with learning difficulties have difficulty judging appropriate behaviour and constantly resetting a game that doesn't go their way will quickly drive the other children away and cause resentment.

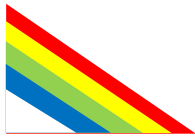
When choosing which games to install it is probably best to stick to games that are approved for under 15 years old. No matter what your personal views on violence in video games are, you must remember that this is for all children to enjoy and some parents may not wish to expose their children to the more violent video games which are really intended for a more adult audience.

Hotel/Bar/Restaurant

Many of the same considerations for the hospital apply to any machine that is to be installed in a public place. i.e. Laminated glass, un-tippable design, spill protection. One of the things I would recommend though is installing drinks holders at each station. This might seem like a horrifying thought, but face facts, people are going to rest their drinks on the table as they play. By giving them a drink holder that is deep enough to hold their pint glass stable when they bang into it you will probably avoid the vast majority of potential spills.

Just make sure the drinks holders can be removed for cleaning, or drain through to the floor.

Most laminated glass has a high heat resistance, however you should check that the glass you are using is able to withstand at least 100°C. It is worth remembering that in a restaurant hot plates may be placed directly onto the table. While this should be discouraged for other reasons, if it does happen you want to be confident that the glass will not shatter.



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Home Use

When designing a Da Vinci Gaming System for your home media room you can be a lot more relaxed on a lot of the guidelines such as exposed low voltage wiring etc. I would still recommend making the design tip resistant and using the laminated glass surface though.

Also, all high voltage circuits (in the TV for example) should still remain inaccessible without a key or screwdriver.

I would probably put a beefier sound system into a home based unit as well, because annoying other patients/patrons isn't so much of a concern.

The adjustable table height would also work well in the home scenario as the system can be used as a sit down table or bar depending on the required height.

Sit or Stand (or both)

When coming up with a cabinet design, the first fundamental question is: Will your players be sitting or standing?

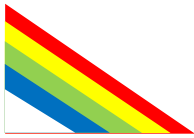
For home use or bar use a standing position might work well as the whole cabinet can double as a bar table. A standard bar table is 36" tall, which is a comfortable standing height and can also be used with a bar stool (if you leave enough room underneath). Standing tables are easier to make as you do not have to worry so much about leg room and can put the computer in a central pedestal. However for Hospitals, standing cabinets are not wheel chair accessible and many children will be unable to sit on the bar stools unsupervised.

Making a sit down table requires a bit more work as the computer and electronics can interfere with each player's leg room. I would recommend at least 28" of height between the bottom of the table and the ground to allow for wheel chair access and for no obstructions for at least 19" under the desk. If a cabinet is to be wheel chair accessible, then the top of the cabinet (the table top) cannot be more than 34" off the ground.

A more flexible approach can be achieved by using the legs off of a "sit-stand" height adjustable desk. These desks allow the operator to adjust the height of their desk between sitting and standing positions. The legs for these desks are purchasable from many office supply chains without buying the desk top. These would make an excellent base for a Da Vinci cabinet. They come in motorised and manual versions. Although the motorised one is cooler, it might present a danger to small children if the adjustment control is easily accessible. Therefore the manually adjustable version might be a better fit for hospitals and restaurants, where the crank handle used to adjust the height can be removed and held by a responsible adult.

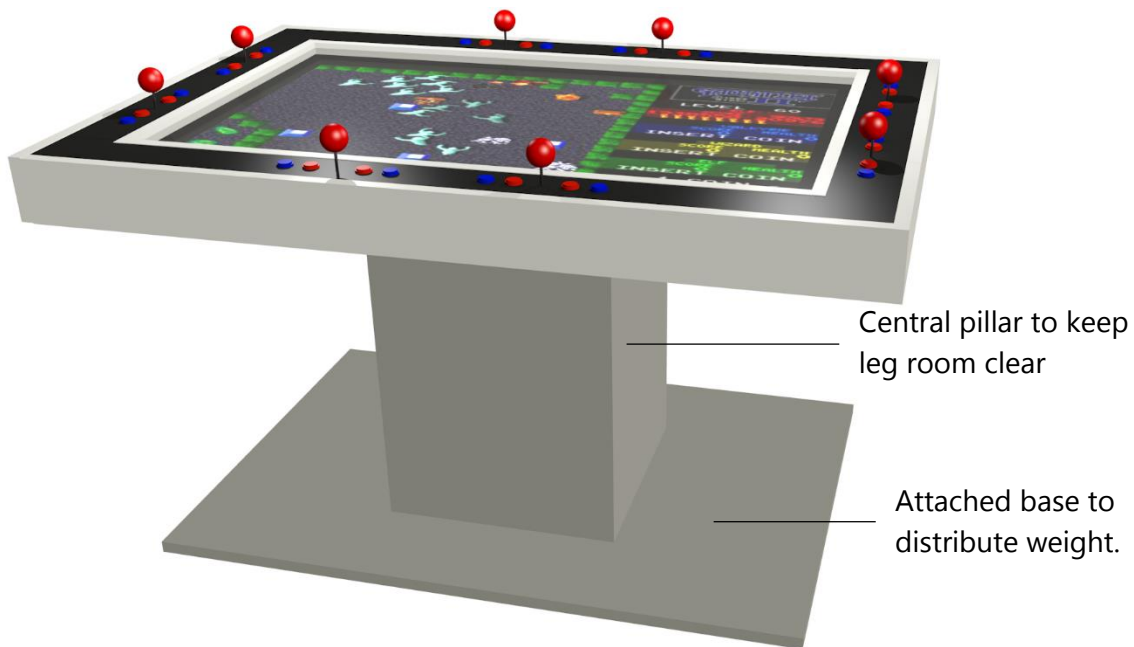
Stability

Regardless of which style you go for, remember to ensure that the cabinet design needs to be very stable and does not topple when an adult sits on any of the edges or corners.

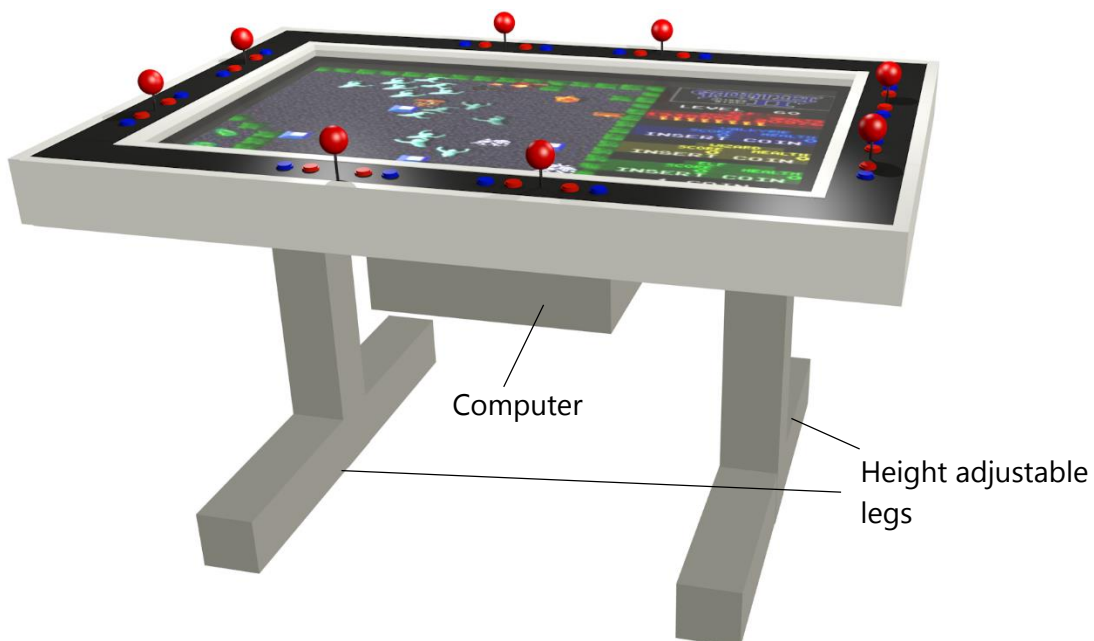


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The easiest way to achieve this stability is to put a leg in each corner (like a traditional dining table), however these will become awkward for the players seated at the short ends of the cabinet (restricted leg room). One possible way around this is to use a central pillar to support the table, then attach a large base (as large as the table top) to distribute the weight.



This design gives all players ample leg room. And allows the computer to be housed in the central pillar. If the unit is to be wheel chair accessible though, care will have to be taken that the thickness of the base does not make it too awkward to place a wheel chair on top of it.





THE DA VINCI GAMING SYSTEM

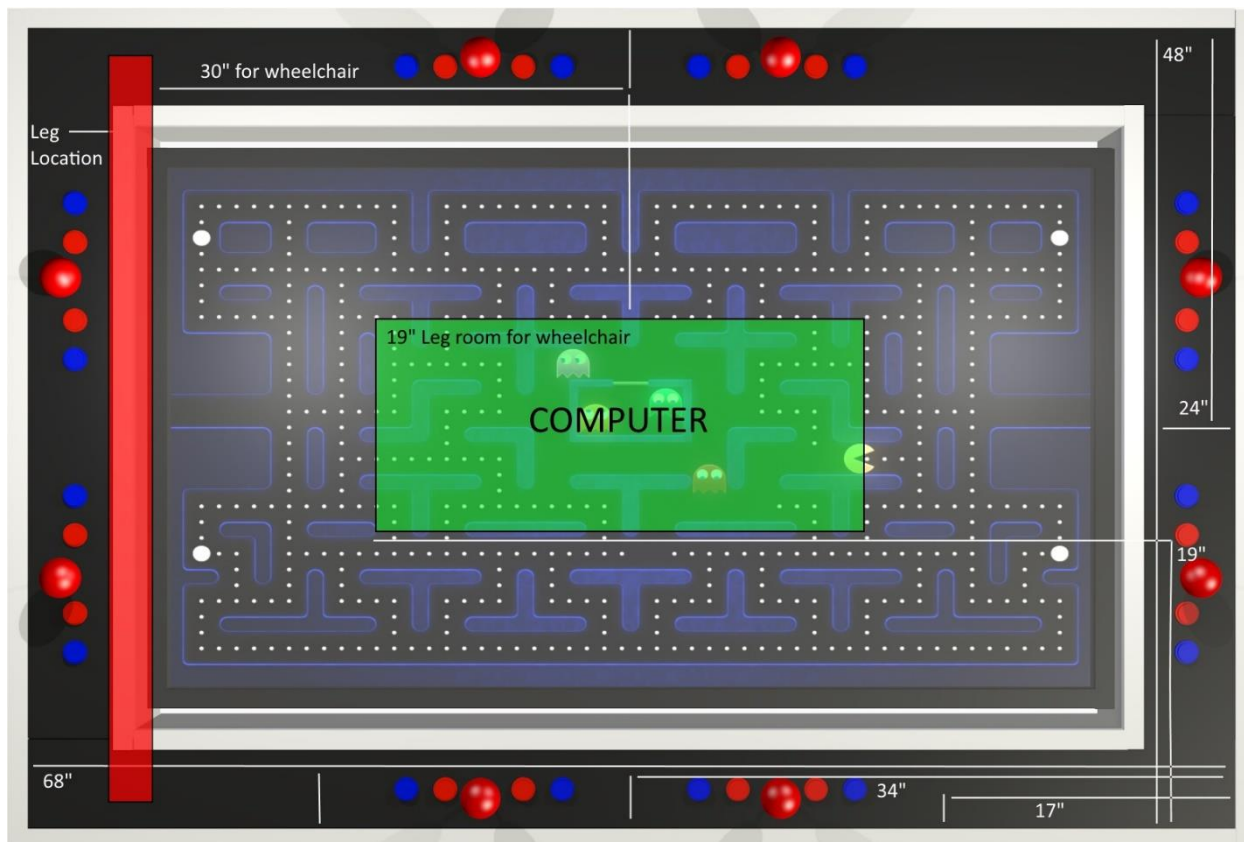
If you do opt to use a height adjustable table (as shown above), these have single central pillars at each end of the mechanism which does free up a lot of leg-room and would allow easy wheel chair accessibility to the four player controls on the long sides of the table, but might be slightly restrictive on the short sides.

As can be seen from the above diagram, space will have to be reserved underneath the table for the computer.

As a rule of thumb, each wheelchair needs 30" of width and 19" of leg room.

If we use an average 55" display and we have a 9" deep control panel around the outside, this would give us an approximate table size of 68"x48" (including TV Bezel). If we space the height adjustable legs 60" apart, this would give us excellent stability and provide enough width for two wheelchairs side by side on the long edges (for a total of 4 wheelchair accessible positions).

In the diagram below, the red rectangle represents the approximate location of the left leg.



The computer (represented by the green rectangle above) would still have to be suspended underneath, but with a 48" deep table, the computer could be up to 10" deep and still have 19" of leg room on either side for the wheelchairs.



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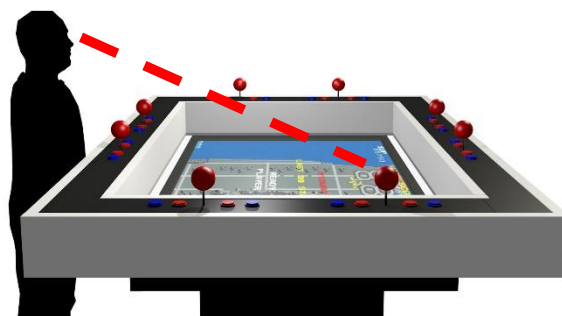
Player Viewing Angle

Full screen games have all players sharing a top down view of the entire playing field. Games such as pong, pacman, gauntlet, tower defense etc. all fit into this category. Players might be able to roam all over the screen or they might be restricted to a specific area in front of them, but ultimately the playfield is rendered as one big image.

So for any particular player's sitting or standing position they need to be able to see the entire TV screen. With some TVs, viewing them from shallow angles distorts or obscures the display. To get around this the TV can be mounted lower down in the cabinet so that players are looking down from higher up, producing a sharper angle. This is easier to do with a standing cabinet as you do not need to worry about the leg room underneath. With a sit down table your tolerances are a lot lower as you need a minimum amount of leg room height under the table (at least 26", 28" if you want to be wheelchair accessible).



Shallow angle is harder to see



Mounting the TV lower makes for a steeper, better viewing angle

For standing cabinets mounting the controls too low down might become uncomfortable, so one option is to mount the controls at hand height and recess the TV down a few inches as shown in the right hand picture above.

I would advise purchasing the TV you intend to use first before designing the cabinet. This will give you an opportunity to experiment with different viewing angles.

Player Location

The second type of Da Vinci Game (after the full screen games) is split screen games where the display is either split into 4 (with up to two side by side players sharing each section) or into eight separate screens. Although a standard Da Vinci table has spots for eight players, there is nothing to stop you building a table for fewer players.

The reason we can make the system work with a wide variety of layouts is that internally we split the single screen into 8 separate view screens that can be grouped together to provide each user with a view of their section of the screen.

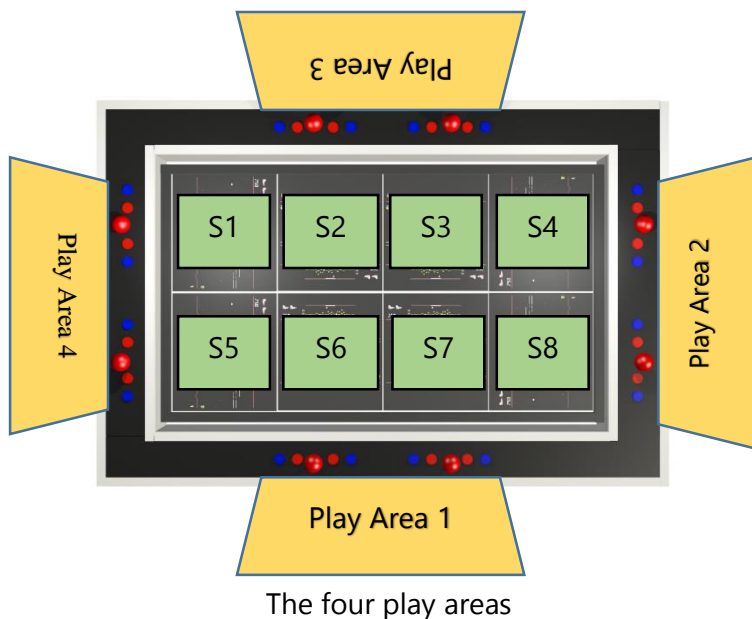


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Regardless of which layout you choose, the screen will still be internally dissected into 8 sections, so player control pads should still be situated physically in-front of “their” section of the screen. See the diagrams below.

