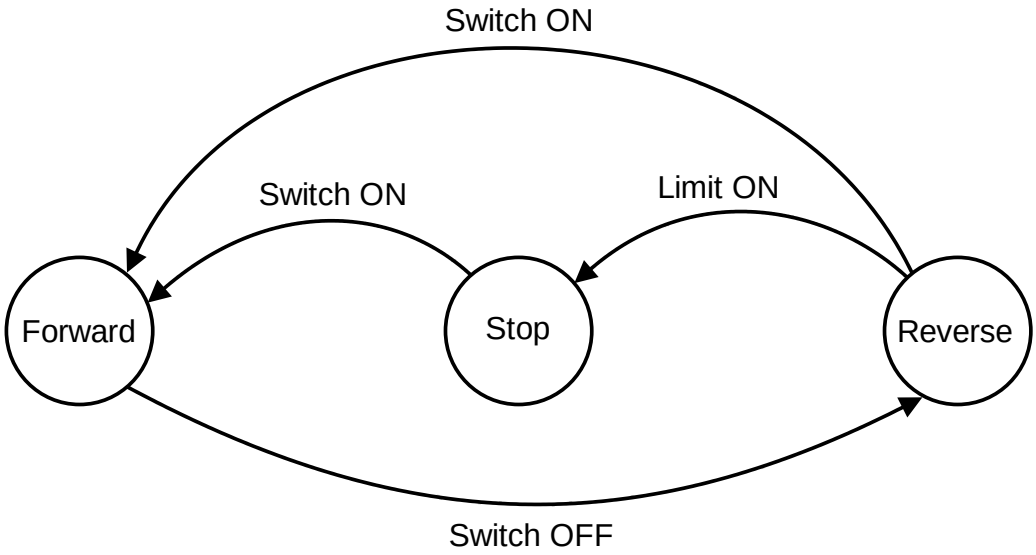
Electronics Lab Circuit Building Activities:

HALLOWEEN HACK!

Welcome to the 2021 Halloween Hack! This year we are making the really-useless Coffin (Box). This is a mechanism that when switched on… switches itself off! The system consists of a toggle switch, motor and limiting switch. The motor has an arm attached to it which is positioned to be able to push a switch when triggered. It may seem a little pointless, but it does have some interesting examples of circuit design in terms of use of components and switches as well as a simple state diagram.

State diagram:



Useless box State Diagram

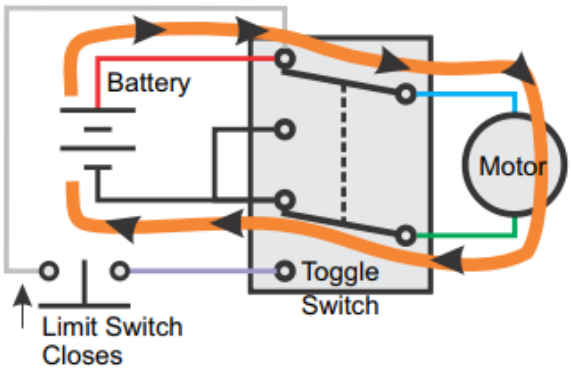
Great resources:

Fantastic basic background notes from Stanford: introduction to making:

https://web.stanford.edu/class/archive/engr/engr40m.1178/slides_sp17/lecture07.pdf

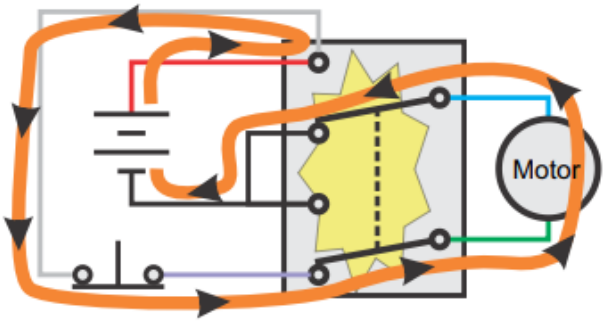
PRINCIPLE OF OPERATION

The circuit is quite straightforward. Follow along with this schematic description:



Motor is toggled on, turning clockwise, moving the arm to the switch.

