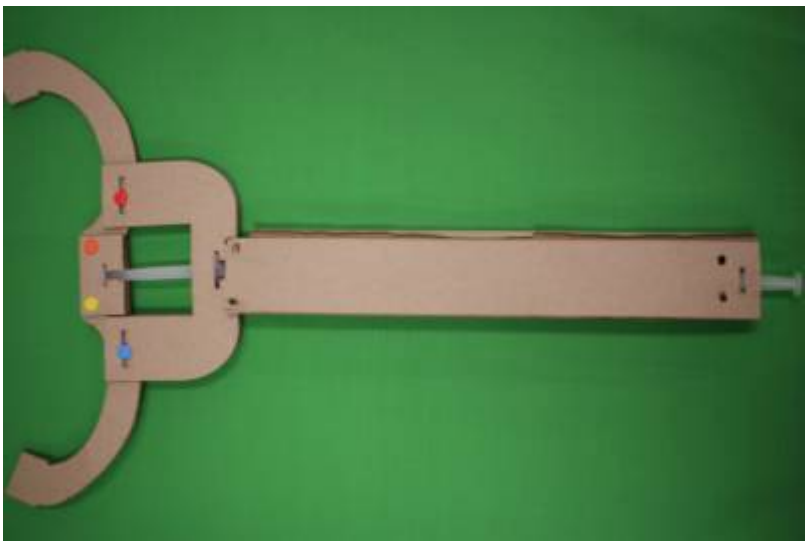
Cardboard Claw

SLQ Wiki Fabrication Lab 2024/07/15 09:25

Cardboard Claw



This workshop was devised by Peter Musk to address a brief to produce a STEM activity to suit all ages, that could be run by unskilled facilitators working without tools or glue, and costing less than $2.00 pp.

The prototype workshop described below has been run successfully several times, and if the sequence of instructions is followed, it can be completed in less than 30min. While the components were laser cut for these trials, costs could be reduced if volumes are increased to the extent that outsourcing a die-cut design using 3mm Kraft board. Costs for the design described were $3 - 4.00 pp at the time of delivery.

Summary

This workshop combines hydraulics and simple mechanics to produce an operational gasping tool made from cardboard.

Because water is used as the hydraulic fluid, it is important that no air bubbles are present in the closed system and that opening and closing the claw is done slowly. Rapid action of the linked syringes will cause a cavitation effect that produces an air bubble in the system, and the device will not function fully. This bubble can be removed, and the syringes refilled, but to do this the device must be dismantled and re-assembled. Alternatively, users could experiment with using an oil based system (cooking oil would work), which will avoid the cavitation effect (but will be a messier build).

Inherent inefficiencies in the construction have been minimised by the design of the gripping jaws - angled jaw faces mean they will close even when the device is not working perfectly.

Materials

For each participant

- i x set cardboard pieces (see design files below)
- 2 x 2mL disposable syringes (slip tip)
- 200mm approx 6mm OD soft plastic tubing (depends on length of handle)
- 1 x 100mm zip tie
- 1 x 150mm zip tie
- 4 x 20mm long round metal paper brads (split pins)

Tools

Participants can complete this workshop without using tools or glue, but it is helpful to have on hand

- scissors or side cutters to trim zip ties and cut tubing to length as required

Instructions

Step 1: Check for fit

Locate the parts required: two syringes, and a length or plastic tubing.

Attach one syringe to each end of the tubing, and lay on the handle part to check for length:

- the barrel flange of one syringe fits into the slots at the bottom of the handle
- the tubing lies along the length of the handle
- the barrel flange of the syringe at the gripper end must be just clear of the top of the handle

Trim the tubing to length if necessary.

Step 2: Fill the system with water

It is essential that the closed system is completely filled with water (NO bubbes) for the claw to work.

- Start by attaching a syringe to the tubing, and push the plunger down fully,
- place the end of the tubing into the water container and then draw back the syringe to fill the tubing with water. Some air in the syringe is OK at this stage
- remove the tubing and fill the syringe completely, directly from the water container
- hold the syringe vertically with the plunger down, and push up to expel any air bubbles present (you can flick the syringe to get the bubbles to the top, just like a doctor in the movies)
- push the filled syringe back onto the tubing, and check that no air bubbles are present. Get rid of them if they are.
- draw up a small amount of water into the other empty syringe, and remove bubbles as before.
- push the second syringe onto the open end of the tubing, and check again all air bubbles have been removed