In the rest of this document we will concentrate on the design of the eight-player variant (which is the most functional) but most of it will be applicable to variants with fewer players.

Before you commit to your final player locations it might be worthwhile to run a few Da Vinci games in different modes on your TV to confirm that you are comfortable with their location.



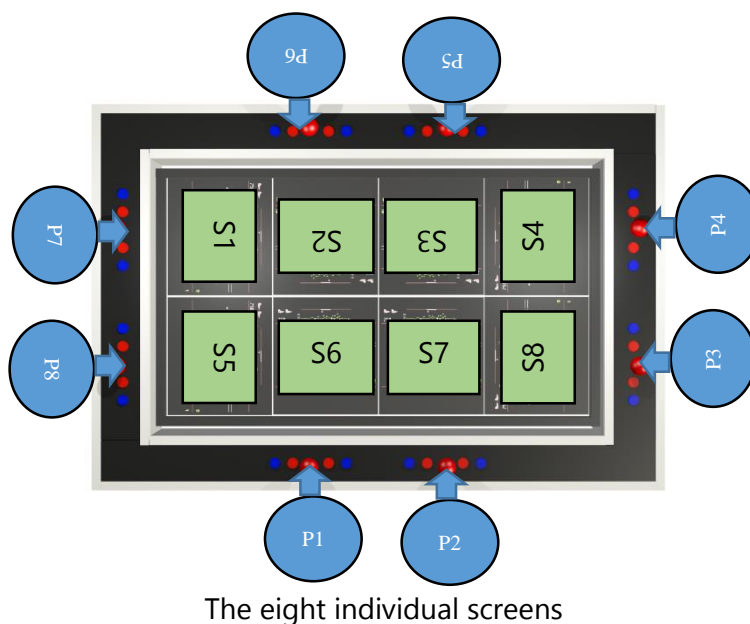
As can be seen from the Player Positions diagram to the left, players are grouped together in pairs on each side of the screen.

These areas are called “Play Areas” and are used to decide how the screen should be split up in split screen games.

When constructing the cabinet it might be neater and easier to build four separate control panels (one for each Play Area) with two players on each rather than eight separate panels.

The diagram on the right shows how each section of the screen is rotated in split screen games to suit the player position.

If there are less than eight players, then each section of un-used screen space will be assigned to one of the players to expand their view. This is covered in more depth in Section 5 – Game Programming.





THE DA VINCI GAMING SYSTEM

Control Panel Layout

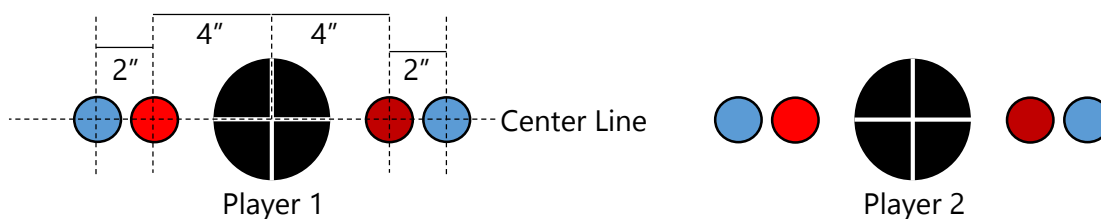
Each player has a joystick with two fire buttons on each side (Fire 1 and Fire 2 doubled up for left or right handed people).

The joystick is at the center of each players control panel, and should be positioned so that is directly below the mid-point of their section of screen. What this means in practicality is that for the players on the long edge (Players 1, 2, 5 and 6) their joysticks should be positioned at the 37.5 % point of the length of the screen, and the 62.5% position.

For the short edge players (Players 3, 4, 7 and 8) their joysticks should be positioned at the 25% point and 75% point of the length of the short edge of the screen.

A bitmap image is available which when displayed on your TV will show the center point of each players joystick.

The standard layout and colour scheme (red for fire 1 and blue for fire 2) should be adhered to if possible so that on-screen instructions will match the button colours and positions.



The standard button spacing for a Da Vinci Gaming System is 4" from the center of the joystick to the center of the red Fire 1 button. The 2" between the center of the red Fire 1 button and the center of the blue Fire 2 button. These distances have been researched and are a comfortable distance apart for children and adults alike.

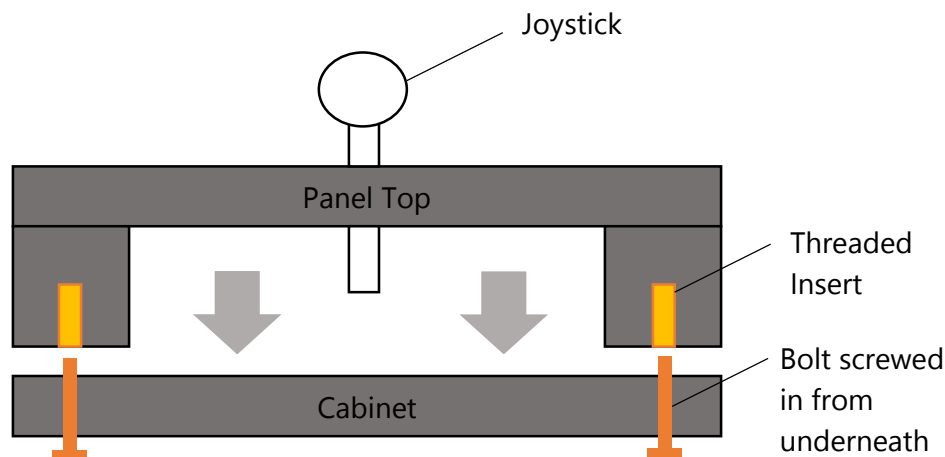
Speaking from experience, there may come a time when one of these panels needs to be repaired due to a broken wire/button/joystick, therefore your life is going to be a lot easier if you design these panels to be removable.

However, if you are designing for a hospital or commercial area you also do not want to make the panels too easy to remove, otherwise children (and adults) may open them up. If you use screws to keep your panels closed, repeated unscrewing will strip the threads out of the wood and the panel will become loose. To avoid this I recommend using metal threaded inserts in the mounting panel, so that the bolts screw into these, rather than bare wood.

This will allow the panels to be removed many times without loosening the threads. The only downside with this is that you might be left with exposed bolt or screw heads. To mitigate this I recommend putting the threaded inserts into the bottom of the panel and screwing/bolting it in from underneath. This will leave the tops of the panel smooth.



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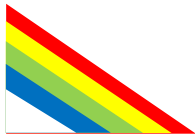
Choosing a screen size

Normally I am a huge proponent of bigger is better, however in this case this may not be true. While fitting a larger screen to the unit may create more play space, it makes it harder for people on one side of the screen to see action at the other end. This can be mitigated somewhat by lowering the play area. The lower down the screen, the better the viewing angle everyone will have.

Another concern is that most TV's are designed to be mounted vertically on a wall with all of the weight hanging straight down. When you mount the TV flat facing upwards the center of the screen is now unsupported. On larger screens this may cause sag or even cracking. If you are concerned about this, then it can be mitigated with a bit of careful engineering by taking the back off the unit and inserting bracing behind the screen to help it support the weight. Remember there are high voltages in the back of the TV, so be careful if you decide to work back there and make sure that it is not accessible when the unit is finished.

The table below shows what height and width of playfield we would get from the various sizes of television.

Screen Size (Diagonal)	Long Edge	Short Edge
55"	48"	27"
60"	52.5"	29.5"
65"	57"	32"
70"	61"	34.5"
75"	65.5"	37"
80"	70"	39.5"



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Even the short edge of a 55" screen is wide enough for two players - Remember, side by side arcade machines of the 80's often only had 17" monitors. Even Gauntlet which had one of the largest for 4 players, was only 19" diagonally, so two people sharing a 27" x 12" display would be the equivalent of a 29" arcade display.

For these reasons we are going to be using a 55" screen for the prototype, but feel free to use whatever size you want – remember it's the resolution (1080p or 4K) that is important for it to meet the Da Vinci Gaming System specification.

All Da Vinci Games will be tested at both officially supported resolutions, 1080p (which is 1920x1080 pixels) and 4K (3840x2160 pixels). In theory if the games have been written correctly they should still work at other resolutions but, these are the two most common supported standards.

Transporting the screen

Being able to separate the screen, control panels and stand into at least three separate components will make transporting and installing the unit significantly easier.

In addition, large LED TVs are not designed to support the weight of their own screens when they are transported flat. Therefore if you are planning on delivering your Da Vinci cabinet somewhere you absolutely must design it so that the screen can be removed and transported in the vertical position (to prevent it from cracking when you go over bumps or sudden jolts).

Being able to replace the screen is also important in case it fails.

Protective Glass

The TV screen is quite fragile. To protect it from spills and knocks a protective layer of laminated glass should be installed over the top of it. Laminated glass is two sheets of tempered glass (which breaks into non-sharp pieces if shattered) with a layer of vinyl between them, so that in the event of a breakage the glass is all contained (the same as a car windshield).

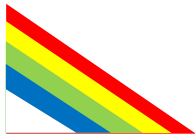
In addition, the edges of the glass (and all sharp edges) should be protected by wood or plastic to prevent injuries if someone trips and hits their head on the unit.

The design of the system should be such that a drink spilled on the glass or control panels drains down to the floor (and not onto the screen or the electronics). This is easily achieved with careful placement of the electronics within the unit and by drilling drainage holes at appropriate points.

Heat dissipation of the screen

A very important problem with mounting a screen flat facing upwards is that any heat generated from the display will be trapped between the screen and the protective glass cover.

Older TVs in particular generate a lot of heat and are not suitable at all for this type of application. Steer clear of any Plasma or LCD technology screens.



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LED TVs produce much less heat. They are basically the same technology as LCD TVs except that they use LED bulbs for back lighting. Of the LED TVs there are two different configurations available. Edge-Lit and Full Array TVs.

Edge-Lit LED TVs just have LEDs around the outside edge of the screen where as Full Array LED TVs have LEDs spread evenly behind the display. Full Array LEDs produce a better TV picture and cost more. Thankfully for our purposes we prefer the cheaper Edge-Lit LED screens. They produce less heat, and the slightly poorer colour accuracy is not a problem with arcade games.

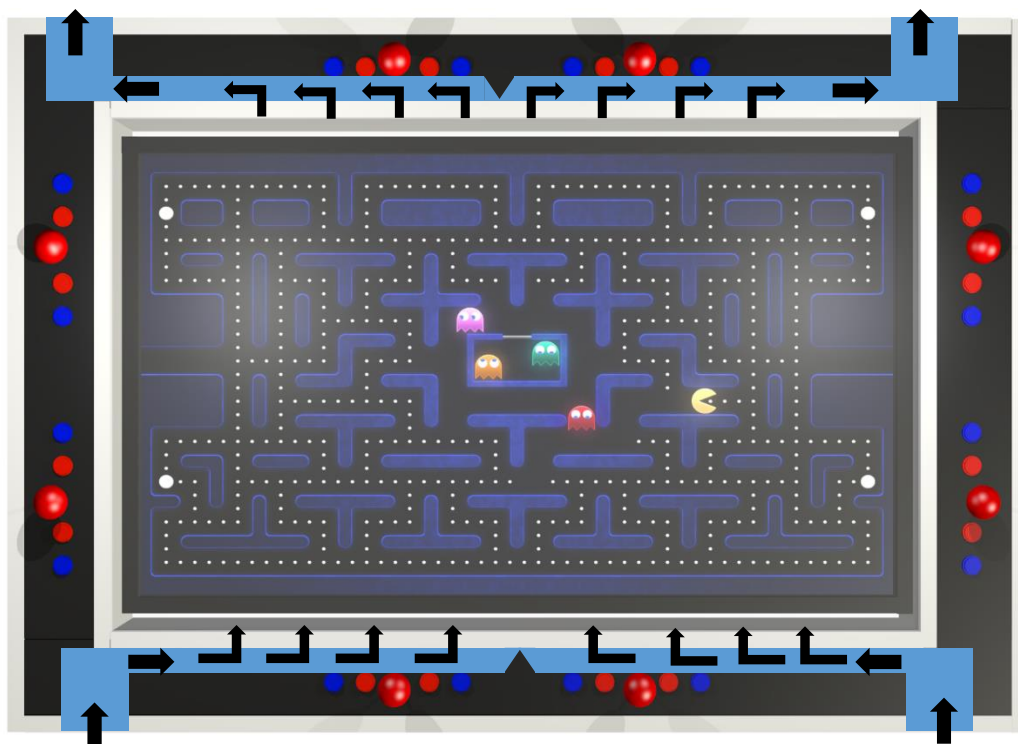
When a TV is mounted vertically on a wall it is designed so that natural convection will take in air from the bottom, and the heat will cause it to rise and exit from the top of the screen. By mounting the display flat we are interrupting this process. To prevent heat damage to the TV components it is advisable to fit two intake fans to your cabinet that blow air into the "bottom" of the flat TV and two extractor fans that suck the air out of the "top" of the flat TV. Remember to ensure that the exit fans are not blowing on to a player, as it might get uncomfortable for them. I recommend venting to the corners of the tables.

Suitable fans can be purchased from computer suppliers (or salvaged from old computers). In general, the larger the fan, the slower it needs to rotate to push the same amount of air as a smaller fan – this makes it significantly quieter. Personally I would aim for 120mmx120mm or larger fans.

The diagram below shows a suggested ducting system to suck ambient air in to the "bottom" edge of the TV and expel it out from the "top" edge. This design ensures that the warm air being expelled is not being blown directly on to any of the players.



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Note: Some fans come with built in LED lights which might be included in your design to provide ambiance.

Choosing and locating the computer

You have two obvious choices for the computer, a laptop or a desktop. The laptop will obviously take up much less space, but might be a little under powered for some of the games. If you have decided on a center pedestal design for the table, then there should be ample room in the base of the pedestal for a desktop computer as long as you remember to provide it with plenty of ventilation.

Otherwise you might have mount the computer centrally under the table. If you do this try to find a case that is small enough that it will not encroach on the leg room of the players.

It might be tempting to ignore the metal case and mount the computer components directly on to a sub board. This temptation should be avoided though, especially for computers destined for hospitals. The fully enclosed metal cases of the computer case provide a Radio Frequency (RF) shield for the whole computer which prevents it from interfering with other electronics (such as pacemakers).

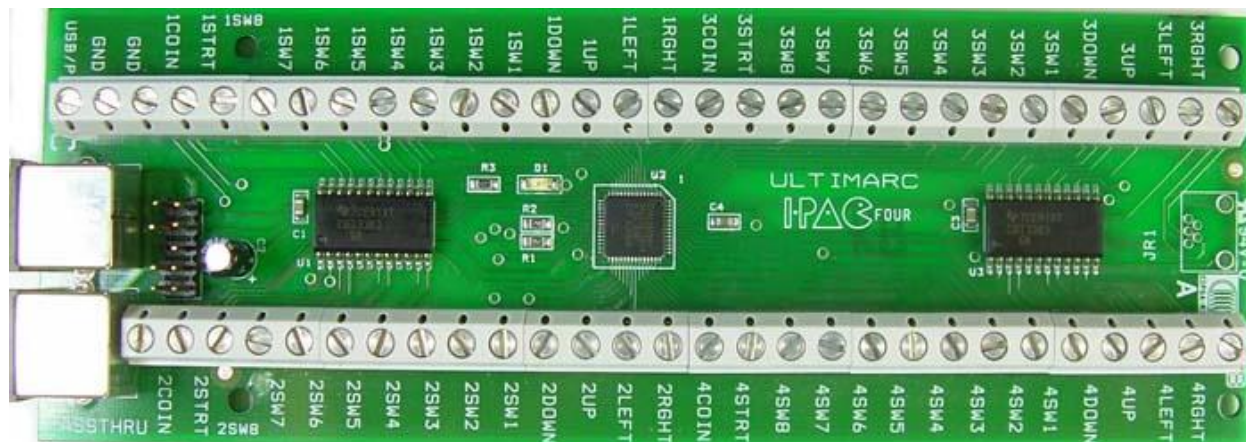


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Routing the wiring for each Player Control

We need to run 7 wires from each player control panel back to the computer. The actual wiring diagram is given in Section 3 – Building techniques and Wiring Diagrams.