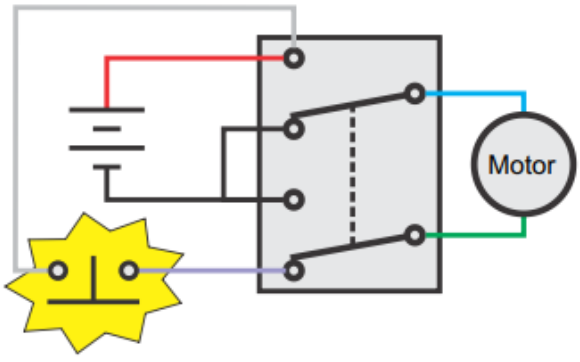
When the arm starts extending, the limit switch inside closes.



CLICK!

The motor successfully toggles the switch, and the power reversed direction.

The arm starts retracting back into the box.



BUMP!

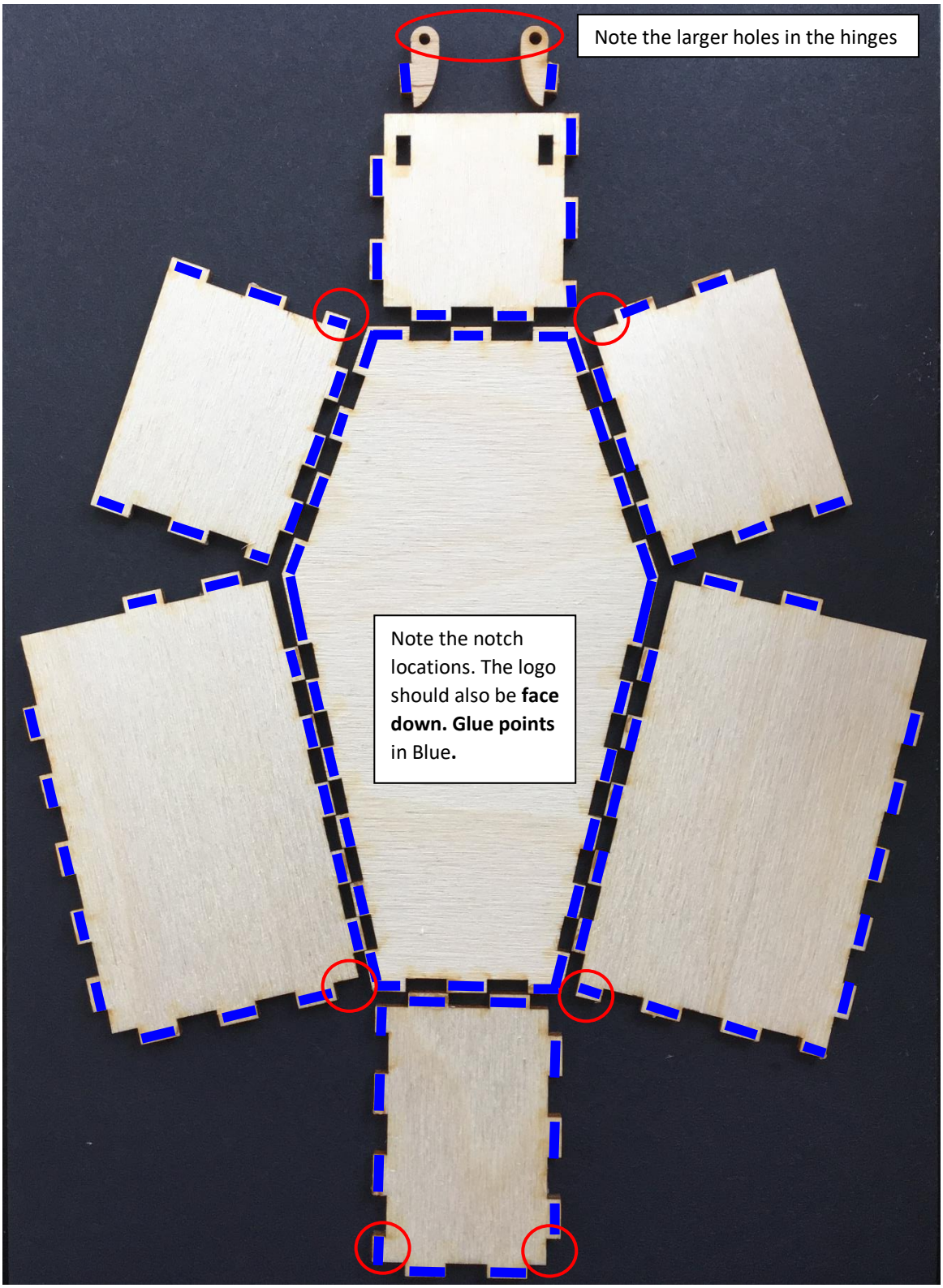
Fully retracted, the limit switch is pushed down, disconnecting power from the motor.

