Automatic Dice Roller
Created by Ruiz Brothers

https://learn.adafruit.com/automatic-dice-roller

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Overview

Project Usage
This project allows people who need accessibility tech to "roll" the dice. Use it to play games like Yahtzee, left right center, math activities, war with dice, rock paper scissor dice and even bowling dice.

Toys & Games
Just press the glowing arcade button to spin the platter! The twisty top snow globe easily comes off and you can put dice or whatever object (LEGO maybe?) you want on the platter to roll and spin. The platter spins pretty fast so you can get a good roll. Or use D20's to make a random number generator!

Assistive Tech – Switch Adapted
This idea originally came from the ATMakers.org facebook group. A thread about adapting a dice roller featured some ideas and started the conversion about different design methods. Member, Brady Fulton, shared a concept he designed in Fusion 360 that I really liked and decided to base our design off his.
Built for Project Lessons

Think of this project as an introduction to electronics and mechanical design. As an educator, this type of project could be useful to teach students how to approach problems and how they can solve them with design and engineering.

Automatic Dice Rollers

These devices are available from online retailers. They all kinda look alike and have similar designs, a black cylindrical box with a cup and small button to make a green velvet platter spin. Our version is much more colorful, visually appealing and generally more fancy.

Prerequisite Guides

If your new to electronics and soldering, I suggest walking through the following guides to get the basics. The Adafruit Excellent guide to soldering will walk you through process of learning how to use a soldering iron to make solid electrical connections.

- Adafruit Guide to Excellent Soldering ()
- Collin's Lab: Soldering ()
Electronic Components

The VERTER 5V USB Buck-Boost, DC Motor and LED arcade button are the main electronic components used in this project.

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<td><a href="https://www.adafruit.com/product/80">https://www.adafruit.com/product/80</a></td>
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<tr>
<td>with 5.5mm/2.1mm plug</td>
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<td>1 x Alkaline 9V Battery</td>
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<tr>
<td>Battery power for your portable project</td>
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<td>Panel Mount 1/8&quot; (3.5mm)</td>
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Hardware and Supplies

Just a few screws, wires and some handy supplies.

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<tr>
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<td>1 x</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>1 x <strong>Panavise</strong></td>
<td>1 x</td>
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<tr>
<td>1 x <strong>Helping Third Hands</strong></td>
<td>1 x</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1 x <strong>Ultimaker 2+</strong></td>
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**Cool Tools!**

These help make the project a smooth building experience. You don't need them all of them, but I recommend them.

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<tr>
<th>Item</th>
<th>Quantity</th>
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<td>Hakko Professional Quality 20-30 AWG Wire Strippers -</td>
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<tr>
<td>1 x <strong>Ultimaker 2+</strong></td>
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Pick Your Circuit

I've come up with two different circuits that do the same thing but differ in cost and complexity. The circuit documented in this guide uses VERTER, a $10 Buck-Boost that does far more than needed in this build but makes wiring everything much easier. The less expensive version uses a diode and extra wiring to create the same functionality.

Circuit Diagram – VERTER

In this circuit all of the components are connected to VERTER. The pins are labeled on the PCB and make it easy to wire up.
This provides a visual reference for wiring of the components. They aren't true to scale, just meant to be used as reference.

- 9V Battery negative (black wire) to VIN– on VERTER
- 9V Battery positive (red wire) to VIN+ on VERTER
- Switch to EN and G on VERTER
- LED anode (positive) to 5V on VERTER
- LED cathode (negative) to G on VERTER
- Motor blue wire to VOUT– on VERTER
- Motor red wire to Button
- Button to VOUT+ on VERTER

Note: The LED is embedded in the 24mm Mini Arcade Button but is displayed as a separate component in the diagrams. A resistor is built-in and not required in the physical build.

The 3D printed case does not accommodate space for a breadboard or Perma-Proto PCB.

Circuit Diagram – Diode

This circuit shows how to use a diode to drop 9V (which will drop to 8V under load) to about 7V for powering the DC motor and LED. This method is less expensive but
might cause more difficulty in wiring. This circuit is nice if you're looking for the most cost effective build and have intermediate experience soldering.

3D Printing

https://www.youtube.com/watch?v=zrratSbl44g

What If I Don't Have A 3D Printer?

Not to worry! You can use a 3D printing service such as 3DHubs () or MakeXYZ () to have a local 3D printer operator 3D print and ship you parts to you. This is a great way to get your parts 3D printed by local makers. You could also try checking out your local Library or search for a Maker Space.

Slice Settings

These parts have been tested and 3D printed on an Ultimaker 2+ and 3 using PLA filament. The parts were sliced using CURA 3.x with the following slice settings.