A keyboard encoder (like the one below) is used to land all of the wires and then send the key-presses to the computer via a USB cable.



This means that for each of the eight control pads there will be seven wires coming back to the computer for a total of 56 wires running through your cabinet (not including power and other wiring).

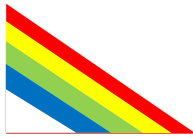
This would make troubleshooting a nightmare and also create a lot of internal mess. Therefore as part of the Da Vinci standard each game controller pad is wired to an RJ45 socket mounted on the same panel of wood as the joystick and fire buttons. RJ-45 sockets are the standard sockets used for home networking and can be purchased at almost all home hardware stores. The picture to the right shows an example.



This means that the 7 wires for each game panel wire directly into the back of each module. A standard Ethernet Cat-5/5e/6 cable is then plugged into it and ran through the inside of the cabinet to the keyboard encoder panel, where the other end of the cable is plugged into another RJ45 socket. This RJ45 socket at the keyboard encoder panel has individual wires connecting each pin out to the correct pin on the encoder.

This massively simplifies the internal wiring and trouble shooting. One of the large bonuses of this design is that if you wish to remove or replace a game pad, you can disconnect the Ethernet cable and the panel is completely de-wired from the system.

The same is true of the keyboard encoder. If there is a fault with the encoder, or one of the wires is loose, it is going to be difficult to repair it in situ. Therefore a sub-panel with the keyboard encoder and the eight RJ-45 sockets all mounted on it, can be removed as one piece just by disconnecting the 8 Ethernet cables and the one USB cable.



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Installing a replacement panel will be just as easy. It will certainly be easier than de-wiring, sorting and re-wiring 56 wires.

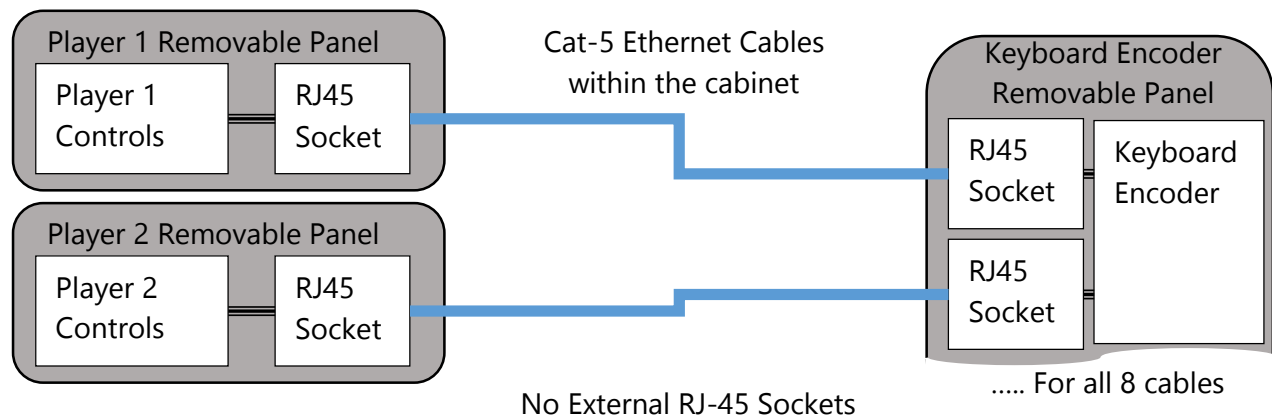
Part of the Da Vinci Gaming standard (covered in Section 3) is that the wiring of these sockets and connectors is standard between all cabinets. If you stick to the standard (including labeling each of the wires and cables as specified) it should be easy for any technician armed with the wiring diagrams to trouble shoot your system.

It also means that people can develop new controllers (possibly for people with disabilities) that can plug into this standard RJ-45 connector.

Note: For hospital use, each arcade control panel should have two RJ-45 connectors which are wired together in parallel. One internally for running the cable back to the keyboard encoder and another that the player can plug their own controller into. We refer to this one as the External RJ45 socket.

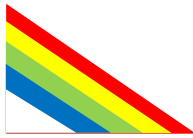
The following diagrams show a rough overview of three potential configurations. Don't worry if you do not understand them, they are described in more detail in Section 3. These overviews are simply provided here to get you thinking about how you will mount your external RJ45s (if any) and how you will run your Cat-5 cables back through the cabinet to the computer.

The first diagram does not have any external connectors and simply uses two RJ-45 sockets per panel.

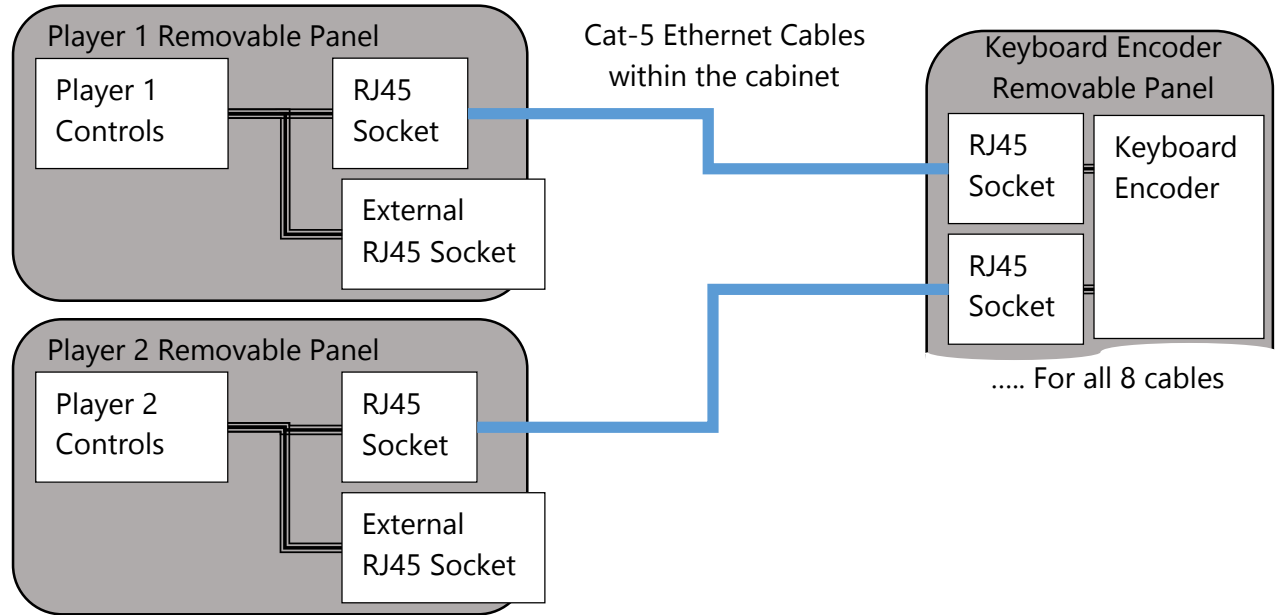


The second diagram has an External RJ45 connector mounted on the same removable panel as the controls – this still only requires one Ethernet cable to be disconnected when removing the panel. The external RJ45 is wired in parallel with the internal RJ45 connector.

The External socket can be mounted using a plate mount (like you would at a wall socket) or as a surface mount (as we are using for the internal connectors).

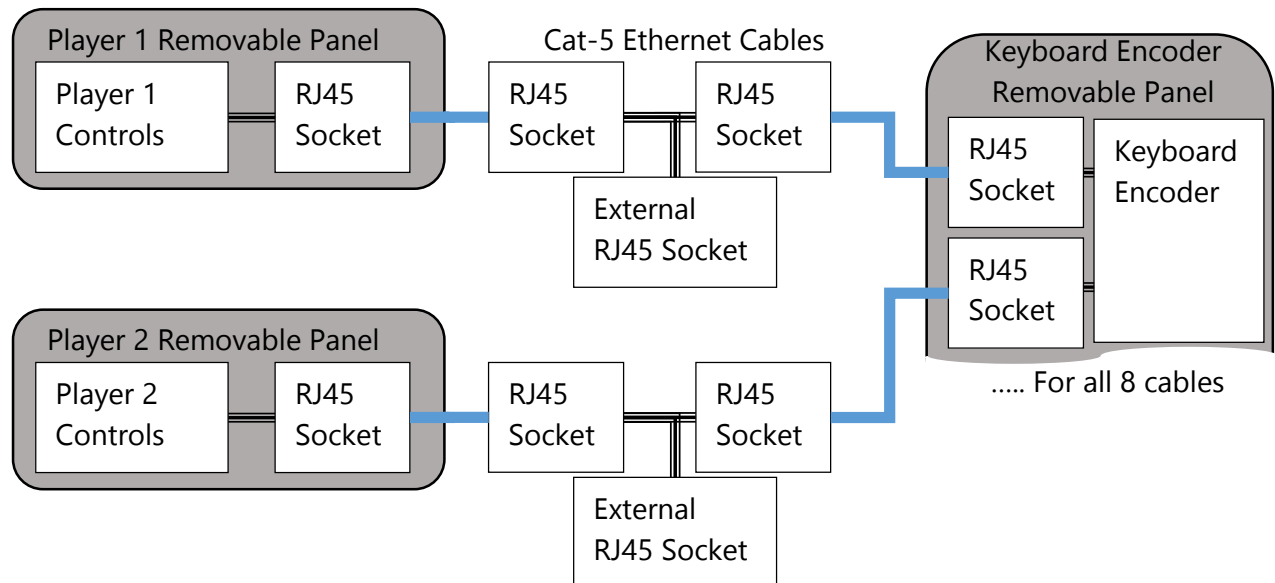


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External RJ-45 Socket mounted on removable panel

The third is slightly more complex. It has the external RJ-45 mounted near the controls (possibly underneath the table), but not attached to the removable part of the control panel (i.e. it is attached to the main cabinet body). We use five sockets for this setup to retain the ability to disconnect the control panel with only one RJ-45 connector.



Cabinet mounted External RJ-45 Sockets

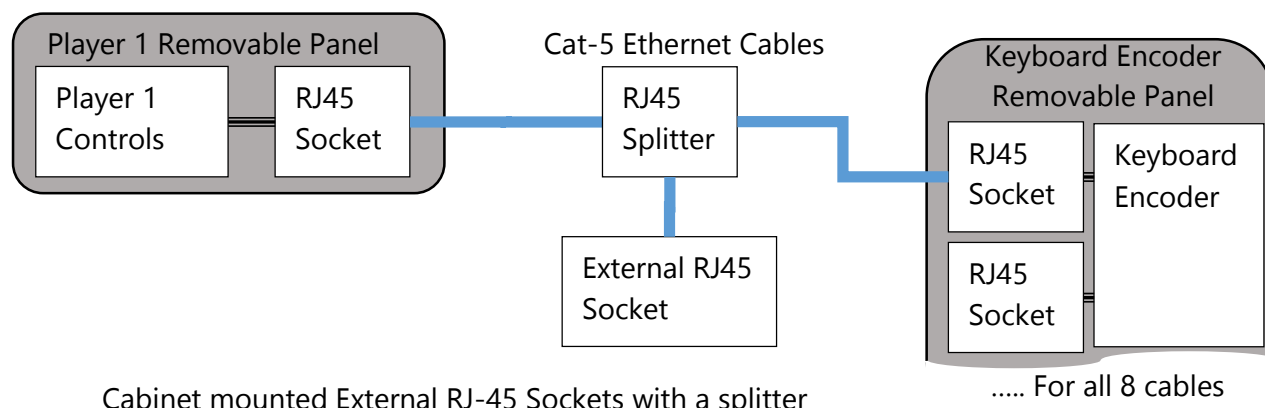


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In reality I wouldn't use the above design as is, because it can be greatly simplified by using an off the shelf RJ45 splitter. Now you have to be careful here, people use the term RJ45 splitter to also mean a splitter/combiner combo which allows two computers to share one Ethernet cable. That will not work for us. What we need is the much cheaper (about \$1.50) RJ45 splitter that is wired in parallel. See diagram to the right.



This replaces the cluster of three RJ45 sockets in the middle of each cable. You will need to use a slightly different type of External connector – one with an RJ45 socket at the front and the back (female to female or coupler). But if anything, this makes it easier to wire up.



Sound

The TV probably has speakers already built into it. These are probably fine for a hospital or commercial unit. The arcade sounds are not particularly high-fidelity and you don't want too much bass sound as this will carry and probably annoy other people. This also makes wiring easier as the sound is transmitted to the TV via the HDMI cable.

For a home setup however, I would recommend on purchasing a separate computer speaker system with as large a sub-woofer as you can find. This will make the explosions and thumps from your games sound a whole lot beefier. I wouldn't spend too much though unless you intend the table to double as a jukebox.

When purchasing your speakers look for ones that will be easy to mount and factor their location in to the design. If you have a central pedestal design, then a good location for the sub woofer would be at the bottom of the pedestal to prevent the unit from becoming top heavy.

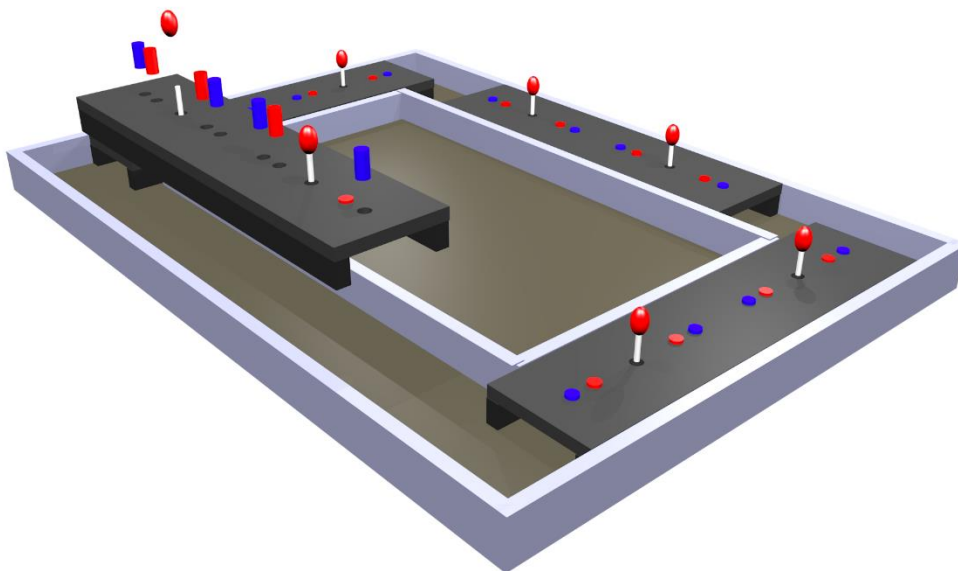
It will probably be desirable to have an externally mounted volume control for a home system as well. Many computer speakers have separate control panels that could be mounted directly on to your cabinet.



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Sketching up your plans

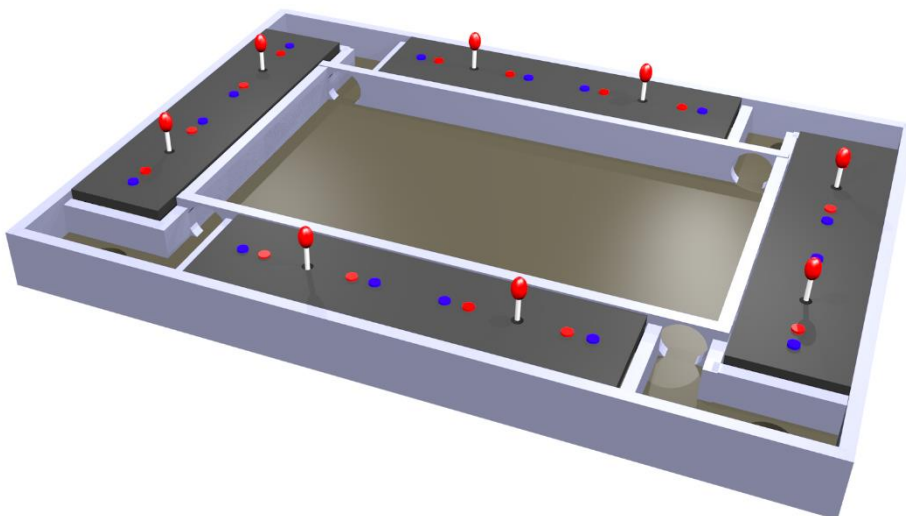
The diagram below shows an example layout with four removable control panels and space for a 55" TV in the middle. We will walk through my thought process in putting my design together. If you want to use this design, then plans are provided at the end of this document, but part of the fun is also in making up your own unique design.