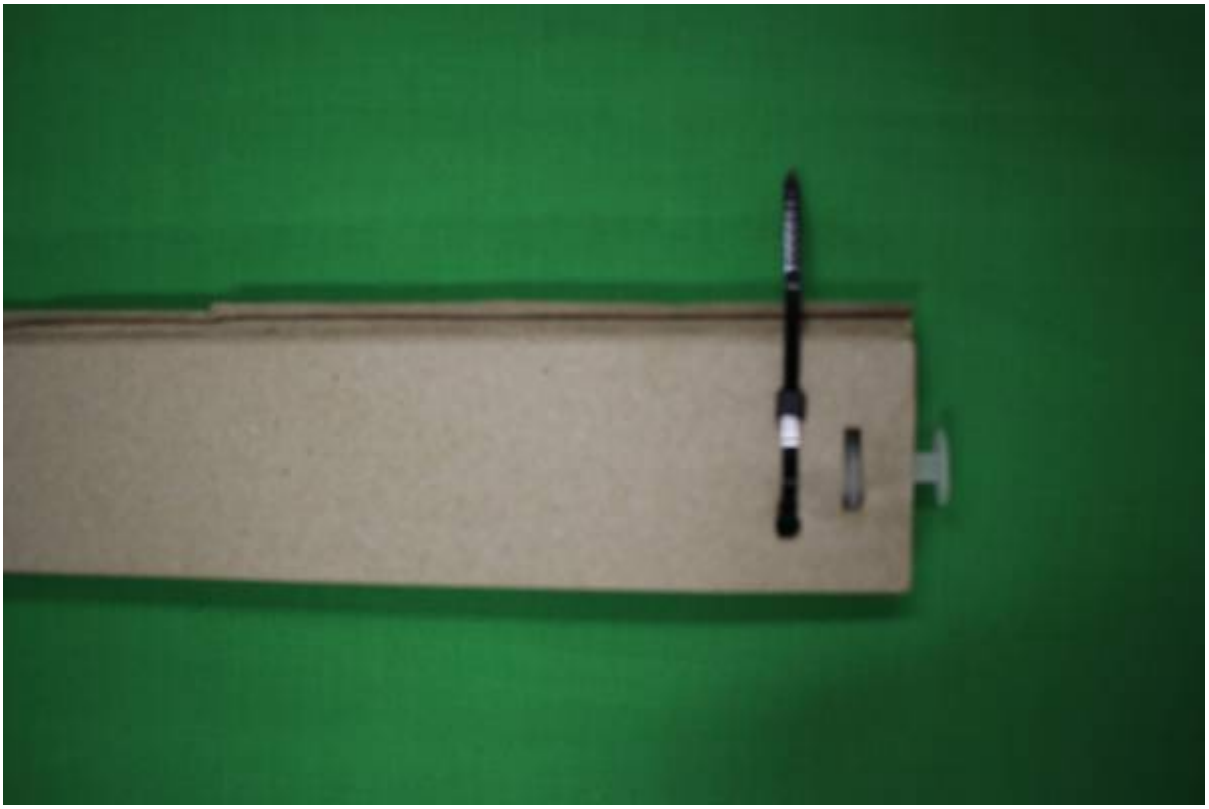
You now have one syringe filled with water, attached to a tube filled with water, and with an emptied syringe attached to the other end.

Step 3: Fit the syringes into the handle

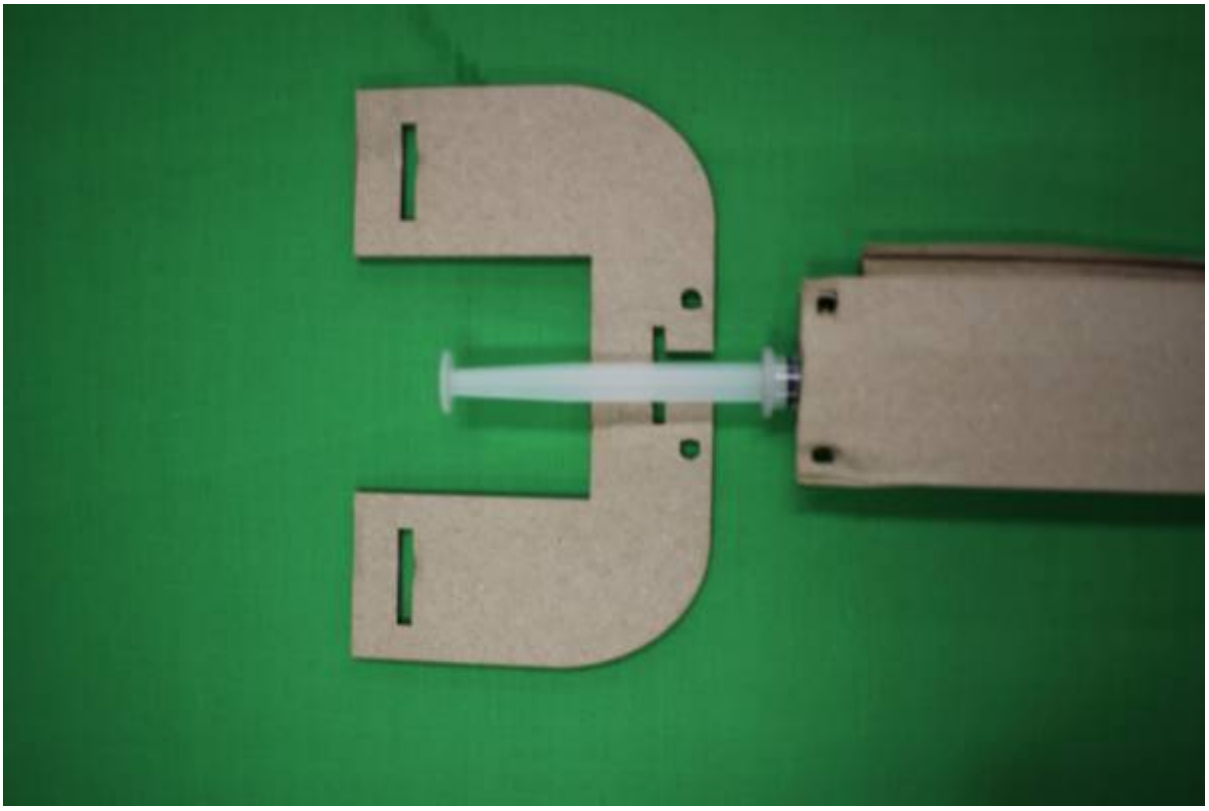
It helps if you fold the handle first along the score lines, and then unfold it again. This way you can be sure it will close easily when the internal pieces are in place.