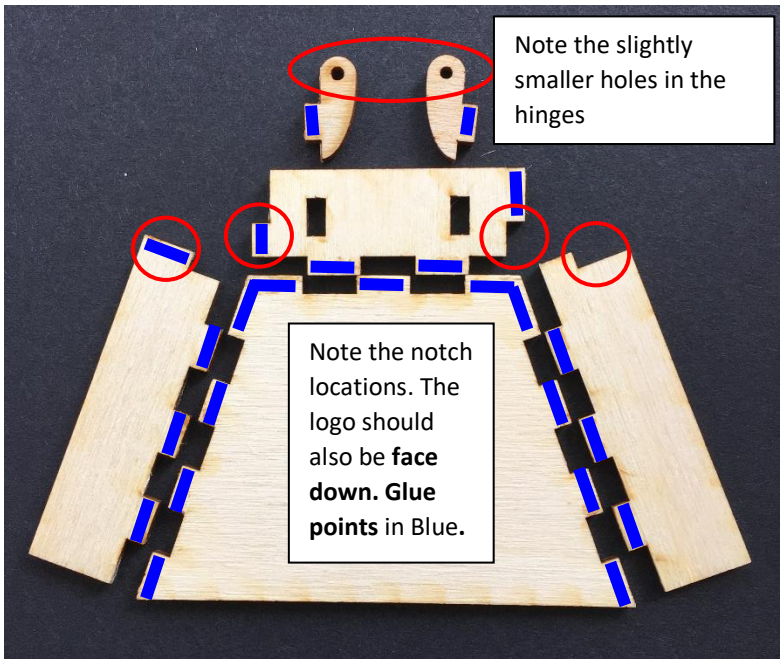
Now it's ready for another cycle!

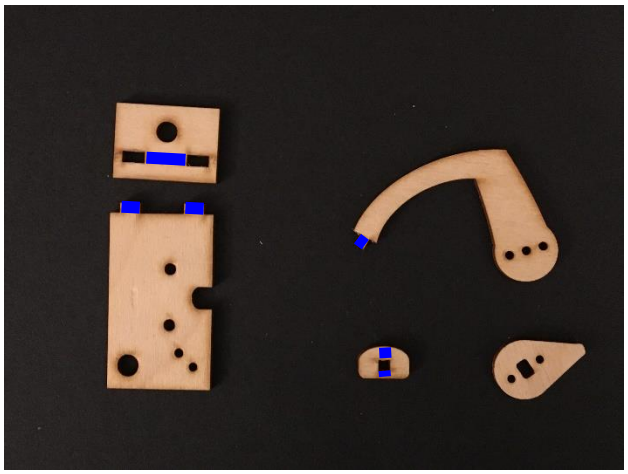
Extract from https://www.solarbotics.com/product/60005/ manual showing useless box operation.