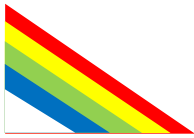


As you can see each control panel has been built as a separate unit that slots into the cabinet. The gaps on either side of the control panel will be covered over with permanently screwed down panels.

The only problem with the above design is that it doesn't have great structural integrity against bending and it does not have ducting for the heat dissipation. So we will alter it slightly.

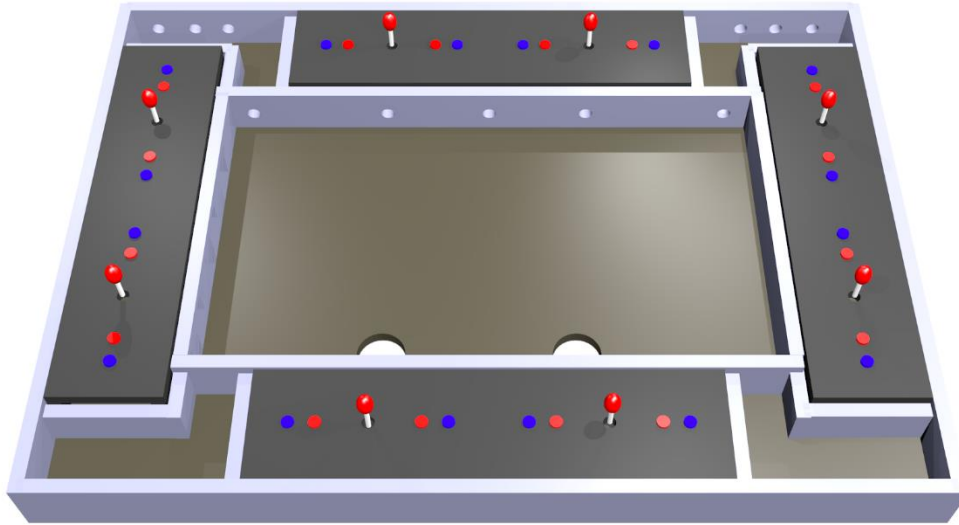
The image below shows a better structure, however the holes cut for the TV cooling have weakened some of the cross beams significantly.





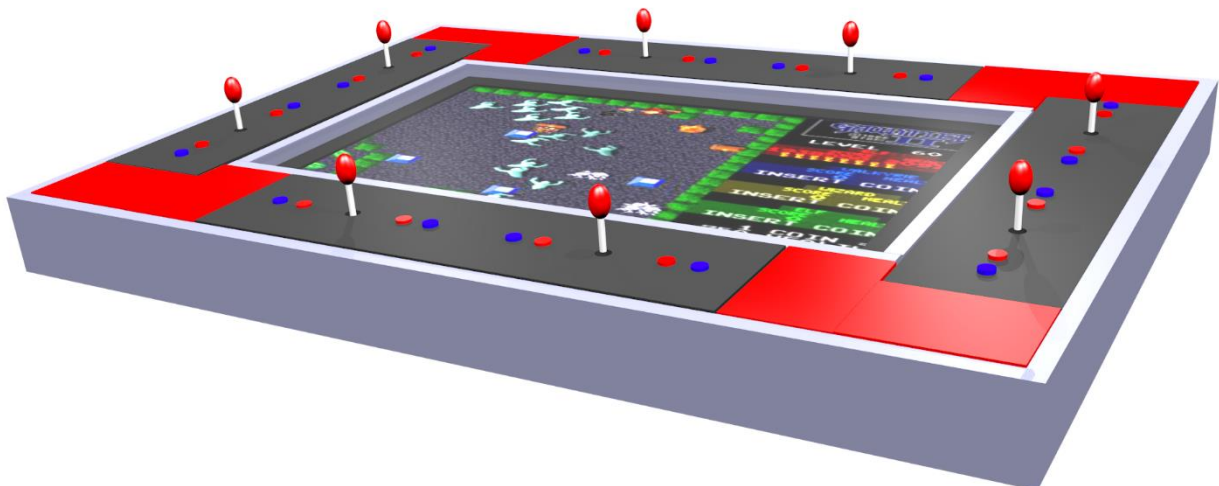
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The next design has replaced the large exhaust air holes with smaller holes. There are more of them to provide the same amount of air-flow, however because they are smaller they do not weaken the cross beams as much. In this design some of the warm is ducted underneath the player control panel.

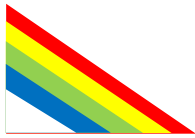


Also, the intake holes have been moved to suck air from directly underneath the cabinet. This design retains the structural integrity while venting the hot TV air away from the players.

All that remains is to install the TV and put the corner covers and protective glass on.



In the above picture the cover plates have been shown in red to highlight them, but in the final product I would probably make them black to match the control panels.



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Branding

Name Logo Use

The logo for the Da Vinci Gaming System is made using a font called Motorwerk. A .png file with a transparent background is available for use within your games and documents.

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All games that are written to run on a Da Vinci Table should use this logo in their start-up screen to show users what system they are using.

Feel free to use the logo on the art or a plaque on you Da Vinci Tables, but it is by no means required.

Rainbow Logo Use

The rainbow logo is a homage to the ZX Spectrum home computer logo from the 80's. It is used to bring some retro-colour to this project.

Its use is entirely optional.

Terminology

When referring to the entire project we refer to it as "The Da Vinci Project" or "The Da Vinci Gaming System".

When referring to a cabinet we call it the "Da Vinci Table" or "Da Vinci Cabinet"

When referring to the game program itself we call it a "Da Vinci Game"

Replacement Parts

Hopefully all of your components will continue to work for many years, however if a component does fail, your life is going to be a lot easier if you have pre-planned how to repair or replace it and built that into your design. Your cabinet design should factor this in and it should be reasonably easy to replace the following parts:

TV

Protective glass over TV

Sit-Stand mechanism (if installed)

Computer

iPac-4 Keyboard Encoder

Speakers

Each of the player game panels

Cooling fans



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Most of these items can be made to size, however getting the exact same size of replacement TV may not be feasible (different bezel size). For this reason the area of the cabinet which holds the TV should be designed with some spare at each end to accommodate a different model TV in the future.

What to buy and where

There are a number of vendors of arcade components on the web.

The two I usually favour are www.ultimarc.com and na.suzohapp.com

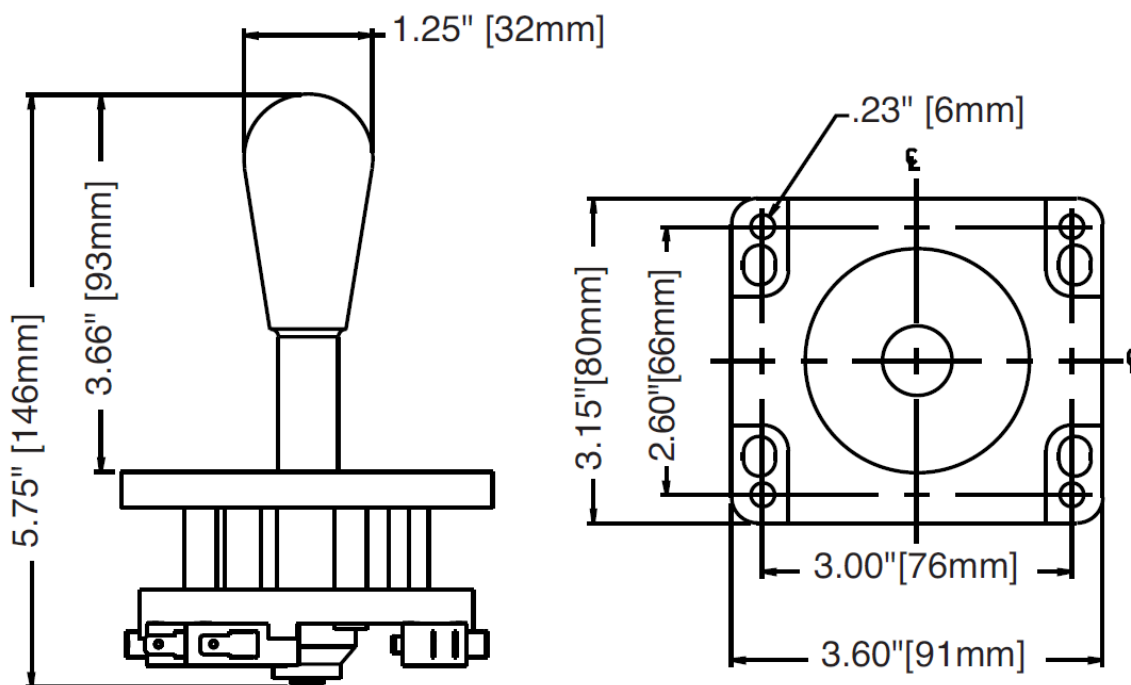
Keyboard Encoder

The i-Pac 4 is the recommended keyboard encoder. The reason the i-Pac 4 has been recommended is that the Da Vinci software has been deliberately mapped to its default key stroke setting to make setup and replacement easier, however any encoder that can be mapped to the correct keystrokes can be used.

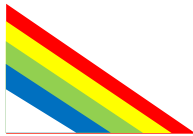
Joystick

The standard Da Vinci joystick is an 8-way micro-switch type. Be sure not to accidentally order 4-way joysticks as these will not work with the Da Vinci Gaming System.

The 8-Way Competition Joystick from Suzo-Happ is an excellent choice and can be purchased for about \$15 each at the time of writing.



One of the advantages of this joystick is that it can be fitted to a shallow panel with a depth of only 2 to 3".

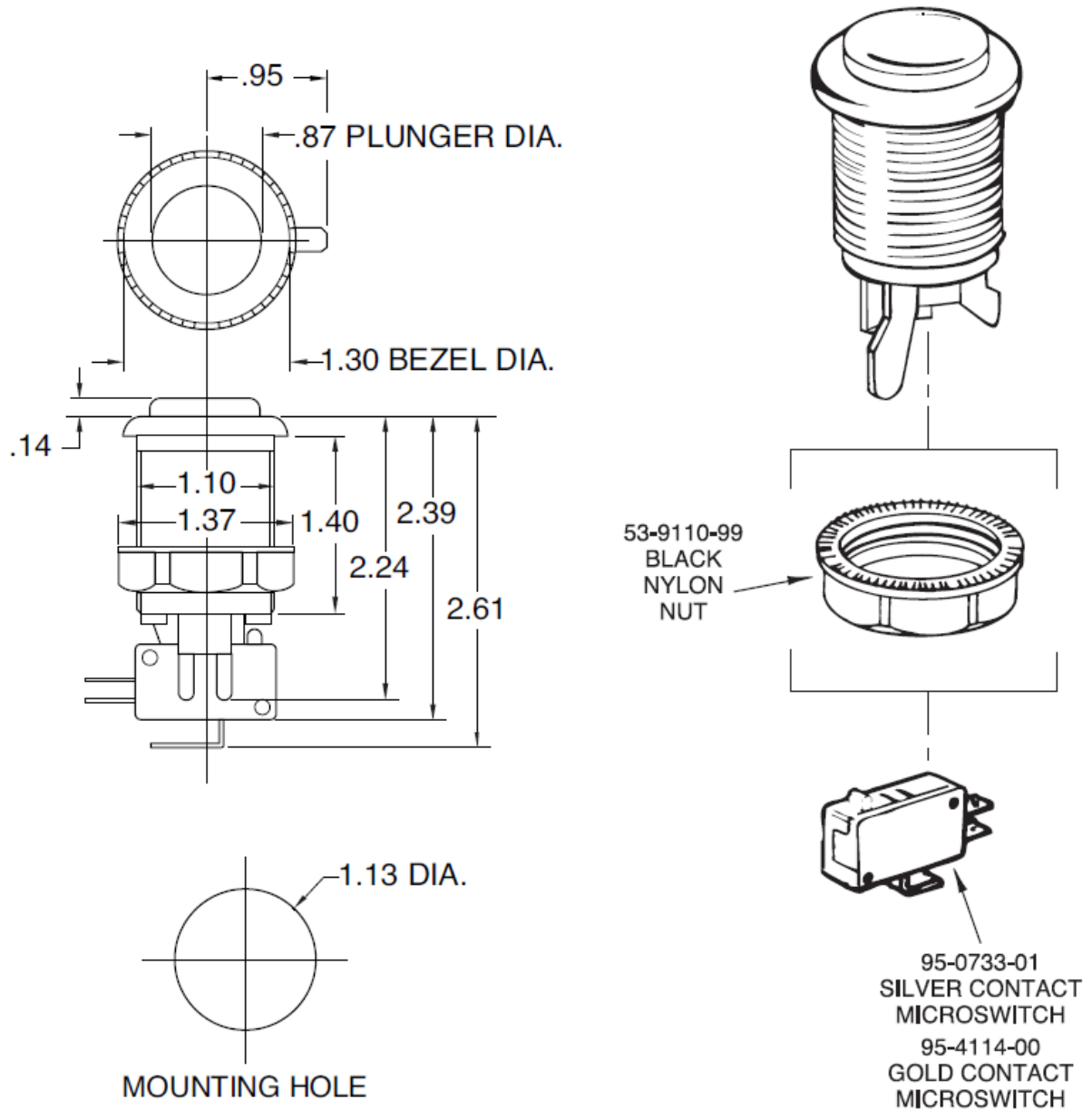


THE DA VINCI GAMING SYSTEM

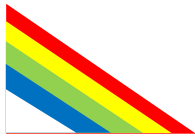
Pushbutton and Lighting

The recommended pushbutton for a Da Vinci Gaming System is the standard arcade pushbutton with horizontal microswitch (Part #58-9100-L (red) and #58-9122-L (Blue) from Suzo Happ).

This also has a shallow depth of about 2.5", allowing for thinner control panels.



At the time of writing, each of these buttons is about \$2.25 each. You will require 16 red ones and 16 blue ones for the finished cabinet.



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If you wish, there are also buttons that have internal LED lights for added effect. They are quite a bit more expensive and you will need a driver card (such as the PacLED64) but if you are interested a good choice is the Ultimarc Ultralux LED button. These have a shallow mounting depth and use internal LEDs to produce an unlimited colour range.

Note: Most other illuminated buttons use incandescent bulbs, which are cheaper, but draw more power, produce heat and burn out. Avoid incandescent bulb buttons.

These buttons are available from Ultimarc for about \$3.95 for a single colour or \$5.95 for variable RGB colour at the time of writing. If the variable RGB colour is used, then a matching PacLED64 driver card (price \$64) will also need to be purchased.



Section 3 – Building Techniques and Wiring Diagrams

Player Controls

Each of the eight players gets an 8-way arcade digital joystick and two fire buttons. The 8-way joystick has four switches in in (Up, Down, Left and Right) with the diagonals being registered when two buttons are pressed at the same time.

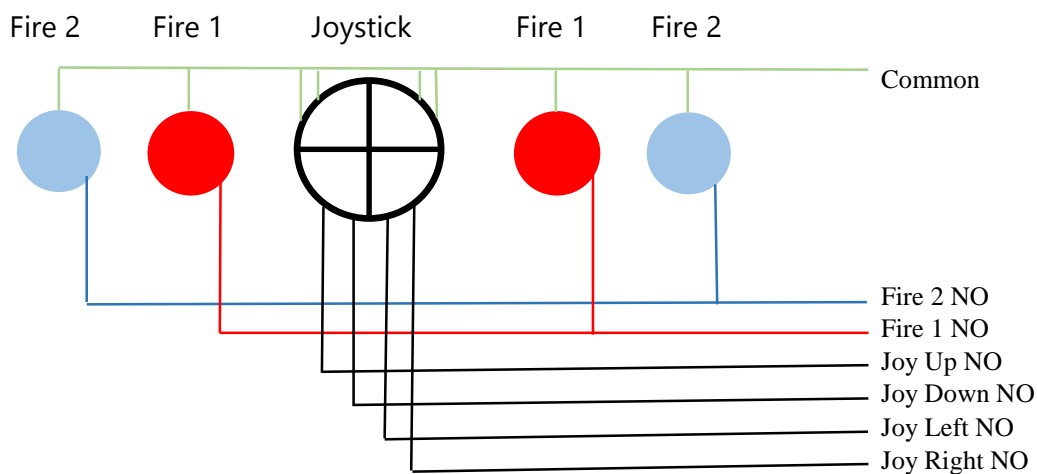
The standard layout for each game pad is to have the 8-way joystick in the middle and then two sets of two fire buttons which are wired together, one set for left handed players and the other set for right hand players.

