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## **STEAM: Make an Animatronic Owl Figure** with Jamie Hudson

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### **Chapter 1 - STEAM: Make an Animatronic Owl Figure**

#### Overview

- Hi, I'm Jamie Hudson. I'm a PhD scientist who started a craft company years ago with his wife. And through that process, I've developed a sort of fascination of bringing kind of technology and scientific methods into art and bringing art and creativity kind of into science and finding that intersection. We're gonna use the print and cut feature of the cricket to play with servos and make ourselves a little animatronic owl, that when you tell a boring story, it's slowly turns his head and judges you. This is a fun project for all ages and a good introduction to basic electronics and servos. (upbeat music)

#### Materials

- To make a robotic owl we'll take advantage of the print and cut feature of the Cricut cutter. So of course you'll need a Cricut cutter, a mobile device to access design space, an inkjet printer to print onto an adhesive film. So we'll use this as an adhesive film. We'll put this onto a cardboard box today, just to take advantage of some recycling. And then for materials, you'll wanna make sure you have a strong grip mat, some basswood to make one small part, the tangential cutter is necessary to cut up the basswood, and then a light grip mat that'll hold down the owl itself. Electronics wise, these are all available online and easy to find. You'll need four AA batteries and a battery holder. You'll need a small hobby servo, and then just a little servo tester that'll help us move the AI's head. To put it all together, we're gonna use just tape, a rubber band. You could use double-sided tape, but I like to use these Velcro dots that are available than the fabric store. It's always a good idea to have an Exacto knife and then just a pair of scissors to help cut up the box. And of course, don't forget to download your SVG files and the PDFs that contain the picture of the outlet itself.

#### Building the Owl

- Let's start by just briefly introducing what a servo is and how they work. Hobby servos have been around for years and originally were analog kind of devices. The way they work is they have what's called a pulse-width-modulated chain. So about every 20 milliseconds it makes a pulse and it just does that on repeat. The width of the pulse determines where the position of the servo goes. So when we set ours up, what we'll do is simply just install the batteries into our little battery holder here, just get those in there and this is gonna be six volts, which is usually what these servos take. This is all pretty cheap. They have a little what's called a JR connector on 'em, it's got power, and we're gonna take this device, which is called a servo tester and it goes through three different modes. One is it'll just go into neutral position or what it thinks is the middle of the servo, the middle pulse width, the other will let you move it using a knob, and the third just sweeps the servo. And so these are really nice and a really fun way just to kinda get used to servos and get some real simple motion in and test out how things look and how they work. To hook it up, it's hard to hook up wrong the way they're designed. Take the plugs and make the black wire is negative, so attach that to the power. The little lights come on and now you can hook up your servo. Again, on the servos there's different standards but the black or brown is negative and again you can't hook this up wrong. If you hook it up backwards it just won't work. Just to show you how the servo tester works, let's just put a little piece of tape on this part, which is the moving bit, and then just watch the three