Putting it together

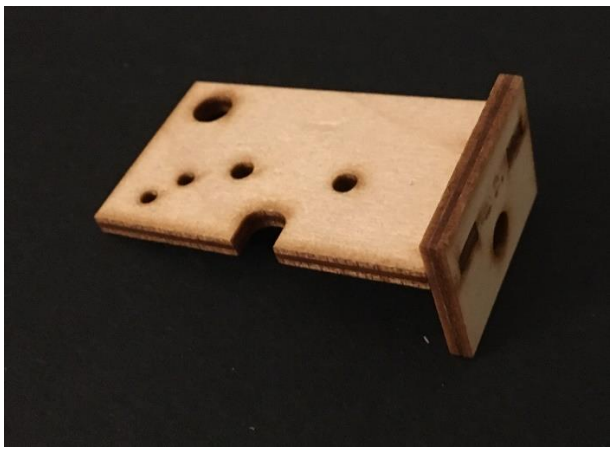
To make the box layout all the parts as below. Note the important parts that are circled as these will need to be in the correct orientation.





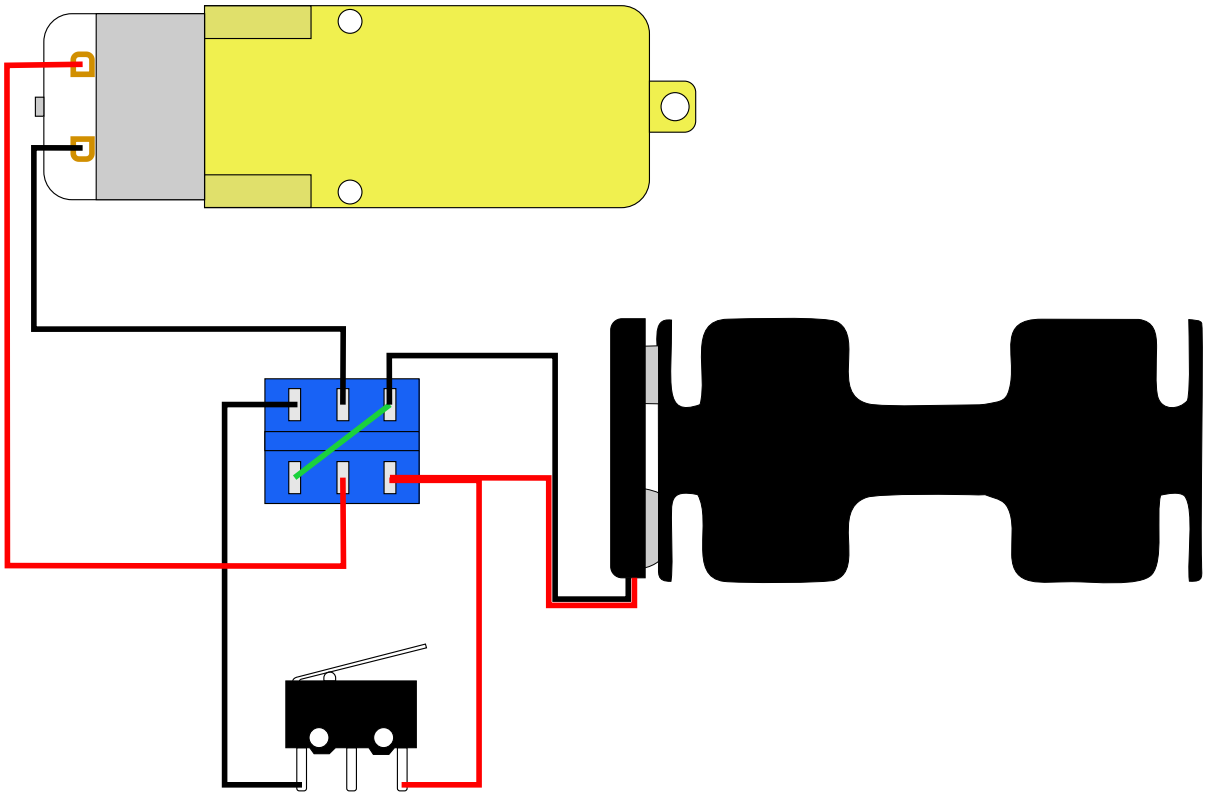


Internal component holder, arm, handle and crank