It is also recommended that a flat surface of at least 9" wide by 8" high is left on either side of the control pad for the possible future introduction of mice based games.

Wiring up each Player Control

The layout and wiring is shown below:

Most arcade buttons and joysticks drive micro-switches that have three connections, Common, Normally Open and Normally Closed. When the button is not pressed, the circuit between Common and Normally Closed is made, and when the button is pressed the circuit is broken. For the Da Vinci System we will be using the Normally Open connections. When the button is not pressed, the circuit between the Common and Normally Open connection is broken. When the button is pressed the circuit between the Common and Normally Open terminal is made.



The common connection on each switch can all be wired together and brought back as one wire. This means that for each control pad there will be seven wires coming back to the computer where they will be connected to a keyboard encoder. This also means that if you use an 8-wire RJ-45 Ethernet connector, each player has a spare button connection. This is used on Player 1 to access the "Select" button, but is not wired up on the other players.



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A keyboard encoder takes closed/open circuits like the one we have created above and turns them into keyboard presses which are sent to the computer via a USB cable. The computer sees these inputs just as if the user has pressed a key. So in the above example, Up, Down, Left and Right might be mapped to keys A, B, C and D and Fire 1 and Fire 2 mapped to E and F. When the computer sees these keystrokes the software will move this player's ship appropriately.

We recommend using the 56 input iPac-4 keyboard encoder from Ultimarc. At the time of press this unit costs about \$65 USD, and can be daisy-chained with other boards to increase the number of inputs.



With 8 separate game pads there will be 56 wires coming back to the keyboard encoder. Trust me this is going to get very messy so we highly recommend purchasing sixteen RJ-45 sockets from your local hardware store (these are the standard Ethernet cable sockets for home networking).

By mounting one of these on the underside of each control panel you can run a short length of wire from the buttons to the inside of this connector box.



For each game pad, mount a corresponding box by the iPac-4 keyboard encoder and run wires from it to the iPac-4 (being careful to keep the wire order the same).

Now all you need to do is run a standard length of Cat-5 Ethernet cable between the control panel and the computer – this will result in far neater wiring.

This also means that if there is a fault with an individual control panel, it can easily be removed by unplugging the RJ-45 cable – rather than having to unwire each individual connection.

We have produced a standard for these connections so that anyone can troubleshoot and repair any Da Vinci Gaming System. It also means that people can develop new controllers (possibly for people with disabilities) that can plug into this standard RJ-45 connector.



THE DA VINCI GAMING SYSTEM

Note: For hospital use, each arcade control panel should have two RJ-45 connectors which are wired together in parallel. One internally for running the cable back to the iPac-4 and another that is exposed to the outside world that allows external controllers to be plugged in.

The standard for wiring these cables up is:

Pin 1	Joystick Up Normally Open
Pin 2	Joystick Down Normally Open
Pin 3	Joystick Left Normally Open
Pin 4	Joystick Right Normally Open
Pin 5	Fire 1 Normally Open
Pin 6	Fire 2 Normally Open
Pin 7	Spare
Pin 8	Common

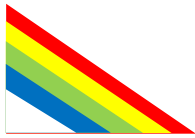
Sticking to this standard will ensure that all controllers will work the same and that anyone troubleshooting the system will understand the order of the wires.

The standard for wiring the connectors to the i-Pac 4 is shown in the tables below. Note: The labelling on the i-Pac board itself, it is designed for a four player video game, so we have re-assigned them to make the wiring tidy and logical for our 8 player game. The spare connection do not need to be connected, however they do each have a slot on the controller that could be used if required.

The key stroke column shows which key the input will be mapped to in the i-Pac, however this is awkward when testing on a normal USB keyboard, so the testing key stroke shows which key each input is mapped to when in development mode.

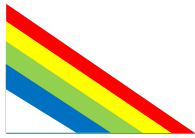
Left hand side connection (Players 1 to 4).

Player	Input	RJ-45 Connector	RJ-45 Pin	i-Pac Connector	Key Stroke	Testing Key Stroke
1	Joystick Up NO	1	1	3RGHT	L	Up Arrow
1	Joystick Down NO	1	2	3LEFT	J	Down Arrow
1	Joystick Left NO	1	3	3UP	I	Left Arrow
1	Joystick Right NO	1	4	3DOWN	K	Right Arrow
1	Fire 1 NO	1	5	3SW1	Right Ctrl	Right Ctrl
1	Fire 2 NO	1	6	3SW2	Right Shift	Right Shift
1	Select	1	7	3SW3	Enter	Enter
1	Common	1	8	GND		
2	Joystick Up NO	2	1	3SW4	O	1
2	Joystick Down NO	2	2	3SW5	!	Q
2	Joystick Left NO	2	3	3SW6	@	2
2	Joystick Right NO	2	4	3SW7	#	3



THE DA VINCI GAMING SYSTEM

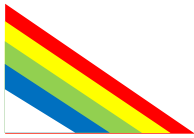
2	Fire 1 NO	2	5	3SW8	\$	W
2	Fire 2 NO	2	6	3STRT	3	E
2	Spare	2	7	3COIN	7	
2	Common	2	8	GND		
3	Joystick Up NO	3	1	1RGHT	Right Arrow	4
3	Joystick Down NO	3	2	1LEFT	Left Arrow	R
3	Joystick Left NO	3	3	1UP	Up Arrow	5
3	Joystick Right NO	3	4	1DOWN	Down Arrow	6
3	Fire 1 NO	3	5	1SW1	Left Ctrl	T
3	Fire 2 NO	3	6	1SW2	Left Alt	Y
3	Spare	3	7	1SW3	Space	
3	Common	3	8	GND		
4	Joystick Up NO	4	1	1SW4	Left Shift	7
4	Joystick Down NO	4	2	1SW5	Z	U
4	Joystick Left NO	4	3	1SW6	X	8
4	Joystick Right NO	4	4	1SW7	C	9
4	Fire 1 NO	4	5	1SW8	V	I
4	Fire 2 NO	4	6	1STRT	1	O
4	Spare	4	7	1COIN	5	
4	Common	4	8	GND		



THE DA VINCI GAMING SYSTEM

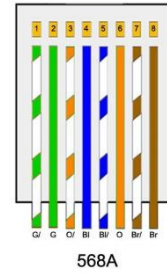
Right hand side connection (Players 5 to 8).

Player	Input	RJ-45 Connector	RJ-45 Pin	i-Pac Connector	Key Stroke	Testing Key Stroke
5	Joystick Up NO	5	1	4RGHT	U	O
5	Joystick Down NO	5	2	4LEFT	V	P
5	Joystick Left NO	5	3	4UP	Y	-
5	Joystick Right NO	5	4	4DOWN	N	=
5	Fire 1 NO	5	5	4SW1	B	[
5	Fire 2 NO	5	6	4SW2	E]
5	Spare	5	7	4SW3	H	
5	Common	5	8	GND		
6	Joystick Up NO	6	1	4SW4	M	A
6	Joystick Down NO	6	2	4SW5	%	Z
6	Joystick Left NO	6	3	4SW6	^	S
6	Joystick Right NO	6	4	4SW7	&	D
6	Fire 1 NO	6	5	4SW8	*	X
6	Fire 2 NO	6	6	4STRT	4	C
6	Spare	6	7	4COIN	8	
6	Common	6	8	GND		
7	Joystick Up NO	7	1	2RGHT	G	F
7	Joystick Down NO	7	2	2LEFT	D	V
7	Joystick Left NO	7	3	2UP	R	G
7	Joystick Right NO	7	4	2DOWN	F	H
7	Fire 1 NO	7	5	2SW1	A	B
7	Fire 2 NO	7	6	2SW2	S	N
7	Spare	7	7	2SW3	Q	
7	Common	7	8	GND		
8	Joystick Up NO	8	1	2SW4	W	J
8	Joystick Down NO	8	2	2SW5	I	M
8	Joystick Left NO	8	3	2SW6	K	K
8	Joystick Right NO	8	4	2SW7	J	L
8	Fire 1 NO	8	5	2SW8	L	,
8	Fire 2 NO	8	6	2STRT	2	.
8	Spare	8	7	2COIN	6	
8	Common	8	8	GND		



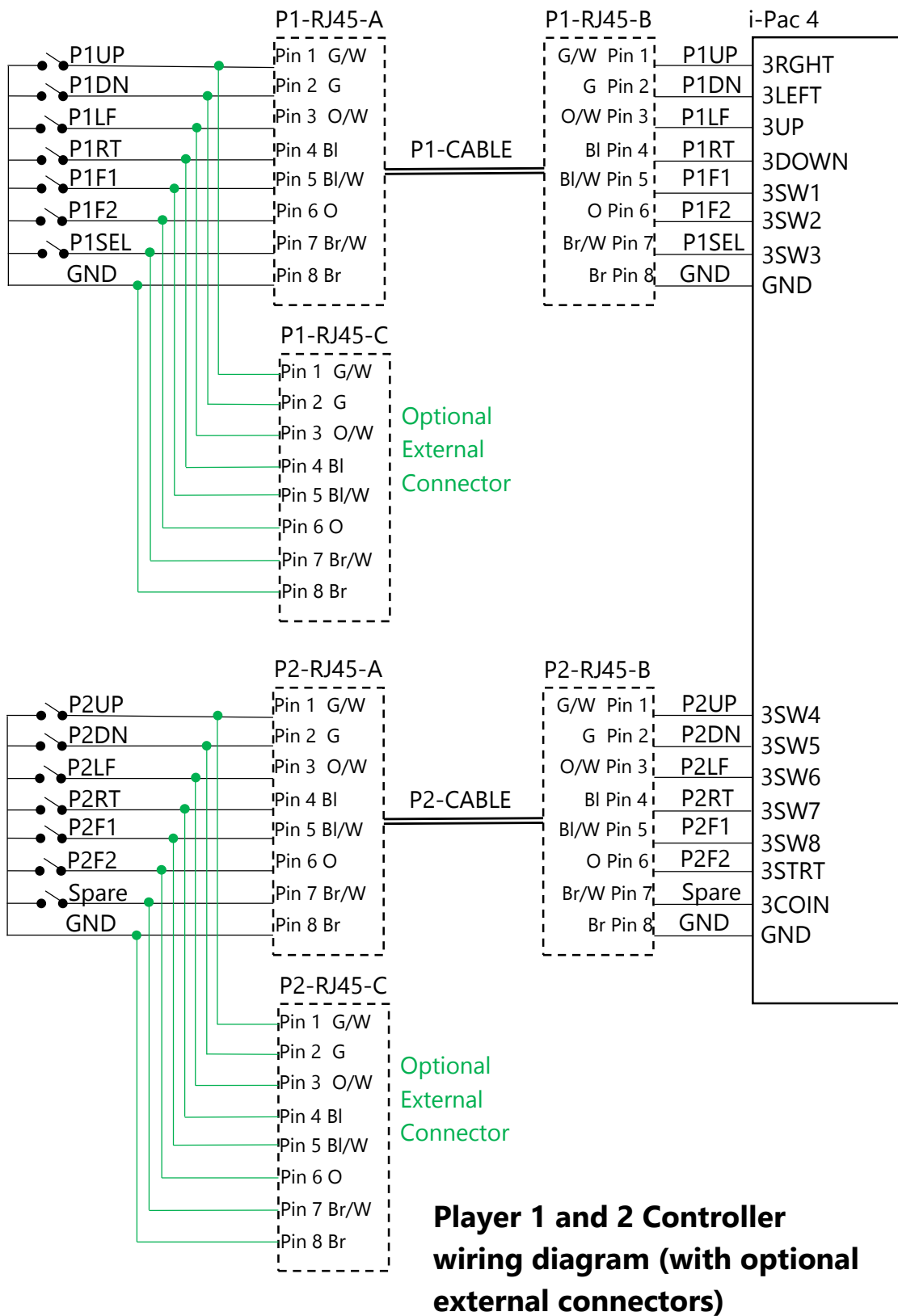
THE DA VINCI GAMING SYSTEM

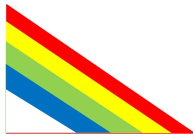
The following pages show the wiring diagrams and suggested wire naming conventions for each of the eight players. There are two standard ways to wire up Cat-5/6 Ethernet cable (type A and Type B). We will standardise on Type A for all connections. The wire colours are denoted besides the pins