- 220C extruder temp
- 65c bed temp
- 0.2 layer height
- 0.38 line width
- 2 Wall Line Count – 0.4 nozzle
- 20% infill
- 70mm/s print speed
Design Source Files

The spool holder carousel assembly was designed in Fusion 360. This can be downloaded in different formats like STEP, SAT and more.

CAD Assembly

The parts are designed to be snap fitted together. Each piece has either a male or female connecting feature that tightly locks together. This makes the assembly much simpler as it doesn't need hardware or adhesives.

3D Printed Parts

All of the parts are 3D printed with FDM type 3D printers using various colored filaments. All of the parts are separated into pieces to make 3D printing easier. Assembly is pretty easy and straightforward. Use the links below to download the STLs files.

Design Source Files

The enclosure assembly was designed in Fusion 360. This can be downloaded in different formats like STEP, SAT and more. Electronic components like the DC motor, VERTER Buck-Boost, arcade button and more can be extracted from the Fusion 360 Archive.
Rotational Motion
The 3D printed wheel is mounted to the shaft of the DC motor. A radial ball bearing is press fitted over the base. The platter is mounted over the outer ring of the bearing. When the wheel rotates, it turns the platters.

Switch

Switch for VERTER
We'll need to connect a slide switch to the VERTER in order to turn the circuit on and off. We'll need to make two pieces of wire, about 3in length. I suggest using 26AWG silicone coated wires which is flexible stranded wire.
Prepping Wires
Next, we'll want to prep the wires in order to attach them to leads of the slide switch. Using wire strippers, remove a bit of insulation from the tips of each wire.

Tinning Wires
Tin the exposed wires by applying a small amount of solder. This will help to prevent the strands of wire from fraying when soldering to pins and leads. A third helping hand tool can assist by holding the wires in place while soldering.

Wires for Switch
Now we're ready to attach the wires to the leads of the slide switch. We only need two of the three leads so we can remove one, either the far left or right, but not the middle! Use a pair of flush diagonal cutters to snip the third lead off from the switch.
Solder Wires to Switch
I secured the body of the switch to third helping hands to make it easier to solder the wires onto the leads. Tinning the leads of the switch with a bit of solder will make it easier to attach the wires.

Connecting Switch to VERTER
Now we're ready to connect the wires from the slide switch to the VERTER board. We'll be attaching the wires from the switch to the EN (enable) and G (ground) labeled pins.

Tinning Pins on VERTER
I suggest using a Panavise tool to secure the board while soldering. Tinning the various pins with a bit of solder will make it easier to attach the wired connections.
Wired VERTER
Using the tip of the soldering iron, heat up the solder on the pin and insert one of the wires while the solder is molten. Repeat this process for the second pin. Double check your solder joints and ensure you have a solid connection.

Power

Powering VERTER
Next up we'll work on hooking up the power source to the VERTER board. A 9V battery clip will connect to the voltage in and ground pins on the VERTER board.

Prep Battery Clip
The 9V battery clip includes a DC barrel jack. We'll need to remove it and prep the wires. Use wire cutters to snip off the connector leaving as much wire as you can. Like the slide switch, remove a bit of insulation from the tips of each wire and tin them with a bit of solder.
Soldering Wires to VERTER
Now we can solder the wires from the 9V battery clip to the voltage and ground pins on the VERTER board. The red wire goes into the positive (+) labeled pin while the black wire goes to the negative (–) pin. I used a panavise Jr. to secure the board in place while soldering the wired connections.

Wired VERTER
Double check your work and ensure you have solid solder joints. They should look like the photo with similar wire lengths. Colored wires help tell the connections apart.

Testing 9V Battery
Now we can test out the switch by installing a 9V battery into the 9V battery clip. Use the slide switch to test the power. The green LED should be lit on VERTER when powered on. If not, double check your work and ensure you have a fully charged 9V battery.
Motor

Wires for DC Motor
The DC motor includes wires but they are not long enough to reach the circuit when installed. So we'll need to remove these and add some longer ones. The ground wire should be about 4 inches long. The voltage wire should be about 6 inches in length.

Remove Wires
You can remove the wires from the motor by heating up the solder joints with the tip of the iron. You can keep note of the polarity if you'd like. The DC motor will rotate in the opposite direction if the polarity is reversed. I used a panavise jr. to secure the DC motor in place while soldering.

New Wires for Motor
Now we can attach the new longer wires to the DC motor. Note the orientation of the wires, they're attached horizontal instead of vertical like the original wires. Having the wires in this orientation makes the assembly easier.
Connect Ground from Motor
The ground (black) wire can now be soldered to the negative pin on VERTER. This is our first connection for the motor. The positive red wire will be connected to the arcade button in the next page.

Button

Wires for Arcade Button
The arcade button will need three new pieces of wire. These should be about 4 inches in length. I picked 2 red colored wires and a single black one. A red and black wire pair will connect the LED from the button to VERTER. The single red wire will connect to the motor and VERTER.