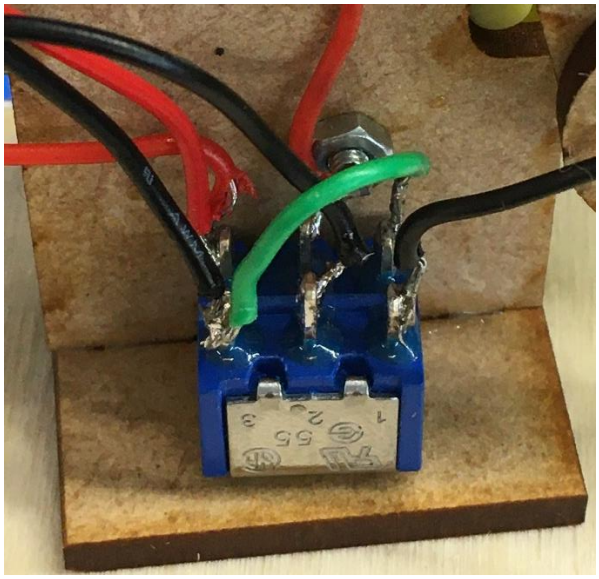
Glue the internal component holder in the correct orientation.

Soldering the connections together



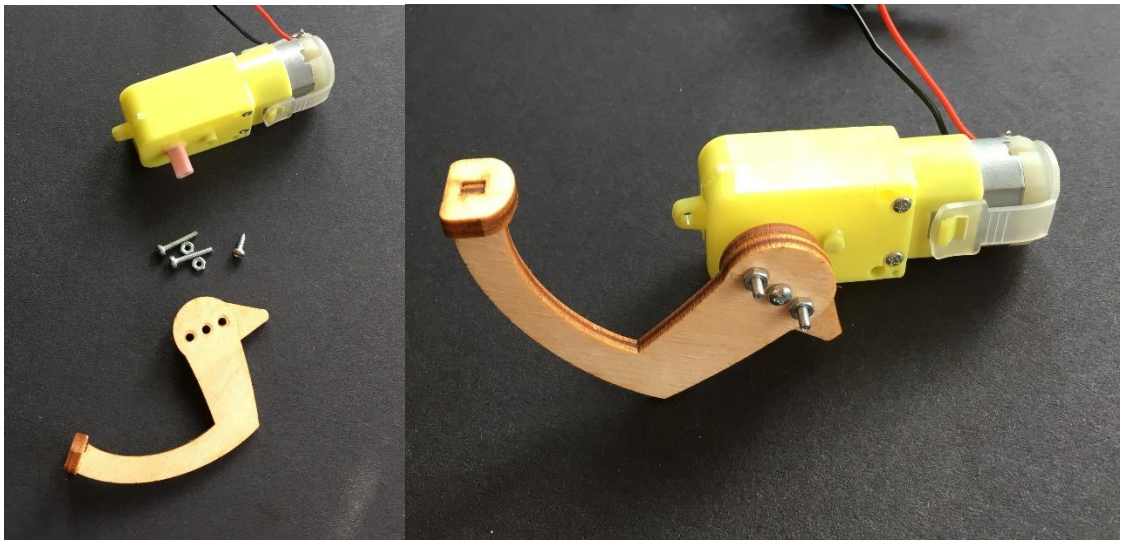
Wiring for circuit useless machine

Start by soldering the 1. Motor pair, 2. Battery, 3. Switch, 4. Green connecting wire.

