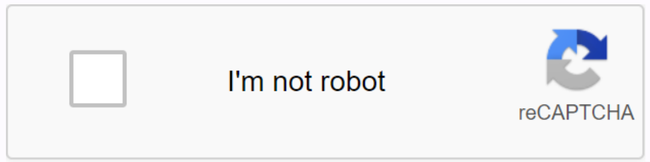

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Pixel gun 3 unity 2018

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Retro games with simple mechanics and pixelated graphics can evoke fond memories for veteran gamers, while being approached by younger audiences. Nowadays, many games are labeled as retro, but it takes effort and planning to create a title that really has that nostalgic look and feel. That's why we invited people from Mega Cat Studios to help us talk about the topic. In this blog post, we'll cover everything you need to create authentic art for NES-style games, including important Unity settings, graphics, and color palettes. Get an example of our project and follow! Mega Cat Studios, from Pittsburgh, Pennsylvania, has turned the creation of highly accurate retro games into an art form. So much so, in fact, that some of their titles can also be obtained in cartridge form and played on retro consoles like Sega Genesis. Medusa & Workflow Coffee Crisis Unity is small for Retro-ocity The latest addition to the Unity workflow has made it a suitable environment to create your retro game. The 2D Tilemap system has been made better and now supports grid, hex, and isometric tile maps! In addition, you can use the new Pixel Perfect Camera components to achieve consistent pixel-based movement and visuals. You can even use the Post Processing Stack to add all kinds of cool retro screen effects. However, before this work can be done, your assets must be imported and set up correctly. Setting up our sprite assets first requires the correct configuration to be crisp and clear. For each asset you use, select an asset in Project view, then change the following settings in the inspector: Filter mode changed to 'Dot' Compression changed to 'No Other filter mode resulting in a slightly blurred image, which damages the crisp pixel-art style we're looking for. If compression is used, the image data will be compressed resulting in a loss of accuracy to the original. This is important to note, as it can cause some pixels to change color, possibly resulting in changes to the overall color palette itself. The less color and the smaller your sprite, the greater the cause of compression of visual differences. Here is a comparison between normal compression (default) and no compression. Normal compression / No compression looks accurate for the original Other thing to note is the Max Size setting for the image in the Inspector. If your sprite image has a size on any axis larger than the 'Max Size' property (2048 by default) it will automatically resize the maximum. This will usually result in some loss of quality and cause the image to become blurry. Since some hardware won't support textures more than 2048 on any of the axes, it's a good idea to try to stay within that limit. The maximum size is set to 2048 / Now with the maximum size set to 4096 Above, is the sprite of the spritesheet which is 2208 on one axis with the maximum size set at 2048. As you can see, upgrading the Max Size property to 4096 allows for precise-sized images and avoids loss of quality. Finally, when setting up a sprite sheet or sprite, make sure you set the pivot unit mode to 'Pixels' instead of 'Normalized'. This is so that the pivot sprite points will be based on pixels rather than a fine range from 0 to 1 on each image axis. If the sprite doesn't rotate from the pixel exactly, we'll lose the pixel perfection. Pivots can be set up for sprites in the Sprite Editor, which can be opened from the Inspector when you select a sprite asset. Install the Pixel Perfect 2D package With assets set up, we can set our camera to The pixel-perfect result will look clean and crisp. Signs telltale art pixels that are not displayed are displayed pixel-perfect includes blur (aliasing), and several pixels appear rectangular when they should be square. Pixel Perfect 2D packages can be imported through Package Manager in Unity. Click the 'Window' menu in the toolbar followed by 'Package Manager'. In the new window, click 'Advanced' and make sure you've turned on 'Show preview packages'. Select 2D Pixel Perfect from the list on the left, and select install at the top right of the window. That's it. Now you're ready to start using pixel-perfect camera components. The high level of pixel-perfect-itude Pixel Perfect Camera components is added to and adds the Unity's Camera component. To add it, open the main camera and add the Pixel Perfect Camera component to it. If the Pixel Perfect Camera component option doesn't exist, follow the instructions stated earlier to first import it into the project. Now let's take a look at the settings we have. First, I recommend checking out 'Run In Edit Mode' and setting the aspect ratio of the display in Game view to 'Free Aspect' so you can resize the look of the game freely. The component will display a helpful message in the game view that explains whether the screen isn't pixel-perfect at a certain resolution. Now, you can go through each setting to see what they do and how they affect the look of your game! Pixels Per Unit Asset - This field refers to the settings you can select in the inspector for each asset. As a general rule of thumb, any asset to be used in the gaming world space must use the same pixels per unit (PPU), and you'll also place that value here. If your gaming world existed as a grid of tiles and sprites, with each being 16 pixels by 16 pixels, ppu 16 would make sense – each grid tile would be 1 unit in the coordinates of the world. Make sure you place your preferred PPU here. Reference Resolution - Set this to the resolution you intended all your assets to see. If you want a retro look, this usually means a very small resolution. For example, the original resolution for Sega Genesis was 320×224. When porting the game from Sega Genesis, we will use reference resolution 320×224. For general use 16:9, 320×180, as well as, 398×224 (if you want to maintain vertical resolution instead) should work fine. Upper Class Render Textures - This causes the scene to be rendered as close as possible to the reference resolution and then above to fit the actual display size. Since this setting results in a filled screen, we recommend that you want a full-screen pixel-perfect experience with no margins. 