different modes. One lets you turn the knob back and forth and position it however you want. The other goes into the neutral position, so that's the center of the servo sweep, and the third one causes the sweep all the way from one extreme to another. So this is a very simple, very easy way to bring a little bit of motion into your projects without any soldering. Let's make it a little more interesting and turn it into a robotic owl. We've got our materials ready, so let's go over into Design Space and load an owl in that we're gonna print and cut on the Cricut. First, create a new canvas. We'll go to Upload on the bottom left of the toolbar. We'll go to Upload Image at the top left. We'll say Browse, Owl Body, double-click on that. Now what that does is it imports an image. What Cricut is very smart and does is it takes your picture and it's gonna try and figure out what in that you're trying to keep. And so here I have a transparent background so you can just take the simple option and that will find the outline of that owl. And so what it's gonna do is you'll print it out, the Cricut's gonna go realign, and it's gonna know how to find the owl on your piece of paper and it's gonna carefully cut that out following all the contours, it's really neat. You can play around with simple, moderately complex, and complex depending on your designs when you do this yourself but simple for this will work great. So go to the bottom right and click Continue. It'll give you the option of erasing and modifying. For us, we won't need to do that so just say Continue again. And now what you see is an option where you can either say save as a print then cut image or save as a cut only image. The whole point of this is to print and cut so we'll pick the one on the left, it's the same as most Cricut things, it'll outline in green and then in the bottom right you'll say Save. Okay, before we import that, let's say Upload Image again. We're just gonna go through those exact same steps except this time we're gonna do it with the owl head. (laughs) So we'll say Simple again. We'll say Continue. Nothing to erase, and then again we're gonna do a print then cut image and we'll say Save. Now what we can do is click on either each one of these individually or if you hold down Shift you can multiselect so you can grab two different ones and whichever ones are highlighted in green will be the ones that are imported. So you can go over and say Insert Images. So if you only do it once just go back to that Upload button and import the other. So at this point we should actually be able to say Make It and it'll lay those two images out with the owl head and the owl body and you'll notice there's a black box drawn around it and that's the thing that the Cricut's gonna use to find it. By looking at where the top of the box, the bottom of the box left and right is it can go backwards and figure out where the owl must be based on how it laid it out. And so at this point we're in print and cut. So we'll say Continue and you can say Send to Printer and that'll send this image down to your inkjet printer. Now, just briefly about the paper you're gonna use, it's an adhesive film that's got a backing on it that comes off and it's basically just a giant sticker. Cricut sells this and it's available in a few other places but this is an adhesive inkjet film, anything you print out on will be fine. So first we'll say print and so this is how you'll print that image through your inkjet printer onto some adhesive paper. I've already printed mine out and there's the owl body, owl head with a black box around it that the Cricut's gonna use to realign. I thought I'd use a cheese cracker box. So I'm just gonna cut that up. This is a nice way to use something that was gonna go off to the recycler's. I'll just cut out a piece that's oh, a little bit bigger than our owl and then we'll cut that owl out of the piece of paper as well. We'll just pull off the adhesive backing on that and just apply it like a sticker. Any time you're using a large sticker like this it's a good idea to start at one side, kinda hold it down, and then just very slowly pull it back. If you ever go to a sign shop or something you'll see they do the exact same thing. So we'll just apply it that way. When the Cricut aligns it's looking for these black lines. It's a good idea when you're using a darker colored box just to go ahead and cut off those dark edges of the box so that we have just white showing and then position that white square