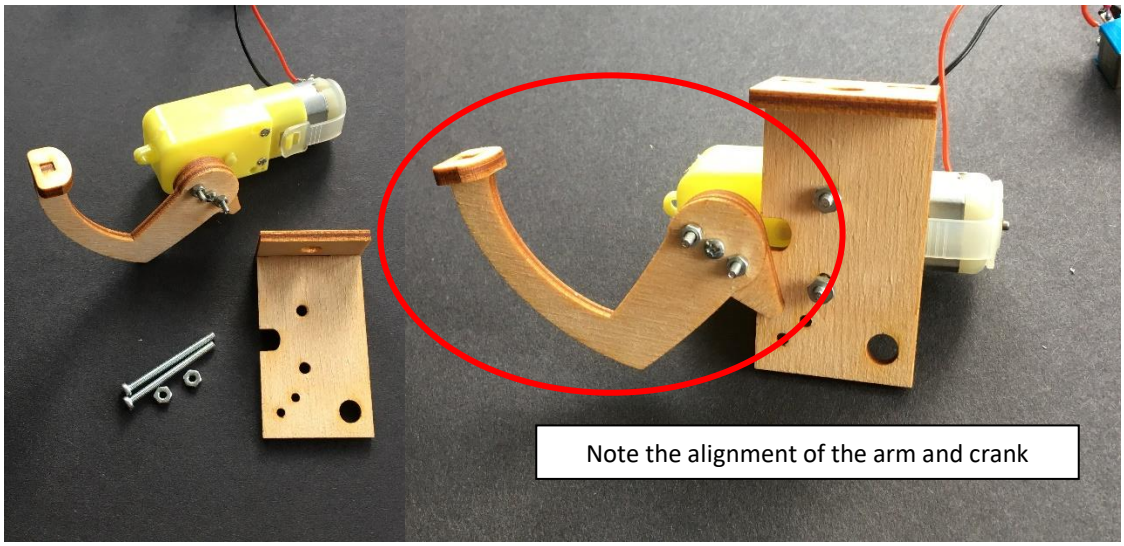


Soldering the connections to the switch

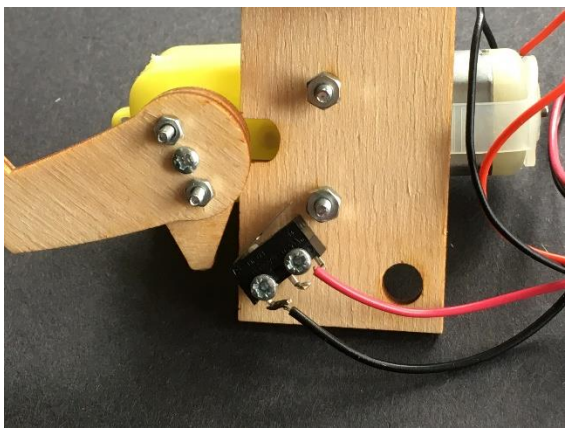
Putting together the components in the box.



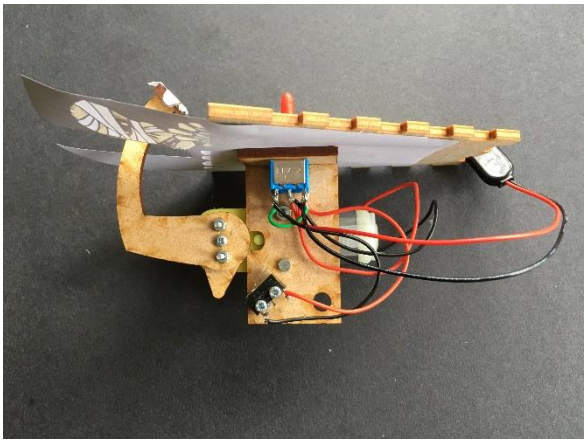
Using the provided screws bolt the arm and crank together. Fix to the motor axel as shown with the small screw (shortest screw with point).