'Upscale Render Texture' will also significantly affect how sprites look when rotated. 1. Original (not played) 2. No Texture Render Class (rotated 45 degrees, pixel perfection is lost because pixel size varies at diagonal edges) 3. With Top Class Texture (rotated 45 degrees, pixel perfection is maintained because all pixels are the same size, but sprites are less accurately visible compared to the original.) Pixel Snapping (only available with High-End Render Textures disabled) - With this sprite presenter enabled it will be snapped to the world's space grid automatically, where the grid size is based on the PPU of your choice. Note that this does not really affect the transformation position of any object. As a result, you can still interpolate objects between positions smoothly, but the visual movement will remain pixel-perfect and sharp. Pixel Snapping is disabled. With our background in position (0, 0) and our characters sprite in (1075, 0), we get a few pixels not lined up correctly. Notice how there are a few pixels that are only half covered by shadows. Pixel Snapping is enabled. Same position – background (0, 0) and sprite characters (1,075, 0). Pixels are perfectly put together. Cut Frame (X and Y) - Crop this region of the world exactly the same as the reference resolution, and add a black margin to the screen to fill in the gaps at the edges of the screen. Stretch Fill - Becomes available if you enable x and y for Crop Frame. This causes the camera to scale to the game display to fit the screen in a way that maintains the aspect ratio. Since this scaling will not only occur in multiples of the overall number of reference resolutions, it will cause pixel perfection to disappear at any resolution that is not a whole number multiple of the reference resolution. The advantage here is that even if you lose pixel perfection for a lot of resolution, you won't have a black margin bar and will instead have a fully charged screen. Note that although blur often occurs from stretched fills, the usual warning display messages do not appear. Characters and backgrounds are blurred from stretch fill Pixel Perfect Camera usage recommendations If you want a pixel-perfect and snappy screen that will work for a variety of use-cases, I recommend: Use a reference resolution that will never be greater than the resolution of the player window (such as 320×180). Turn High-End Render Textures on or off Enable if you're going to use rotations beyond 90, 180, and 270 and if you prefer the visual effects on the rotated sprites. Upscaled rendering textures can produce imperfect images of pixels at multiple resolutions, depending on the resolution of your reference. Experiment with these different screen resolutions using pixel-enabled 'Run in Edit Mode'. The Camera component is perfect for determining whether this is a problem for your resolution. If you can get this to produce pixel-perfect at all target resolutions, this will result in the best full-screen pixel perfect experience. Turn Pixel Snapping on or off however you like It's a more personal preference than anything else. Without flicking, you have a lot of movement, but pixels can get out of alignment. Enable Cut X and/or Y Frames if you don't use High-End Render Textures If you can't consistently get pixel-perfect results with high-end rendering textures, cutting X and/or Y will ensure pixel-perfect images for any resolution greater than the reference resolution, but create large margins at the edges of the screen for multiple resolutions. Disable Stretch Fill We recommend setting the camera to be optimized for a 16:9 aspect ratio display, including reference resolution if possible. At the time of writing, most gamers play on 16:9 monitors, and at 1920×1080 resolution. For example, the reference resolution of 320×180 is 16:9, so it will not have a black bar margin when played in 1920×1080 or any resolution that is even a multiple of 320×180, such as 1280×720. On the Unity toolbar, you can go under Edit > Project Settings > Player and limit the aspect ratios that games will support. If you find a specific configuration works the way you want in the ratio you're targeting but looks bad in certain aspect ratios, you can prevent the window from being at that ratio here. However, keep in mind that not all users will have display settings that will work well with your limitations, so this is not recommended. Instead, enable cropping so that these users will have margins, rather than having to play in resolutions that don't match their screen. Creating Authentic NES-Style Artwork Now that we've discussed how to set up Unity for pixel-perfect art, let's take a look at the basics of creating artwork for games that follow the restrictions of the classic Nintendo Entertainment System. This console generation places a large number of restrictions on artists trying to create authentic images. These restrictions include things like the palette used and the size and number of objects on the screen. Additionally, the import to keep in mind is reference resolution 256×240 when targeting this console. Palette When creating original artwork for NES, there are a number of limitations that artists must follow. Some of them will be consistent no matter what retro console an artist is trying to emulate, while many others are specific to the NES itself. The first, and perhaps most important of these restrictions involves the way the color palette is used in images. The SPN is quite unique when it comes to its color palette because the console's colorful palette is hardcoded to the console. The SPN chooses which color to use in the image by sending a set of values to the graphics processor on the SPN, and then the graphics processor returns the color associated with that value. Below is an image of the NES color palette: These colors cannot be due to the fact that they are part of the console itself. Every game you've