onto the mat. Be ready to load it into your Cricut. Back in Design Space let's go over and Browse All Materials and then let's just search for poster board again. Search for poster board, select that, say Done. What I'm gonna do since this cereal box is a little thicker than poster board is we're gonna go into where it says Pressure and let's say more, and what that'll do is just put a little bit of extra cut on there and let's see if that works. Sometimes when you're playing around with recycled materials you might have to try a few things, maybe do two passes on the cut, but it's worth it just to kind of save the world a little bit of wasted paper. So, we'll hit the load button and once it's ready the Cricut light will start flashing and when you see it flash just click it 'cause everything should be okay to go. And then what you'll see is the mat will load and if you look carefully you'll see a little light come on underneath the Cricut. It's looking for where that black line is. It's watching the reflective signal go and so you'll see it find the top edge and you'll see it find, there it goes, the left edge and then you'll see it find some other spots on the top edge to try and figure out whether or not those images have been rotated when you put 'em in there. So this is a really great system. You'll wanna get it as square as you can just to give the robot a hand but it should work pretty well. Once it does that, everything will all align and it'll begin to cut. And when you're done it'll unload, click the Unload button, and check your mat. It looks like that didn't quite cut through the owl. So you could either, it's pretty close, but you could either run around with an X-ACTO knife and try and clean that up a little bit, even get your scissors using it as a guide. Let's try recutting it and see if we can't get it to go on the second pass. So I'm just gonna load again. When it's ready with the Cricut light I'll hit that light again. And it'll go back through, it'll realign everything, and it'll do two more passes on that owl. We'll unload it again and I'll bet that cut through. I like to pull off the negative space first. It looks like that owl is still on there just a little bit. This isn't a very precise thing but oh, look at that. Just a little bit of elbow grease, here comes our owl and our owl head. Let me clean that up a little bit. May have benefited from one more pass through the Cricut cutter. Okay. Now we have our owl head and our owl body look disapproving at us (chuckles) and I think we're ready to make the next piece which is just a little servo mount that's gonna help hold the servo head up here while we have the owl body down here and it can turn back and forth. To make our servo mount, we're gonna use basswood, which requires the strong grip mat and just a piece of basswood. This is a pretty simple little device here. I like lining the wood up at about the two-inch mark on the mat and I'll be clear why. Anytime you're using basswood you need to use the tangential cutter, which is this kind of pretty intense-looking utility knife blade that sits in there. It'll tell us to load it in a minute, and we'll do that. You also need to use a strong grip mat and it's recommended that you tape the sides and the top down. Here I'll just do the sides 'cause this is such a simple cut. Here I'm using art tape but masking tape or anything like that'll work. And we're just doing everything we can to make sure that this piece of basswood doesn't get caught in the blade and start to move around when we're doing the cutting. All right, that's set up. So we'll go back into Design Space, we'll say new, and now I have a blank canvas. In the bottom left click Upload and in the top left say Upload Image, Browse, and then we'll browse down to the SVG you downloaded called servo mount basswood and say save. And we'll select that image that we just uploaded, it'll be highlighted in green and on the bottom right we'll say Insert Images. This is ready to cut. So we'll simply say Make It. We'll take our file and we'll move it over that two-inch line because again, that's where it's at on the material so we'll move it to about, let's say 2-1/2 inches over, that's plenty, and say Continue. We'll now want to select the material. We'll just go to browse all materials and you can search for basswood and we'll select the 1/8 inch basswood and it'll tell us that we need to load the knife blade into clamp B. So we'll move over and take out whatever is in there and we'll set this knife blade in there carefully because that

thing is indeed very sharp. Don't find that out the hard way. One important note when you're working with the basswood is to always take a look at these starwheels that are used to help clamp down the material while they go back and forth. Because that basswood's so thick you wanna move those out of the way. So you just wanna make sure that when this mat loads the basswood won't have one of these wheels driving over the top of it. When it's ready to load this light will flash, click it, it'll load, and then the Cricut light will come on when it's ready to cut. So go ahead and click that and now it'll load, it'll drive over, it'll actually find the orientation of that blade so that it knows how to always keep the blade moving in the same direction of the cut that helps cut the basswood a lot better. The other thing the Cricut cutter does is it takes several passes, up to 14 passes to cut through. So you have to be a little bit patient with it but it's worth it for the results. Sometimes when you're cutting basswood it's taking multiple passes and it'll actually cut through far enough it can get in and cut your mat. For such a simple cut like this, this'll be very easy to clean up with an X-ACTO knife. Let's just go ahead and cancel it here after about eight passes. Say yes I wanna cancel the cut and it'll just unload your mat for you. We'll go back in, we'll pull off the tape. Since basswood breaks and the mat doesn't, what I like to do is keep the basswood flat and then just pull the mat away by bending it carefully away and as we do that what we find is that in fact that cut through and that we have our little servo holder. We have a little square in the middle here and that should just punch right out and if it doesn't just grab an X-ACTO knife and very carefully come around and clean up those edges. Since it's all straight lines, this is a really simple thing to do. We'll set that aside. So here's our servo mount and I think we have all our parts to start making our owl. The servo plugs into the back of this little thing, so it fits right in there. To hold it on, in principle you can use the little screws that came with it but I do this all the time where I just get a piece of tape and hold it on that way 'cause it makes it just a lot easier. And what's fun about this is we've got a little bit of motion, we've got some parts. What can we do that's just kinda fun and interesting. I like keeping it really simple and if you can hold it on there with a piece of tape that's great. If at some point later you wanna make it a little more robust, that's great too. Grab another piece of tape. And what I'm doing is I'm just taping over the back of these servo horns and holding 'em down to the piece of wood. Here I'm using yellow art tape but masking tape works and something that maybe that looks a little bit more like the color of an owl might be a little subtler. I'm gonna go ahead and trim the top of the tape off of there just in case that owl's head comes over the top. To attach the head to the servo, we're gonna use these little servo horns that came with the servo that you bought. There's usually a couple different varieties. A nice versatile one is this things. You can take the rest of them and use 'em in a different projects. Basically, this is a little horn that sits on top of the servo and as that servo rotates that horn rotates. So just to get this in about the right spot we're gonna put it on the back of the owl's head and then just use a piece of tape to hold it on, 'cause again tape works really well for this. There's probably a much fancier, more robust way to do this but art and crafts often are about just being fast and fun with it. So, let's just take a little piece of tape and attach that to the back and put a little piece of tape across the top there and then I'm being a little sloppy with them over the edge but I'm gonna come around with my scissors again and just cut off all that visible tape because I'm sloppy. You're probably better at that than I am. But just like that we have an owl head that sits on our servo and then we're gonna have the body sit underneath that. So let's just go ahead and plug that back into our servo tester real fast. Again, the brown wire goes to negative. It might be black on your servo. And then as we go through those modes what we'll already start to notice is that there's your owl head. So again, if you recall on this it has three modes; sweep, one that lets you move the position, and one that goes into the neutral