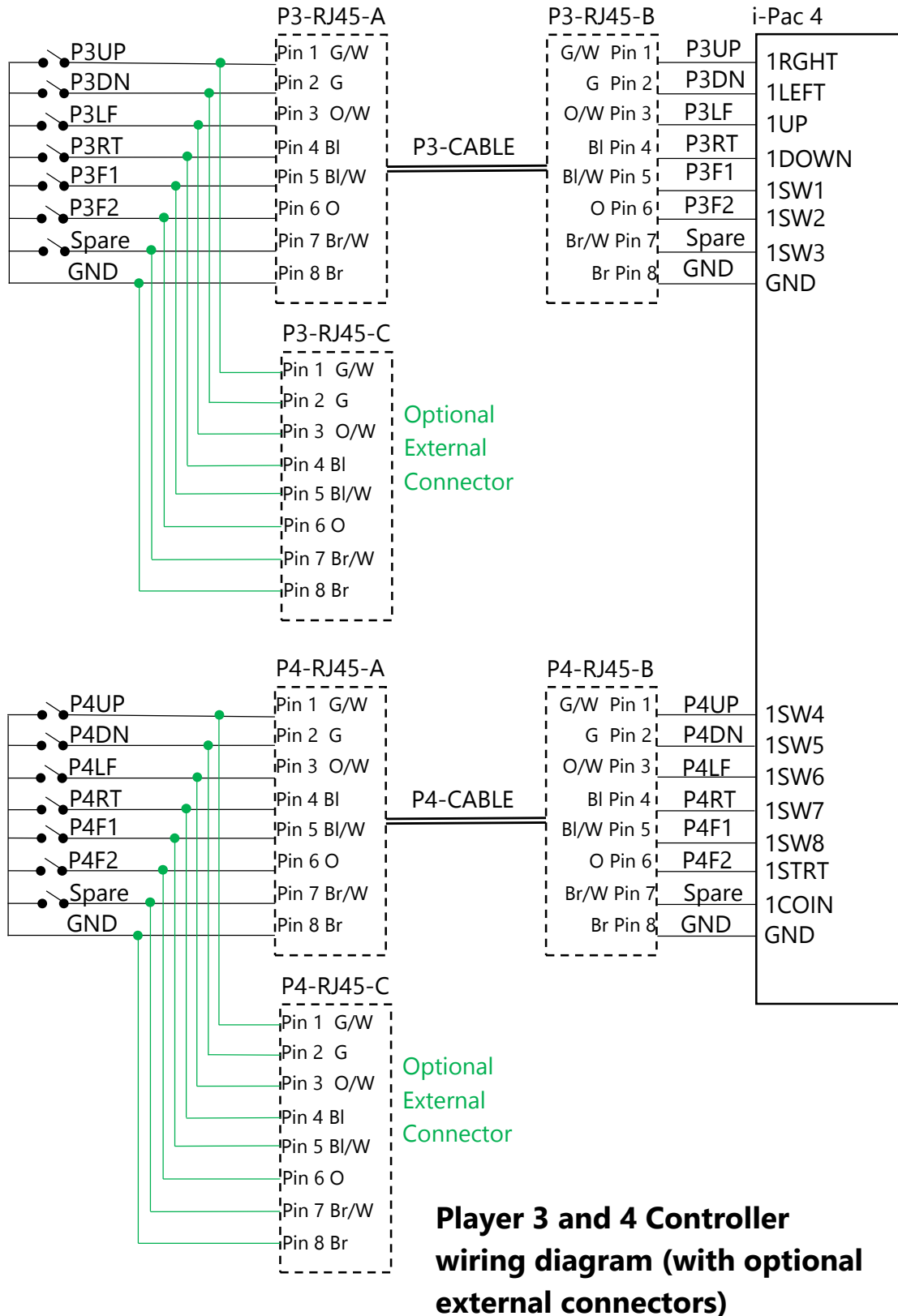


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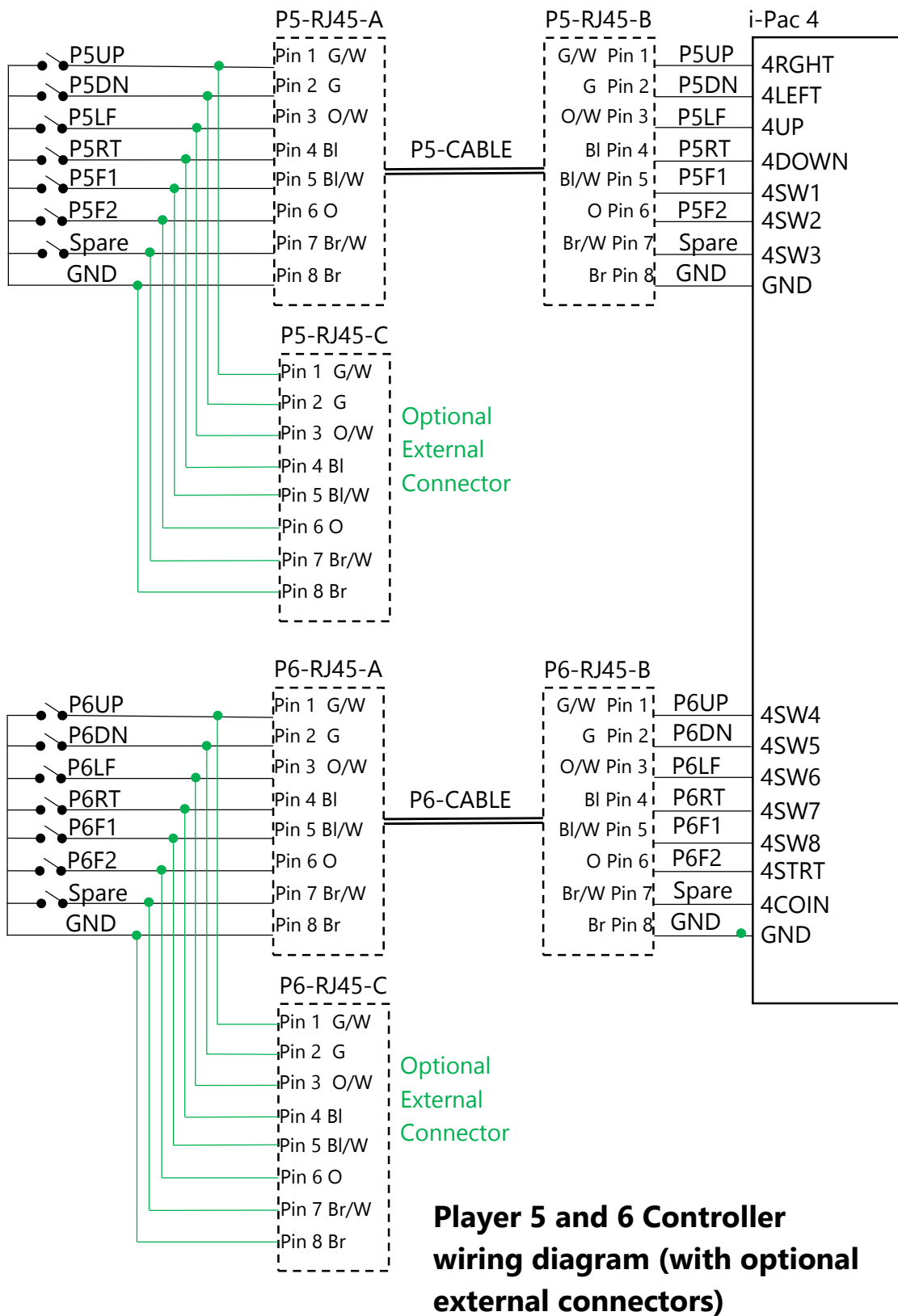


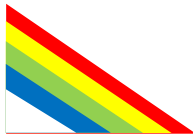
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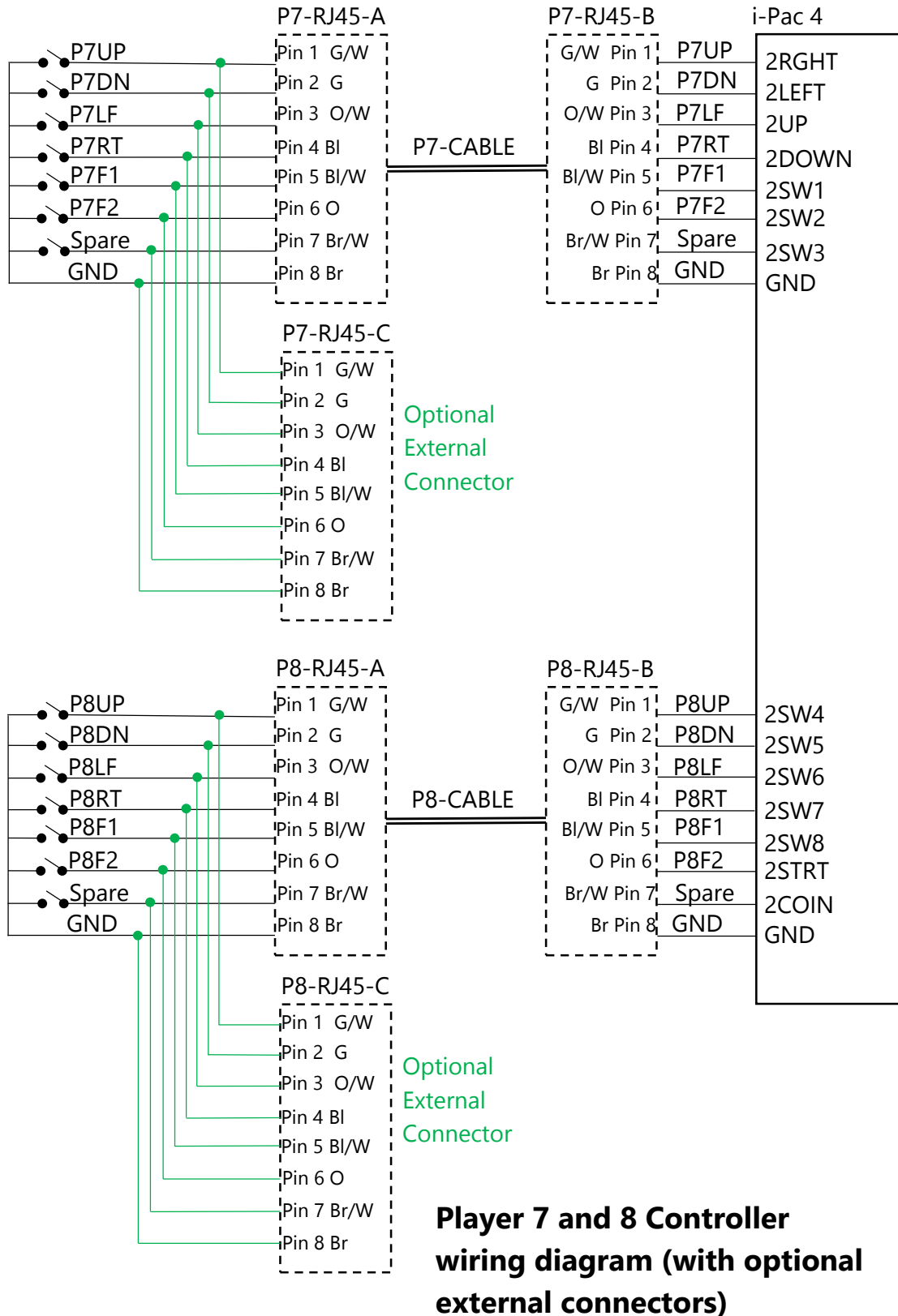


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Power Supplies

Ideally the Da Vinci table will only need one power cable running to it. From here a power bar will be split to the computer, TV and speakers.

Option 1 – Power everything individually

This is the simplest and cheapest option. Use a normal power bar to provide power for the computer, the TV and the speakers.

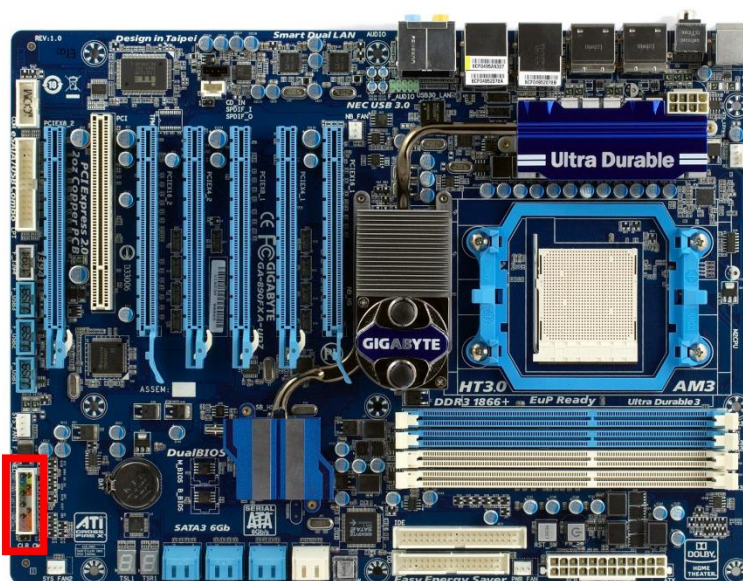
All desktop computers use a momentary contact switch to turn them off and on. That is to say, pressing the switch makes the contact and releasing the switch breaks the contact. These switches do not have an on/off position, they are spring loaded to return to the same position once you take your finger off.

Normally these switches are built into the computer case, but if you have mounted the computer inside the cabinet this might not be easy to get to. Not to worry, it's very easy to connect another power switch to the motherboard. This new momentary switch can be mounted in an easy to reach part of the cabinet and used to switch the computer on/off.

If you look at the picture of a motherboard below you will see the connector block for the case switches highlighted with a red rectangle in the bottom left of the board. It is usually situated here on motherboards, but might be in a different location on your motherboard. Look up the manual for the motherboard (you may have to search the internet for it).

The actual pin connections differ for different manufacturers or models but there will be a connector marked POWER SW. This is the power switch. If you unplug this connector and short out the two pins it was plugged into your computer will start up (or shutdown if it was on).

Be careful, there is also a connector marked "POWER LED" this is the light on the case to show the power is on. This is not the connector we are interested in.

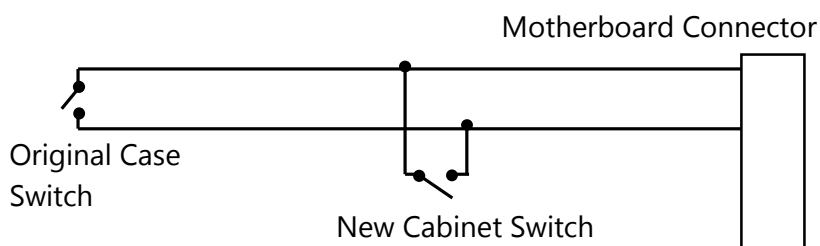
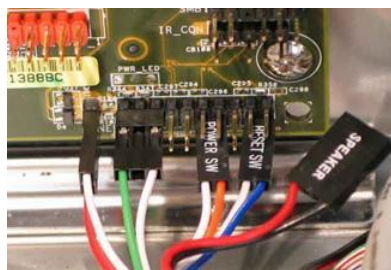


If you have a spare connector you can mount a momentary pushbutton into your Da Vinci Cabinet and wire it directly to the mother board, but it might be easier to cut the two wires going to the "POWER SW" connector (don't cut them too close to the connector – you want to leave yourself some room to work with).



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You can then wire the two switches in parallel, so that both the case switch and the Da Vinci Cabinet switch will work.



This sort of setup will still require the TV to be turned on (probably with the remote control) and the speakers to be powered up along with any separate lighting that has been built into the cabinet.

For this reason, this sort of setup, although the cheapest is probably best suited to a home based arcade cabinet, where the owner knows the start-up/shutdown process and there are no kids climbing underneath pressing the power button.

Option 2 – Use a Master/Controller Power Bar

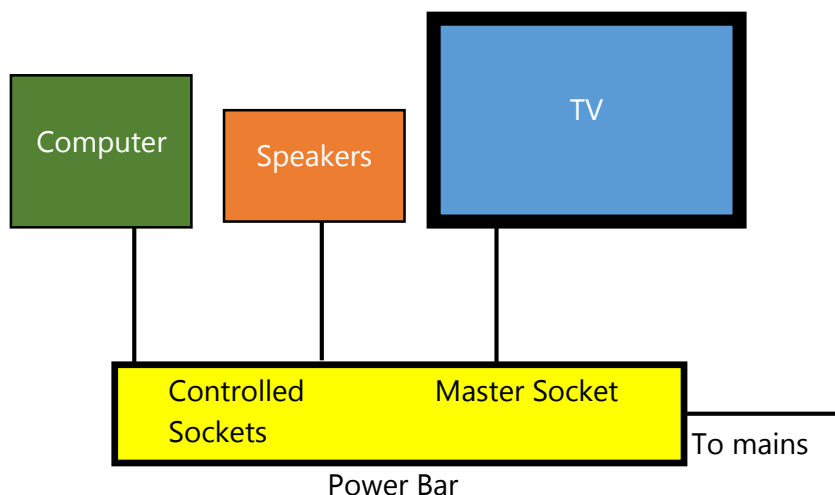
Rather than everything needing to be powered up and down separately, you can purchase power bars that have master and controlled circuits. The way these are designed to work is that you plug your computer into the master socket, and your monitors, lights and speakers into the controlled sockets. When power is flowing through the Master socket, the controlled sockets are live, and when the computer is switched off, the power is automatically cut to the monitors and speakers.

The problem with this for our purposes is that instead of a computer monitor (which is designed to switch on when it gets power), many TVs just go into stand-by mode when the power is applied. But we can make this work in our favour. If we plug the TV into the master socket and the computer into the controlled socket, and set the computer BIOS so that it automatically powers up when power is switched on¹, then you could use the remote control for the TV to switch the entire Da Vinci Arcade system on or off. The TV would switch on, which would power up the computer socket which would boot the computer.

¹ Almost all desktop computers have this as a BIOS feature.



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This would be better suited for a public place where you don't necessarily want a power button on the cabinet that might be discovered by kids exploring.

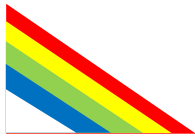
If you are lucky enough to have a TV that switches on when the power comes on, then certainly wiring it up to the controlled socket and having the computer drive the master socket would be a neat solution for many location. Most desktop computer BIOS settings allow computers to be set to wake up at specific times and there is plenty of software that will shut the computer down at a specific time. These settings would be useful for hospital/restaurant installations, though there should probably still be a physical switch hidden somewhere that staff can use to manually start or stop the system.

Option – 3 Use a Master/Controller Power Bar with an Uninterruptable Power Supply

Option 2 still isn't perfect though, because if you switch off the TV it will kill power to the computer instantly – which is rarely a good thing to do. To fix this we can use a battery backup unit. It doesn't need to be very powerful as all it will be powering is the computer for a few minutes as it shuts down. The one thing it does need though is a USB connection to tell the computer when power has been lost.

Most battery backup units in the \$100 range have this feature and come with software which can be configured to power down the computer after running for a set amount of time on battery. I have an APC XS-1300 which comes with the PowerChute software package, which can be configured to shut the computer down after the power has been off for 1 minute (this is the shortest option available). This works well though if someone accidentally switches off the TV; any running game is not lost or disrupted and turning the TV back on will allow the players to carry on. If the TV is left off for more than 1 minute, then the PowerChute software will shut the computer down in a controlled manner.