ever seen for this console combination of these colors to create their images. Sub-Palette To create combinations used in the game, sub-palettes are created and assigned to in-game sprites or background elements. The SPN breaks down its palette into sub-palettes that can be assigned to sprites and backgrounds. Each sub-palette includes one common color used in all sub-palettes and three unique colors. It is able to load four sub-pallets for the background and four sub-pallets for sprites. In the case of sprites, the general color at the beginning of each sub-palette is treated as transparency. This is an example of a series of sub-palettes used in a game. The top row shows the background sub-palette and the bottom row represents the sprite sub-palette. In this example, black is used as a common color shared across all sub-palettes. Because common colors are treated as transparency on sprites, a second black palette entry is required to be created for the sprite sub-palette, to use it as a visible color. Sub-Palette Assignment Restrictions on the use of palettes get tighter as artists switch to how palettes are used in games. To explain this, there needs to be a further discussion about how retro consoles store, use, and display art. Artwork in any retro console is stored in the game as 8×8 px tiles. Using this tile-based approach allows artists to save space by reuse tiles for different things. (For example, a piece of sidewalk can be changed and used to create a ledge in a building.) Another important thing to note about tile-based storage is that color information is generally not stored with graphics. All tiles are stored with a monochromatic palette. In this way, whenever a tile is displayed in a game it can have a sub-palette assigned to it, allowing the same tile to be simultaneously displayed on the screen with different sub-palettes It is significant when creating artwork that corresponds to the retro console on a modern platform because it affects how you assign the palette to the artwork. The SPN sets the palette for sprites and backgrounds differently. This assigns sub-palettes to sprites based on tile by tile. That means that any 8×8 tile in a sprite can have one of four sub-pallet sprites assigned to it. This Ninja character uses two sub-palettes to provide greater color depth. On the right, you can see it divided into ×8 individual tiles. With this split view, it becomes clearer that the darkest light and red teals used in swords and headbands are unique to the tile, while dark purple and black outline pieces are used on the three remaining tiles. The background, on the other hand, is much more The background sets their palette in 16×16 pieces. Sub-pallet Sub-pallets the entire screen background is referred to as the Attribute Table. This Attribute Table is the reason why most retro artworks involve heavy use of repetitive tile segments. These segments tend to consist of 16×16 tiles so they match the Attribute Table perfectly. Despite responding to hardware restrictions, this 16×16 tile-based approach to the background eventually became a defining characteristic of retro artwork and was absolutely necessary when trying to recreate it. This is an example of a nice RPG-style city background made in limitations. The image on the right shows how the image is neatly split into 16×16 px blocks, and the palette is selected per block. Things like roof tiles, grass, and bricks on the bridge consist of repetitive segments of these blocks to save space. Roof tiles on smaller buildings all use the same tiles, but assign different sub-palettes to give them all a unique look. Sprite Layering Although artists are free to use different sub-palettes for each 8×8 tile of sprites, they may find themselves in situations where they want to have greater color depth in sprites than what is already available. This is where the sprite layers can enter the sprite layer just splitting the sprites into two separate sprites and then placing them on top of each other. This allows artists to avoid one sub-palette per 8×8. Doing this will basically allow artists to double the number of colors that can be used in a single 8×8 area. The only major drawback of doing this is the sprite rendering limit. The SPN is only able to display 64 8×8 sprite tiles on the screen at once, and only 8 sprite tiles in the same horizontal line as each other. Once the numbers are reached, further sprite tiles will not be rendered on the screen. This is why many NES games will flicker sprites when there are many of them on the screen at once. That way, it only displays certain sprites on alternate frames. These boundaries are something that artists need to take care of when they layer sprites on top of each other because while it doubles the number of colors, it also doubles the number of sprite tiles on the same horizontal line. This is an example of Sprite Layering in action. Starting from the left, is the original three-color version of Ghost Pirate Sprite. From there, the artist divides them into two parts, body/hat and face/hand, and gives them a different palette. Finally, you can see the results of layering two sections on top of each other. Sprite layers can also be done with a background to resolve attribute table limits. This trick is commonly used for static images, such as story screens and characters, to give them much greater color depth. To do this, the artist will draw part of the image as background and then layer the sprites on top of it to fill the rest. Ghost Pirate portraits also use sprite layers to provide greater depth. His green skull is being rendered on screen as a sprite, while his collar and hat are being rendered as part of the background. This allows artists to use more colors in an area of 16×16 to completely avoid attribute table constraints. Graphics Banks To explain the large restrictions of the next NES, first, we need to circle back the fact that the chart is stored in tiles. Graphic tiles stored in 256 pages of tiles and tiles from these pages cannot be loaded into VRAM in different locations, making it difficult to mix and match tiles from different pages quickly. VRAM SPN is only able to display these 512 tiles at once. Beyond just that restriction, it divides tiles in half for sprites and backgrounds. That means it is only able to display 256 sprite tiles and 256 background tiles at any given moment. This can be very strict if the artist wants to display a wide variety of sprites and background elements. This is a visual representation of the background and sprite tiles of the game loaded into VRAM. The console cleanly stores backgrounds and sprites that load on separate pages. To combat these restrictions, SPN has a feature that allows artists to break each page into partial pages called banks. So, although the SPN is unable to load individual tiles from different points in the graph data, the SPN is able to load different parts of the page at different times. For most games, these banks will be 1K or 2K banks. 