position, and this is a good chance to take that owl head that you mounted and then just get it as close to centered. I happen to get really lucky there and do it almost perfectly, but get it really close to centered so that when we have this mode we'll be able to sweep it from looking that direction all the way to that direction. To put this together we're gonna keep it very simple. Let's just leave it all plugged together and I'm gonna use a rubber band and I'm gonna take that rubber band and just double it over. You could use glue dots or a piece of tape again but it just makes it nice and easy to put on there. What's cool about this is those batteries act like a counter weight and give that owl a little bit of balance. And we'll wanna take the owl body itself and mount it here. It looks like that owl body is just a little bit too tall to fit underneath the servo. So what I'll do is I'm just gonna cut a little hole around the neck here. I just left a little bit extra there just so you can kinda play around with it. But let's just go ahead and cut this neck out a little bit just with a pair of scissors. Let's see how that looks. (chuckles) It looks great. Let's go ahead and just, because I like to sort of position that owl around and have a little bit of fun with it that way as well, let's put a VELCRO dots. I'm gonna pull 'em off as a pair and set those onto the base and then I'm gonna take the owl body itself and I'm gonna just push it in to grab that dot and so what that means is that if you want you could take this off and try it in a different orientation if you wanna have it be a little more jaunty, a little taller, a kind of a squatty owl or a tall owl. It's kinda whatever owl you want it to be and again the owl head just pops right off the servo whenever you want. That is your robotic owl. The way this works is if somebody starts telling you a really boring story, for example, "I was walkin' down the sidewalk "and I saw a sign "and that sign seemed like maybe it was misspelled," slowly the owl just looks maybe bored at you. (laughs) That owl is judging you. So that's my judgmental owl. So anytime someone starts telling you a boring story the owl can just slowly look over and be sad. And I'm moving its head just using this nice little knob and if I want I can move it into this mode where it's centered. Of course I can move into this mode where it just rocks back and forth. (laughs) Maybe it's just slowly dancing to its own music. What's really nice about this is you have a servo owl. The same hobby servo can be used in lots of programming environments like Pi and Arduino and all kinds of neat hobby electronics and what we've done is just take a very simple picture and turn it into a very simple robot. Going through something like this servo tester let's you just kind of play with the motion, make sure it's sort of funny enough or is doing what you need it to do. What's really nice is you can amuse your friends, confuse your pets, bemuse yourself, and of course maybe do something other than an owl. I'm really excited to see what you guys are gonna do with this project.