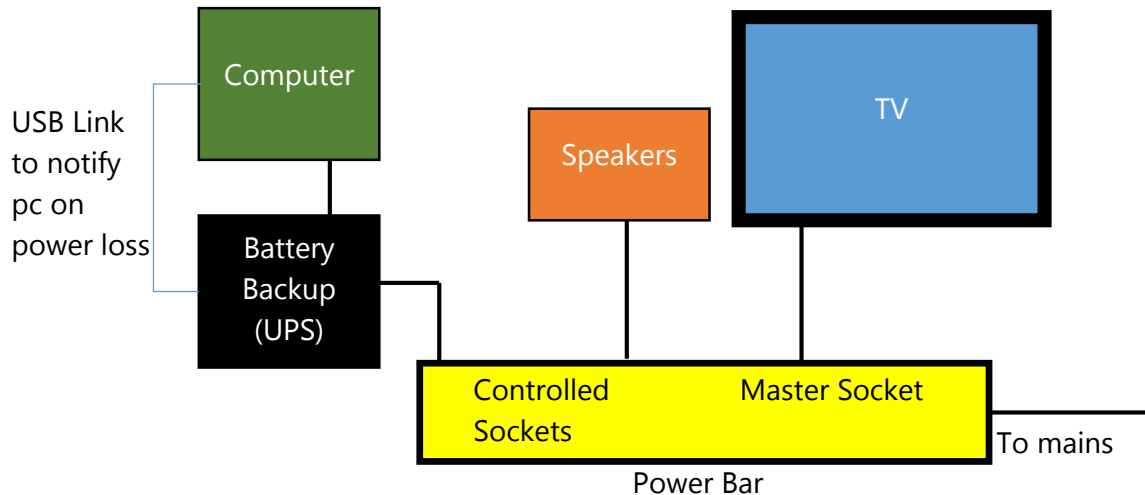




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It should be noted that by default the APC units beep when the power is cut. This can be switched off by turning off the Notification option in the PowerChute software.

The diagram below shows how we could wire up the Master-Controlled power bar to switch on and off with the TV and then connect the Battery Backup unit to one of the controlled sockets to power the computer up and down.



This would be the preferred setup for hospitals and restaurants as the staff can use the TV remote power the whole system up or down and there are no obvious power buttons for kids (or adults) to find.

It also provides a far more stable power supply for the whole system which might prevent it being damaged by power spikes or outages.

Woodworking skills

The majority of the arcade cabinets built in the 1980's were actually quite simple and poorly constructed (to keep the costs down). This partly explains why so many of the old cabinets have been damaged beyond repair. There are of course exceptions, and certainly some of the fancier cabinets (the Star Wars sit down cabinet for example) are a work of art in themselves.

With the Da Vinci Cabinets we want to build high-quality cabinets that last for many years. So we will cover some basics of wood working that will help make your cabinet stand out.

The cardinal rule of all of these techniques is to try it out first on scrap material. Make sure you understand the techniques and have selected the right tools and hardware.

Selecting the type of wood

This is very much down to two considerations, ease of use and finish. We have given a rundown of the main types of wood you might consider.



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MDF (Medium Density Fibre Board)

Pros:

- MDF is very heavy which makes it ideal for arcade cabinets. If you have eight 150lb guys wrenching on a cabinet, then you want it to have some weight.
- MDF cuts very cleanly. Because it is made up of small densely packed particles, when you cut it with a blade you are left with a very flat smooth cut (as opposed to pine which is often quite rough after you cut it).
- MDF is cheap.
- MDF is very strong vertically – i.e. if you stand a piece on its side it can support a great deal of weight.

Cons:

- MDF creates a very fine dust when cut which can easily irritate the eyes and lungs. This dust also contains urea formaldehyde, which is about as nasty as it sounds. It is very important that you cut it in a well-ventilated environment and that you wear goggles and breathing masks.
- MDF isn't very strong horizontally – i.e. if you make a shelf out of it then it will flex quite a lot. This is easily fixed by bracing the shelf with a pine 2x4.
- MDF absorbs paint very readily, so you may need a few thick coats to get a good finish on it.
- MDF needs to have screw heads dressed or countersink otherwise they will stick out.

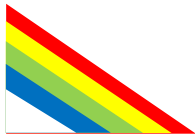
MDF is ideal for use in the large panels of the arcade machine. It comes in a variety of thicknesses. I use ½" thick MDF for the side and front panels and then thicker ¾" for the shelves (for computer, Monitor and Speakers). However if you are using T-Molding (see later) it will probably be easier to use ¾" thick MDF for the side panels as well (as this is the standard size for T-Molding).

Urea formaldehyde can slowly leak from the surface of MDF, it is therefore a good idea to paint all sides of the MDF before installing it. When screwing close to the edge of the panel it won't split as badly as grained woods such as pine – however it is still a good idea to keep your screw holes at least 1" away from the edge.

Pine

Pros:

- Pine is very strong in all directions, which makes it great for strengthening your cabinet and making it more rigid.
- Pine is cheap
- Pine takes paint very well and usually has a nice finish on smooth surfaces
- Pine is soft enough to bury a screwhead without needing to countersink it.



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Cons:

- Cutting pine usually leaves a rough unfinished surface that needs to be sanded.
- Large flat panels of solid pine are not easily obtainable

Pine is great to use for strengthening struts (using 2"x4" lumber). If you are screwing straight into a piece from the end then it will be very strong, however if you try to screw into a piece near the edge you will get splitting.

Oak and other hardwoods

Pros:

- Oak is very strong in all directions and very heavy, making for a very solid cabinet.
- Oak cuts very cleanly, leaving a very smooth edge.
- Oak can be painted or varnished for a fantastic finish

Cons:

- Oak is very expensive

If you are looking at making a non-traditional arcade cabinet, maybe one that can sit in your living room as a piece of furniture, then oak is a great choice. However it is very expensive and bear in mind that its strength makes it very hard to cut by hand, so power tools are a must.

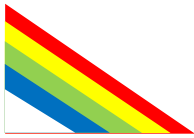
Pre-drilling screw holes and countersinking

If you have every tried to drive a screw into a piece of wood, then you know that it can very often slip and either go in slightly askew or slightly off centre. The easiest way around this is to select a drill bit that is slightly smaller than the thickness of the screw body. Clamp the two pieces of wood that you wish to connect together and then drill a hole through them both where you want the screw to go.

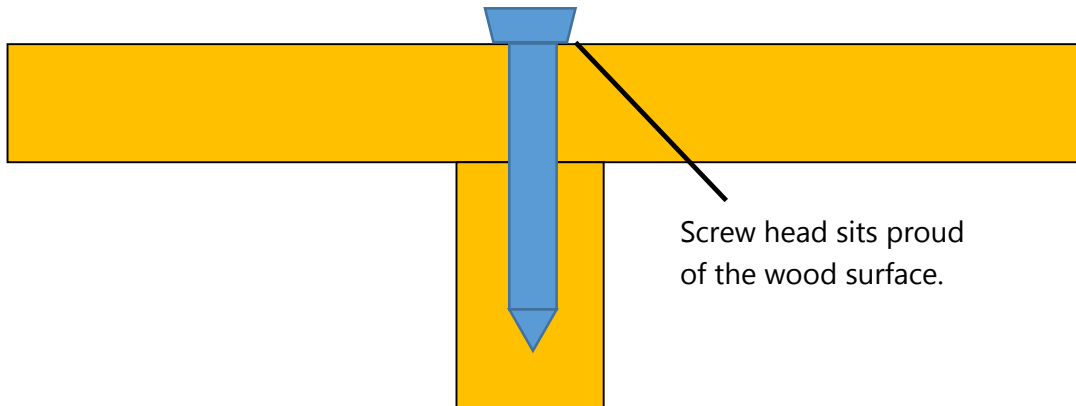
Now screw the screw into the hole and you will get a perfect and clean join with a greatly reduced chance of splitting (see later).

As always you should practice this on some spare lumber to make sure that you have selected the right size of drill bit.

The only problem with this is that if you are using a denser wood (like MDF) the screw head is left sticking up above the edge of the wood. See diagram below.

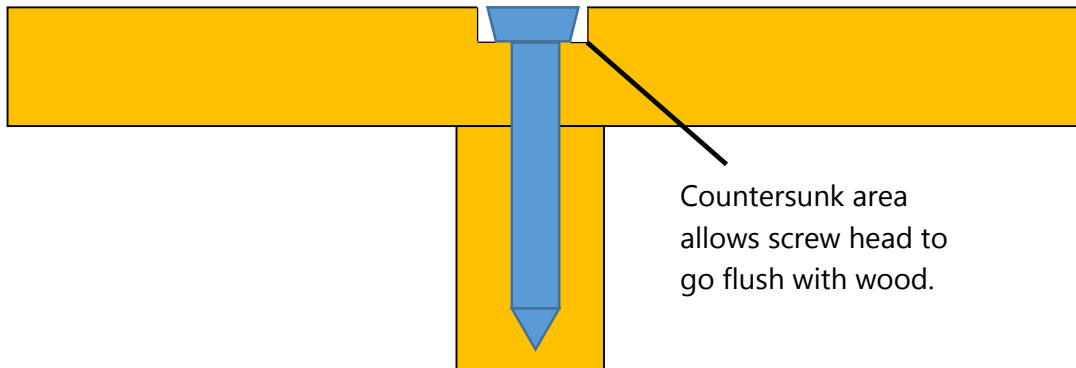


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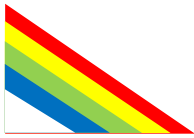


The most common way to fix this is to use a technique called counter-sinking. This involves drilling the screw hole with the small bit as before, but then using a much larger bit (about the diameter of the screw head) to notch out a divot for the screw head to sit in. Of course, changing drill bits becomes very time consuming, so I would recommend that you use a second drill and swap between them as needed.

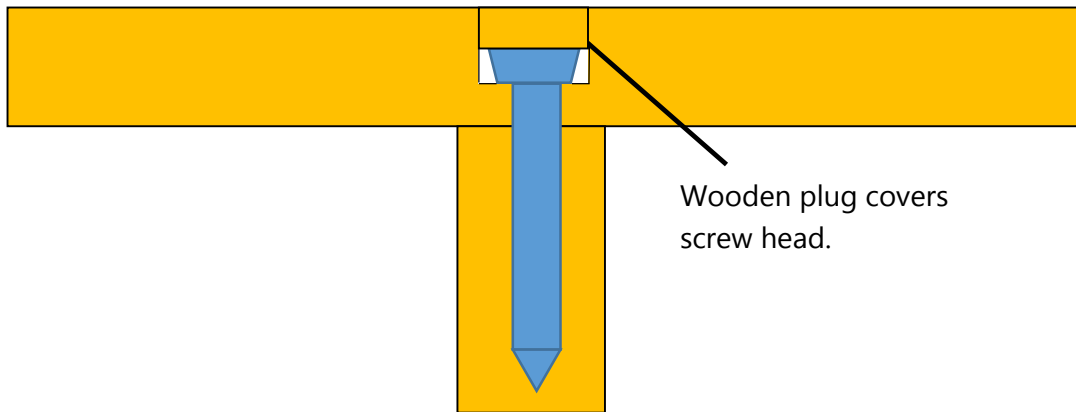
Getting the depth right for the countersinking might take a bit of trial and error, so it is worth practising on some scrap pieces of wood before trying it on your arcade cabinet.



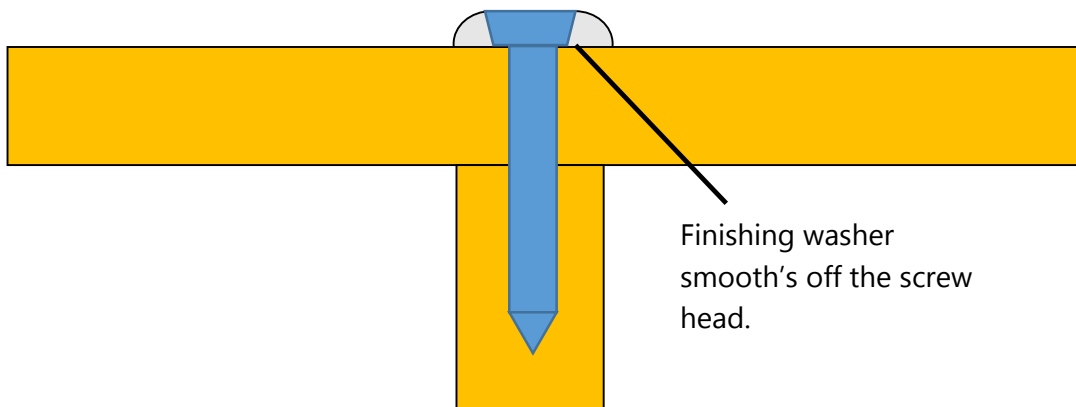
If you wish to completely conceal the screw you can purchase screw digger and plug cutter sets which come with a number of bits. The first drills your screw hole as before, but as it goes down it drills a wider hole (the counter sink). A second drill bit is then used to drill a wooden plug out of a scrap piece of similar wood. This plug can then be pushed down into the hole – completely hiding the screw head.



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The easiest method however is to use a finishing washer to dress the screw head. This technique was often used on 80's cabinets. However the finishing washers do tend to highlight the position of the screws, so you have to be very careful to evenly space your screw holes around the cabinet, otherwise it will look very messy.

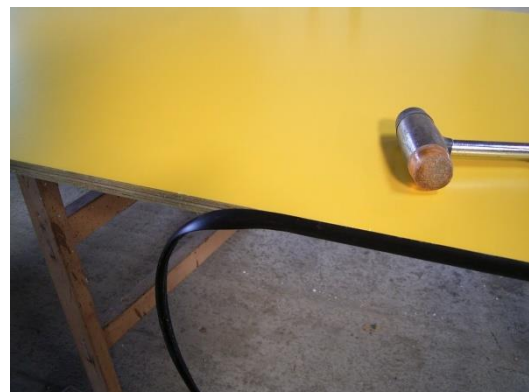


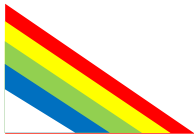
Screw caps can also be used. These are small plastic covers that pop over the top of the screw head. However I have never had much luck with them and have found that they often pop off when you are moving the cabinet. I would avoid them personally.

T-Molding

If you look at a typical 80's arcade game you will notice that it has a plastic strip running down the edges of the panels. This is called T-Molding and it can be bought cheaply online in a variety of colours.

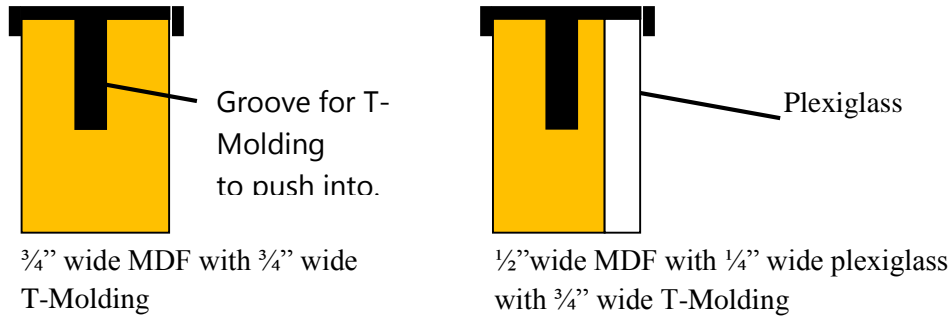
The picture to the right shows some T-molding being installed.





THE DA VINCI GAMING SYSTEM

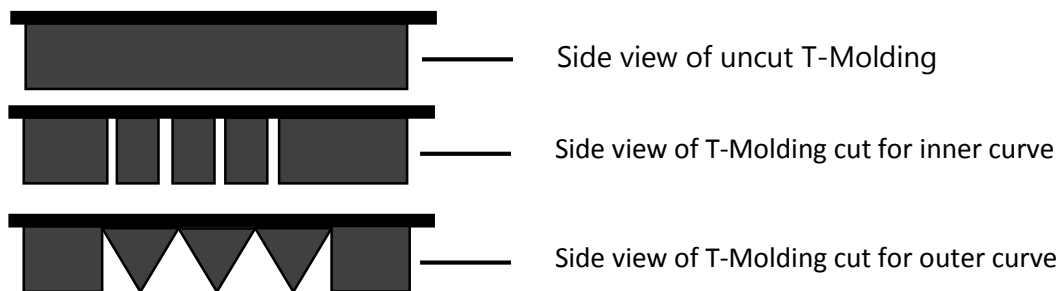
T-Molding gives an excellent finish and is easily installed if done correctly. The name comes from the fact that if you look at T-Molding straight on it is T shaped. The flat top of the T covers the wood and the vertical bottom bit slides into a groove in the edge of the wood which holds it in position.

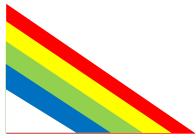


T-Molding is sold by width size, so be sure to buy the correct width to match your wood (e.g. $\frac{3}{4}$ "). If you intend to use MDF and plexiglass side by side, remember that your T-Molding has to be as wide as the combined width of the MDF and the Plexiglass.