1K banks are equal to a quarter of a page or 64 tile, while a 2K bank is half of a page or 128 tiles. Artists must decide whether they want to order the use of each type of bank for either sprite or Background elements because both types of banks need to be utilized. That means that you can't have a 1K bank for sprites and backgrounds. One page needs to use a 1K bank and the other needs to use 2K. In general, most games tend to use 1K banks for sprites and 2K banks for backgrounds because background tileset tend to be more static and require less in terms of fly varieties. It shows how the same image above has been broken down into banks. The background panel on the left uses a 2K bank, which means it is split in the middle, while the sprite panel on the right uses a 1K bank. Each bank can be exchanged freely quickly. The usefulness of 1K banks for sprites is quite significant. If the player sprite has various animations that won't fit in one page along with all the other sprites that need to be loaded, individual actions can be saved 1K bank and then exchanged between depending on what action happens on the screen. It is also possible to various sprites that can be used in a single area of the game. For example, if the player faces six different types of enemies in the game area, but the sprite page only allows for the player and the other three types of sprites, then when one type of enemy is cleared from the screen, the game can swap one of the enemy banks for a new type of enemy. One of the main drawbacks of using 1K banks for sprites and 2K banks for backgrounds is how NES handles background animations. To animate background elements for NES games, artists must create duplicate banks of animated background elements. Each new duplicate bank will contain the next animated frame for each animation element. These banks are then exchanged in and out one by one like flip-books, to create animations. If an artist uses a half-page bank for the background, then storing all duplicate banks can take up a lot of space. One way to avoid this is to put all the animated background elements for the whole game into one bank. But, it also leaves artists with restrictions of having only 128 tiles left for static elements for each background. It's up to artists to decide the best course of action when deciding what kind of bank they'll use for art. Layering Tricks Many games from that era will use tricks to create parallax-like effects scrolling in the background, but this also presents artists and designers with challenges. Although the 16-bit console is then allowed for multiple background layers, this is not an option on the SPN. All backgrounds are single flattened images. To create a sense of depth and layers, different programming tricks are used. To create a parallax background, for example, developers can set a register that can tell when a specific horizontal line (known as a raster line) is being rendered on the screen. They can then use that register to control the speed and direction of the screen scrolling in by using it, they can create horizontal rows of backgrounds that scroll at different speeds as the rest of the background. The trick for artists and designers at the moment is to be careful that the background is still one flat image. If a platform or other element that is supposed to be in front of a slower moving background is placed in that region, then it will also scroll slower than other images. That means that designers need to pay attention to where they put the background elements in the scene, and artists need to create the background in a way that the effect will be seamless. In this screen example, areas highlighted in red can be set to scroll slower than the background to simulate depth. The Heads-Up view on it will so it never scrolls, although it's also part of the flattened background image. There are also other tricks for artists who want to have one of their background elements appear in the foreground. On an SPN, developers can set the sprite priority to less than zero. When this is done, it will cause the sprite to be displayed behind a background pixel that is not transparent. Sprite priorities can be modified and triggered quickly as well, allowing certain elements to change sprite priorities as needed. Conclusion When someone tries to create an authentic project into a retro console, there are many technical considerations they need to remember that may not be things that modern development should worry about. Because the way older machines will create images and handles has a small amount of room to maneuver with CPUs and GPUs, designers have to think creatively to overcome hardware limitations. In the modern era, it becomes important to learn about these limitations and techniques, to completely recreate the look and design of the game from that era. In the next post, we'll look at the design limitations imposed by the 16-bit era as well as the Unity work needed to get a real old TV feel. Pixel Perfect's 2D guide to 16-bit retro visuals is now available here. — First time designing levels with Tilemap? Explore worldbuilding in 2D in this beginner tutorial on Unity Learn. Learn.

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