LED Button Connections
We'll need to familiarize ourselves with the electrical leads on bottom of the arcade button. Total of four, 2 sets of 2. The lower two leads are for the embed LED. The upper two leads are for the momentary switch. Use icon in the center as a visual reference for the correct orientation.

Anode(+) on the RIGHT
Cathode(−) on the LEFT
Tinning Button
I tinned the four leads of the arcade button by adding a bit of solder to each. This just makes it easier to attach the wires to them. I was able to secure the button to the jaws of the panavise jr. so it was stable while soldering.

Wired LED
Attach the red and black wires to the leads that are connected to the embedded LED. The anode (positive) connection is the one on the right while the cathode (negative) is on the left when referencing the previous photo with the wire lengths.

Add Motor Wire
Now we can attach the single wire to one of the two remaining electrical leads. It doesn't matter which one since we'll be connect the motor to the remaining lead.
Button Box
Before we hook up these wires to the motor and board, we'll need to panel mount the body of the arcade button to the button box. Grab em’ and get ready to install it!

Install Button to Box
Start by inserting the wires from the arcade button through the top of the bottom box. Then press the body through the hole until the flange is flush with the surface of the box. It should have a loose fit, so no need to screw it in.

Installed Button
Now grab the included plastic hex nut and thread the wires through the nut while fastening it onto the threading of the arcade button. Twist to screw the hex nut until its fully tightened the arcade button to the box.
Install Box to Frame
Next up we'll work on attaching the frame to the button box. I used two short M2.5 sized flat Phillips machine screws and hex nuts to join and secure the two parts together. You can optionally use glue or other adhesives if you'd like.

Install Hardware
Line up the holes on the side of the frame and button box. Then, while holding the two parts together, I inserted the screws through the inside of the frame while fastening with a screwdriver. I held a hex nut on the tip of my index finger on the other side of the box while fastening. Repeated the process for the second screw.

Secured Button Box
Here's the two pieces secured together with machine screws and hex nuts. I think it works very well and you don't have wait for glue to dry so that's nice.
Solder Motor Wire to Button
With the arcade button now panel mounted to the box, we can continue to work on wiring up the components. We'll need to connect the red positive connection from the DC motor to the last available lead on the arcade button – should be next to the single red wire.

Connect Button to VERTER
Now we can connect the single red wire from the arcade button to the positive connection on VERTER.

Connect LED to VERTER
Next up we can connect the voltage and ground wires connected to the LED on the button to the 5V and G labeled pins on VERTER. The 5V pin voltage pin connects to the positive (anode) connection. The G (ground) pin connects to the negative (cathode) connection.
Test Circuit
Now we can test the circuit we have so far. Turning on the slide switch should power on VERTER and the LED in the arcade button. If not, double check your work and ensure you have solid solder joints.

TRS Jack

Wires for TRS Jack
We’ll need two wires to connect the TRS Jack. These should be about 4 inches in length. Just like our previous wires, using wire strippers, remove a bit of insulation from the tips of each wire and add a bit of solder to tin them.

Wiring TRS Jack
Two of the three leads on the jack will need to be bridged together in order to properly connect to AT switches. Insert a wire through the hole of one lead and thread it through another.
Solder Ring to Tip
We'll use a bit of solder to connect the wire to both leads on the jack. A bit of extra wire may be helpful. Try keeping the jack stable while soldering. Holding the wire with third helping hands might also be helpful.

Solder Wire to Sleeve
Now we can attach the second wire to the remaining lead on jack using a bit of solder.

Check Solder Joints
Thoroughly inspect the solder joints and see if they're solid. Double check the leads to ensure the correct ones are bridging.
TRS Jack to VERTER
Connect one of the wires from the jack to the positive pin on VERTER. I’m using the secondary pin on the voltage output. This pin arrangement is typically for USB.

Solder TRS Jack to VERTER
A bit of solder here to seal the deal.

Connect TRS Jack to Motor
Now we can connect the second wire on to the jack to the motor. This wire will need to share a connection with the lead that has a wire connecting to the arcade button. Soldering to the existing lead might cause the first wire to come loose so you might need to hold on to both of them while soldering.
Test TRS Jack Circuit
With everything wired up now we can test out the circuit. The LED should light up and motor spin when pressing the button. To test the jack, you can connect a regular pair of headphones or 1/8 audio cable and see if that makes the motor spin. If everything is good, we start putting it in the enclosure!

Assembly

Install TRS Jack
Panel mount the jack to the frame. You'll want to remove the hex nut from the jack first. Then, insert the tip of the jack through the hole on the inside of the frame. If it's too tight to fit all the way through, use a filing tool to sand. Use the hex nut to secure the jack to the frame.