When you buy your T-Molding, be sure to also purchase a matching router bit that will be used to cut the groove. Before you assemble the sides of your cabinet use a router and the T-Molding bit to run around the outside of the panels cutting the required groove. This is important: Remember that your screw holes cannot go into the groove of the T-Molding, so when you are designing your cabinet ensure that all screw holes are at least an inch away from edges with T-Molding.

T-Molding can be bent around gentle curves. For inner curves cut slots in the insert part of the T-Molding to allow it to curve back on itself. For an outer curve, cut triangles out of the insert part to give it space in the groove.





THE DA VINCI GAMING SYSTEM

Splitting

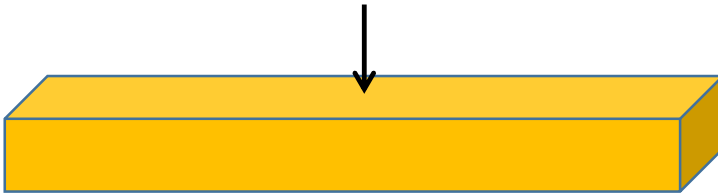
If you screw too near the edge of a piece of wood you run the risk of splitting the wood wide open. If this happens then that screw hole is useless (if cannot support any weight) and in many cases you will have to cut a new piece of wood.

You can mitigate the risk a lot by pre-drilling holes for the screws with a drill bit, however it is best to design your cabinet so that you avoid the situation.

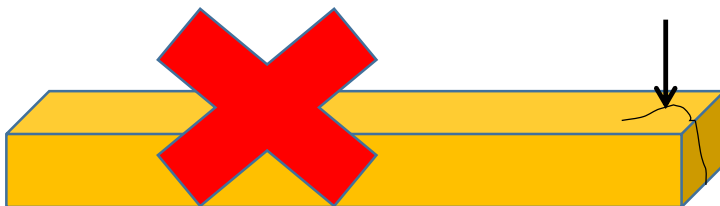
Splits usually occur along the grain of the wood, so splitting is much worse in thick grained woods such as pine, however it can still occur in non-grain woods such as MDF.



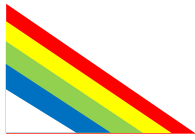
Screwing directly into the edge should be okay.



Screwing down in the middle of the wood is okay.



Screwing down near the end will cause splitting of the wood – rendering this screw point useless.



Section 4 – Game Design

Startup Sequence

Games designed to work on the Da Vinci Gaming System should adhere to the following guidelines to give players a consistent experience.

As soon as possible a splash screen should be shown. It doesn't matter if the game takes a while to load after that, however once the user has selected the game they wish to play, the Da Vinci Game Selection window will vanish from the screen. If the game doesn't throw up a splash screen it will look as if nothing is happening.

The splash screen is an ideal time to show instructions.

If in doubt as to what to put on the screen use the Bauhaus 93 font for the title.

Frogger Scramble Space Invaders

Once the game has loaded it should not start a game straight away, but wait for players to press their fire buttons to join. Typically a game will wait about 10 seconds from the first fire button press before starting, to give other players the chance to join.

If you want players to be able to join after the start of the game that is up to you, but if you don't allow them to join you should display a message at that player location explaining that they need to wait for the next game.

For some games, such as Gauntlet, if a player leaves the table their character blocks all of the other characters from progressing. For this reason, for some games it might be appropriate to remove a player from the game if there is no input from their joysticks or fire buttons for 1 minute. A warning and countdown for the last 30 seconds is probably appropriate.

Player 1 has a "Select" button. Pressing this should pause the game and bring up an option to "Continue" or "Exit". The default (top) value should be to continue.

Once a game is finished it is appropriate to run an "attract" mode, showing some of the gameplay. Remember to check the system variables to see if the owner wants the sound to be on or off during the attract mode.

If the system variables show that the owner has set up a screen saver (for example menus in a restaurant), then after 5 minutes of not being played, the game should terminate itself and hand back control to the Da Vinci Game Selection window (which in turn will start the screen saver).

When the game is shutting down, the game should display a message that it is closing, but the window should close after everything else has been unloaded from memory. This is because the Da Vinci Game Selection window will not re-appear until the game process has finished running (it is monitoring the Windows handle).



THE DA VINCI GAMING SYSTEM

Playability Ideas

Eight player games need some slightly different game mechanics than single or double player games. This section highlights some of the playability factors that should be taken into consideration when designing your game, and presents some ideas to counter them.

If your game involves players being knocked out of the game once their character dies, then the first player out might be waiting for quite some time, and the by the time only one player is left you have seven other players all hanging around waiting. Possible alternatives are to have time or point limits that signal the end of the game for everyone, or indeed have no end to the game (such as Gauntlet).

Other options are to penalise dead players by locking them out of the game for 30 seconds, then allowing them to rejoin the action.

It might work well for your game if you have eliminated players take over the roles of the enemy. For example: In an 8 player Pacman game, after a player loses their 3 lives they could come back as a ghost (appropriate) chasing the players.

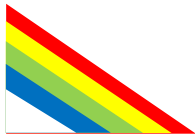
Maybe eliminated players could take on a secondary role, helping the remaining players by firing at the enemy from a ground installation or maybe even a second gun attached to a current players ship.

In some games, dead players come back with inferior ships/weaponry, but in the Starfleet Command game this idea is turned on its head to good effect. Players are engaged in a multi-player head to head fight with Starships. All of the players start off with a weak ship and when they die they get a more powerful ship. Finally after the fourth most powerful ship is destroyed they are out of the game. This helps less experienced players stay in the game for longer. Sure they will eventually be knocked out, but not before reeking massive damage with the fourth most powerful type of ship.

Another issue with 8 player games is the sheer busyness of the screen. If your characters can wander anywhere on the screen (for example Pacman, Gauntlet, Hockey) then players will quickly lose track of where their characters are. One option for this is to draw a thin line from the player's physical location at the table to their character. (See image to the right).



Each player is assigned a standard colour based on their player number (regardless of which game it is). For example: Player 1 is always Red. This fact can be used to highlight player ones character with a red circle.



THE DA VINCI GAMING SYSTEM

Sound

With a normal arcade game sounds are directly related to the player's actions or enemies and provide atmosphere and clues as to what is happening. With testing eight player games it is very apparent that even the most subtle of sounds quickly rises to a cacophony when multiplied 8 times. Take for example the aerial dogfighting game. Each player has an engine which decreases in pitch when it climbs and increases in pitch when it dives. In a one or two player arcade game these sounds come across as realistic because they would be close to the player action. In an eight player game the speakers are re-creating the sound of all eight planes climbing and diving and it quickly becomes a jumble of noise. It is not unmanageable, but it is something you will want to play particular attention to when play testing your game.

Intermittent sounds, like gun fire or bonuses aren't so much of a problem as the brain seems pretty good at linking the sound with the action on the screen.

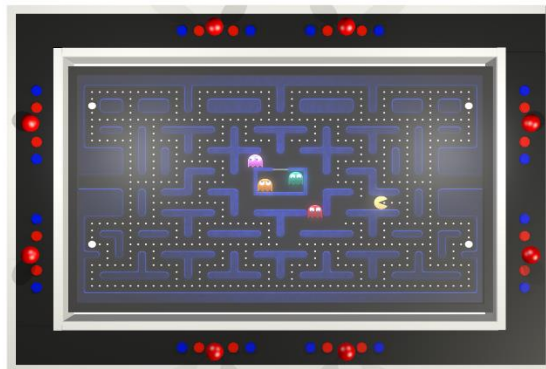
Screen Split

Games designed for the Da Vinci Gaming System fall into two categories, full screen or split screen, with the split screen sub-divided into either a 4-way or 8-way split.

Full Screen

Full screen games have all players sharing a top down view of the entire playing field.

Games such as pong, pacman, gauntlet, tower defense etc. all fit into this category. Players might be able to roam all over the screen or they might be restricted to a specific area in front of them, but ultimately the playfield is rendered as one big image.

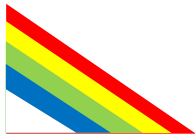


4- Way Split Screen

Split screen games are more complex and form one of the standards for the Da Vinci Gaming System so that they are all handled the same way and the players come to know what to expect from a multiplayer experience.

The first split layout is a 4-way split, which allows four teams of two players, with each team sharing a side by side view of the action.



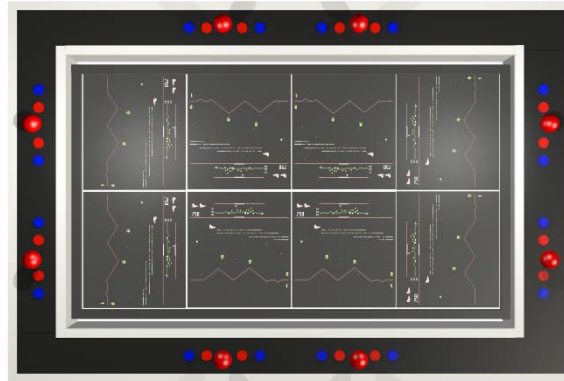


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8-Way Split Screen

The 8-Way Split Screen gives each player their own individual view of the action. With both the 4-way and 8-way split screen views, inactive screen space (due to missing players) is re-assigned to existing players to increase their screen size.

Although a standard Da Vinci table has spots for eight players, there is nothing to stop you building a table for fewer players. The split screen logic will assign the unused space as required.



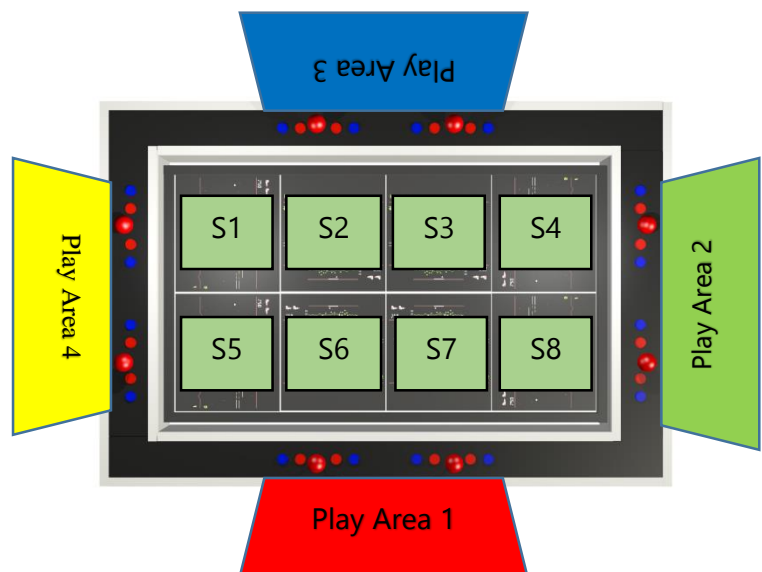
The reason we can make the system work with a wide variety of layouts is that internally we split the single screen into 8 separate view screens that can be grouped together to provide each user with a view.

First the table is split into four “Play Areas” which account for the four sides of the table.

There can be none, one or two players in each Play Area. If any player is active in a Play Area then the following screens will be assigned to the one or two players in that play area (See table below).

For some games the screens will be shared between the two players, in other games if two players are present then they will get individual screens.

The table below shows which screen are assigned to which play area.



The four play areas

For the colour diagrams, Play Area 1 is red, Play Area 2 is green, Play Area 3 is blue and Play Area 4 is yellow.

Play Areas Active	S1	S2	S3	S4	S5	S6	S7	S8	
PA1	PA1	PA1	PA1	PA1	PA1	PA1	PA1	PA1	<div>1 2 3 4</div> <div>5 6 7 8</div>
PA2	PA2	PA2	PA2	PA2	PA2	PA2	PA2	PA2	<div>1 2 3 4</div> <div>5 6 7 8</div>



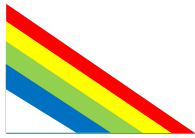
THE DA VINCI GAMING SYSTEM

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PA2 PA3 PA4	PA4	PA3	PA3	PA2	PA4	PA3	PA3	PA2	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td></tr></table>	1	2	3	4	5	6	7	8
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PA1 PA2 PA3 PA4	PA4	PA3	PA3	PA2	PA4	PA1	PA1	PA2	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td></tr></table>	1	2	3	4	5	6	7	8
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As can be seen from the table above, it is critical in split screen games for the Da Vinci Gaming System that the screen size and ratio should be able to automatically size and/or scale to fit any resolution and any height-width aspect ratio.

The official Da Vinci Gaming System specification supports two resolutions, 1080p (which is 1920x1080 pixels) and 4K (3840x2160 pixels) and games will be tested at these resolutions. However people may decide to use TVs with other resolutions so any games written for the software should be able to adapt to any resolution.

It should be noted that a typical 1980s arcade game has a resolution of 224x228 pixels, so even if we split a 1080p screen into eight, each player would get a 480x540 play area (5 times the resolution) and on a 4K screen this increases to 960x1080.



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Player Controls

Each of the eight players gets an 8-way arcade digital joystick and two fire buttons. The 8-way joystick has four switches in in (Up, Down, Left and Right) with the diagonals being registered when two buttons are pressed at the same time.

The standard layout for each game pad is to have the 8-way joystick in the middle and then two sets of two fire buttons which are wired together, one set for left handed players and the other set for right hand players.

Game Ideas

Here are some ideas for games that could be rebooted for eight players on the Da Vinci Gaming System. When designing games for the Da Vinci Gaming System we want to avoid situations where players get knocked out of the game and are left waiting for other players to finish.

Pacman

A huge screen map with all 8 players running around chomping dots. Each player gets 3 lives, once their lives are up they become a ghost and can chase down the players.

Combat – Tank

The classic tank game from the Atari VCS days. Each player controls a tank in a large top down maze. Points are awarded for shooting the other players.

Combat – Dogfight

One big play area, showing a top down view of a bi-plane dogfight. Shadow on the ground shows the relative height of each plane, so can swoop and climb. Upgrades can be picked up for more power or better guns for a few seconds.

Tower Defense

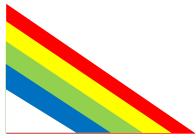
Each player is responsible for buying and placing defense components within their area of the play area. Enemy march out and around a pre-set path to a central goal. More players spawn more enemy.

Defender

Each player gets their own screen, though all eight players are in the same game world and can see each other if they get close enough. Players are co-operating to stop the humans from being abducted. Game is over for everyone when the last human is gone.

Frogger

Each player tries to get the most number of frogs from their base into the island in the middle of the screen within a time limit.



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BattleZone

The screen is split into eight independent views, and players drive their tanks around the game world attempting to get shots on other players. When your tank is destroyed you re-spawn back at your base. At the end of a specified time the player with the most points wins.

Space Invaders/Galaxians/Galaga

It may sound old, but a team defense against the invaders could be made pretty awesome with a bit of imagination.

Gauntlet

This would be a lot of work, but an eight player version of gauntlet is just what the world has been waiting for.

Platform

Splitting the screen into four and having teams of one or two players each working together for a common goal or as opposing teams. There are so many genres to choose from Spy vs Spy, Elevator Action, Black Dragon and Gyzor spring to mind.

Racing Boat/Plane/Car

Top down central race track with small local screens in-front of each player as they race around courses.

Beach Head

Players must use their fixed gun emplacements to fend off enemy invaders.

Stick Ninjas

Different coloured stick ninjas on scrolling platform game

Space war

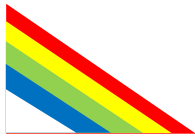
Star fleet battles with the Karg Empire and the Earthican Empire. Each player pilots their starship around a battlefield engaging the enemy team.

Tetris

Multi-player Tetris

Cards against humanity

More of an adult pub gam, but could be fun.



THE DA VINCI GAMING SYSTEM

Section 5 – Game Programming

Approved Games

Anyone can program and install a game for their Da Vinci System, however we will also operate a volunteer database of approved games that have been vetted for malicious code and that have been assigned an age appropriate warning. This allows non-technical hospital staff to use a keyboard and mouse to log into the Da Vinci Gaming System and download new games for their system (via the Internet), safe in the knowledge that they will be age appropriate and virus free. This system will seamlessly install the games and they will now appear in the game menu.

To get approval for a game, an author must submit it with source code to the approval committee. The committee will review the source code for potentially malicious code, the source will be compiled and tested to ensure it meets the required standard of quality. Once approved, the approval committee will assign it an age appropriate rating, produce a short 30 second intro video of the game (that will play from the selection menu) and produce a standard Da Vinci Gaming System icon for the game. It will then be uploaded to the approved games list and become available for download to all users.

Note: The source code still belongs to the author and will not be distributed with the game.