Connect the motor and arm assembly to the component holder using the long screws and bolts.



Attach the microswitch to the 2 holes to the right of the crank. Rotate the arm back over the microswitch to ensure it activates correctly before tightening the bolts. The internal mechanism is now complete.

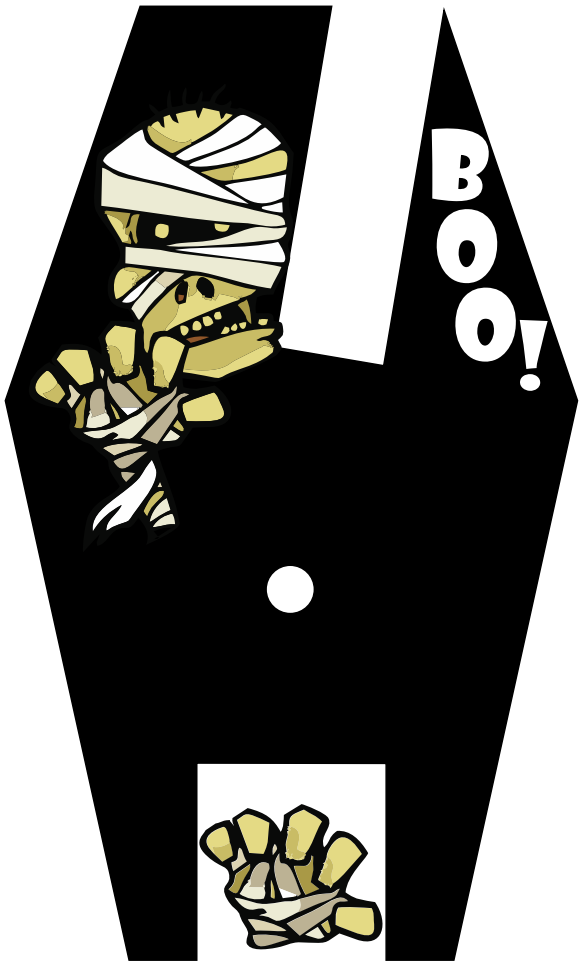


Optional: Use one of the cartoon monster cut-outs in your box. This will also help you align the arm at the correct angle. Clamp the paper cut-out between top part of the box and internal mechanism using the switch and holding nut.

Connect the batteries or battery pack and test that the mechanism switches itself off. Faults may occur if the parts are not held in the correct position, or the switches are in the incorrect orientations.

Happy Halloween!


BOO!


BOO!


BOO!


BOO!

Parts list:

Item Use	Item description	Quantity	Order code	Supplier
Cam to motor spindle	M2.2 6.5mm Screw	1	51-3160	Rapid
Cam to axel	M2.5 10mm Machine screw	2	33-2202	Rapid
Cam to axel	M2.5 nuts	2	33-1705	Rapid
Coffin hinge	M2.2 9.5mm Screw	2	51-3161	Rapid
on/off switch	DPDT Toggle switch	1	75-0097	Rapid
For attaching microswitch	M2 12mm Machine screw	2	33-6544	Rapid
For attaching microswitch	M2 nut	2	33-1725	Rapid
For attaching motor 25mm M2	M2.5 30mm	2	51-3039	Rapid
For motor, 2 for Cam	M2.5 nuts	2	33-1705	Rapid
Yellow main 6V motor	Motor	1	MC02751	Farnell
Stop Switch	Micro switch	1	78-0735	Rapid
Power	AA battery holder	1	18-0125	Rapid
Power	AA battery	2		
Power	PP3 clip	1	18-0106	Rapid
For Motor and Switch	9cm Length of red lead 7/0.2	2	01-0631	Rapid
For Motor and Switch	9cm Length of black lead 7/0.2	2	01-0621	Rapid
Switch link	3cm Length of green lead 7/0.2	1	01-0624	Rapid

Rapid (Rapid Electronics): https://www.rapidonline.com/

Farnell: https://uk.farnell.com/