Secure TRS Jack to Frame
Use a pair of pliers to grasp onto the hex nut and fasten tightly. The nut should have a good hold on the frame and jack. Avoid twisting up the wires on the other end of the jack.
Install VERTER to Base
Place the VERTER PCB over the standoffs on the base. Line up the mounting holes near the battery connections with the holes in the standoffs. Insert two M2.5 x 5mm flat Phillips screws into the mounting holes and fasten until fully tight.

Installing Switch
Insert the body of the slide switch into the switch holder at an angle and firmly press down. The actuator should protrude through the opening. The switch should have a snug fit and holds in place.

Installing DC Motor
Press the body of the motor into the motor mount on the base. The leads should be oriented with the cut away so they don’t intersect with the mount.
Installed DC Motor
The leads should be facing the opening so the wires should be fine. The motor should have a decent hold once in the mount but it should be easy to remove it as well.

Install Bottom Cover to Frame
Now we can joint the base (bottom cover) to the frame. Line up the nubs on the frame with the indentations on the lip of the base. Firmly press them together until they click into place.

Install Battery to Clip
We can connect the 9V battery to the battery clip, if we haven't already. Be sure to fully seat the electrodes of the battery to the clip, they should click when fully connected.
Mounting Battery
I added a piece of mounting tack to the battery so I can stick it to the base. This prevents the battery from moving around inside the enclosure. You can optionally use double-stick tape or similar.

Secured Battery
There's just enough room on one side of the base for the 9V battery to fit. Just be sure to position the wires so they are not being kinked from the battery.

Install Bearing
Now we can install the radial ball bearing to the base. The inner ring of the bearing should press fit into the nub on the top of the platform. It should have a snug fit so you may need to firmly press down on it to fully seat it.
Install Wheel to DC Motor
The wheel should be press fitted onto the shaft of the DC motor. There's a small hole in the center that should allow the shaft to be inserted through. The top surface of the wheel should be lined up with the top of the shaft.

Installed Wheel
The diameter of the wheel may shrink during the cooling process after 3d printing, so I purposely designed the wheel slightly larger. Here I'm using a sticker label to note the diameter of the wheel in CAD, not in physical space.

Cover and Cap
The cap snaps on top of the cover. The inner nubs on the cover will click into the indentations on the edge of the cap.
Installing Cap to Cover
You'll need to firmly press the two parts together to get them to snap fit together. Just be sure the features are lined up. I found fitting them at an angle first works better than trying to connect both nubs are the same time.

Installing Cap to Frame
Now we can fit the cover/cap onto the top of the frame. Line up the indentations on the side of the lip on the cover with the nubs on the frame. Firmly press them together to click them together. Lots of snap fitting parts here!

Installed Cap
The cover/cap should be flush with the frame. The front facing side of the frame features a cutaway – This allows you to pop off the cover when you need to change the battery. You can use your finger nail or a prying tool to remove the cover.
Bottom Cover for Button Box
Now we can fit the button box cover over the button box. It's got a short nub on the box so you can easily press fit the bottom cover.

Installed Bottom Cover
Here’s the bottom cover installed, it’s flush with the button box with a very slight gap between the two parts. The tolerances should be pretty snug so there’s very little wiggle room.

Using Velvet on Platter
When the platter spins, the surface needs to be able to toss dice around. The surface of the platter as is straight off the printer will be fairly smooth so it won't be able to do much to the dice. I cutout a piece of velvet/velour paper and stuck it to the top surface of the platter. This works well and gives the surface a texture. I used scissors to cut out a circular piece using the platter as a template. Secured with double-sided scotch tape.
Installing Platter
Now we can fit the platter over the outer ring of the radial ball bearing. It should have a fairly snug fit but should be easy to remove and pop off as well. Firmly press down on the platter to fully seat it onto the bearing.

Installed Platter
Spin the platter with your finger to test it. The platter should rotate evenly, without too much wobble. If there's a bit of wobble, inspect the inside cavity – You may need to clean out any spring or plastic bits that may have formed during the 3D printing process. Use sand paper or filing tools as necessary.

Rotating Platter
Now it's time to test it out! Power on the circuit with the slide switch and press the arcade button to get the platter going. It should spin fairly fast. If you find the platter will not spin, the wheel must be stuck. Give it a turn and feel how "loose" the platter can rotate. If its hard, you may need to print the wheel slightly smaller to minimize the friction between the platter and the wheel.
Installing Snow Globe to Cap
If everything is working properly, you can secure the snow globe onto the cap by twisting it on. The thread on the cap should mate nicely with the snow globe.

Secure Globe to Cap
The thread on the snow globe requires 1.5 revolutions to be fully fastened.

Testing with Dice
The DC motor will struggle to rotate the platter with too much weight. I've tested with 4-5 dice (d20 type) which is ~22 grams in weight. I tried fitting 7 D20 dice (38g) and it struggled to rotate. When there's too much weight the motor simply cannot handle the load. But for most use cases, it should be fine!