Lay the syringes and tubing down the length of the handle, with the barrel flange of the EMPTY syringe fitting into the slots provided (you might have to turn it through 90 degrees to fit into the slots). The empty syringe will have the plunger completely depressed.

Fold the handle along the scores to close it over the syringes (making sure the flange fits into the slots on both sides), and fix a 100mm zip tie through the holes to lock the bottom syringe in place.



Step 4: Attach the claw yoke



The claw yoke has a slot that fits the barrel flange of the top syringe, and two holes that will align with holes in the top of the handle.

It comes as two identical parts, one that goes underneath the syringe, and the other that goes on top.

Fit both parts of the yoke around the syringe, and slide them down into the top of the handle so the holes for the zip=tie align.

Push the 150mm zip tie through the holes, and tighten to lock the base of the yoke in place.

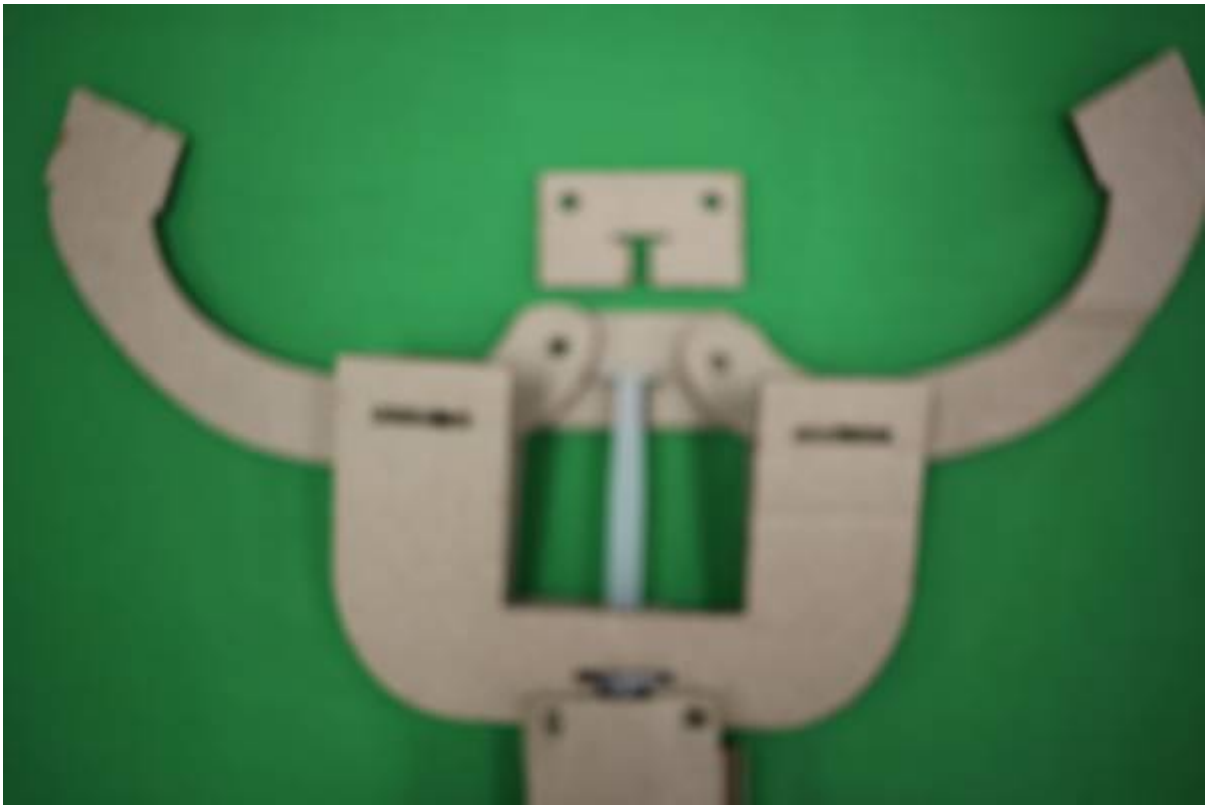
Step 5: Set out the back end piece

The end piece also comes as upper and lower parts, each with a slot for the plunger flange of the top syringe.

The holes will align with holes in the claw arm in the next step.

Lay the bottom end piece over the plunger flange, and get the claw arms ready.

Step 6: Set out the claw arms



The claw arms fit in between the end pieces, so lay them out accordingly, aligning the holes as best you can.

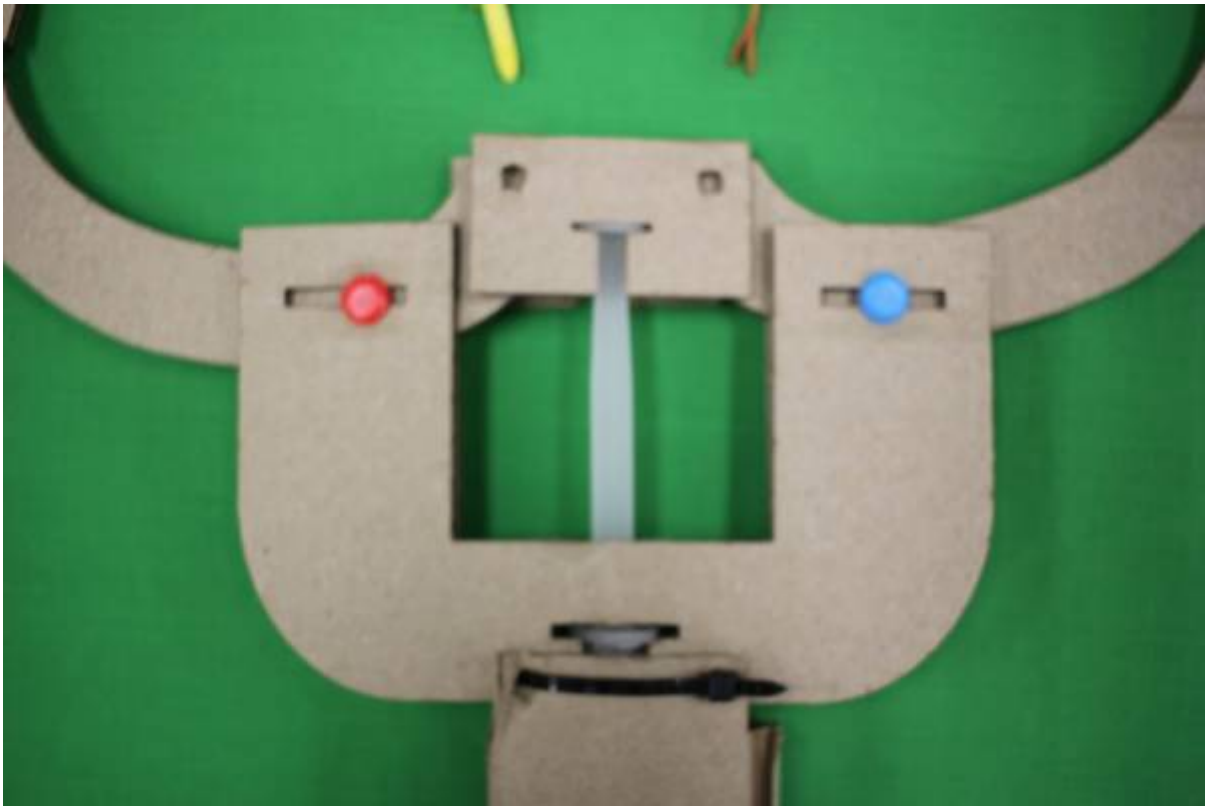
Note that the bottom hole on each claw arm matches a hole in the end piece, and the upper hole aligns with the slot in the yoke.

If the top syringe is completely extended as in the picture, it makes aligning all these holes a bit easier.

Step 7: Set out the front end piece

You can now lay the front end piece in place, and get the paper fasteners ready to join everything together.

Step 8: Join the yoke to the claw arms

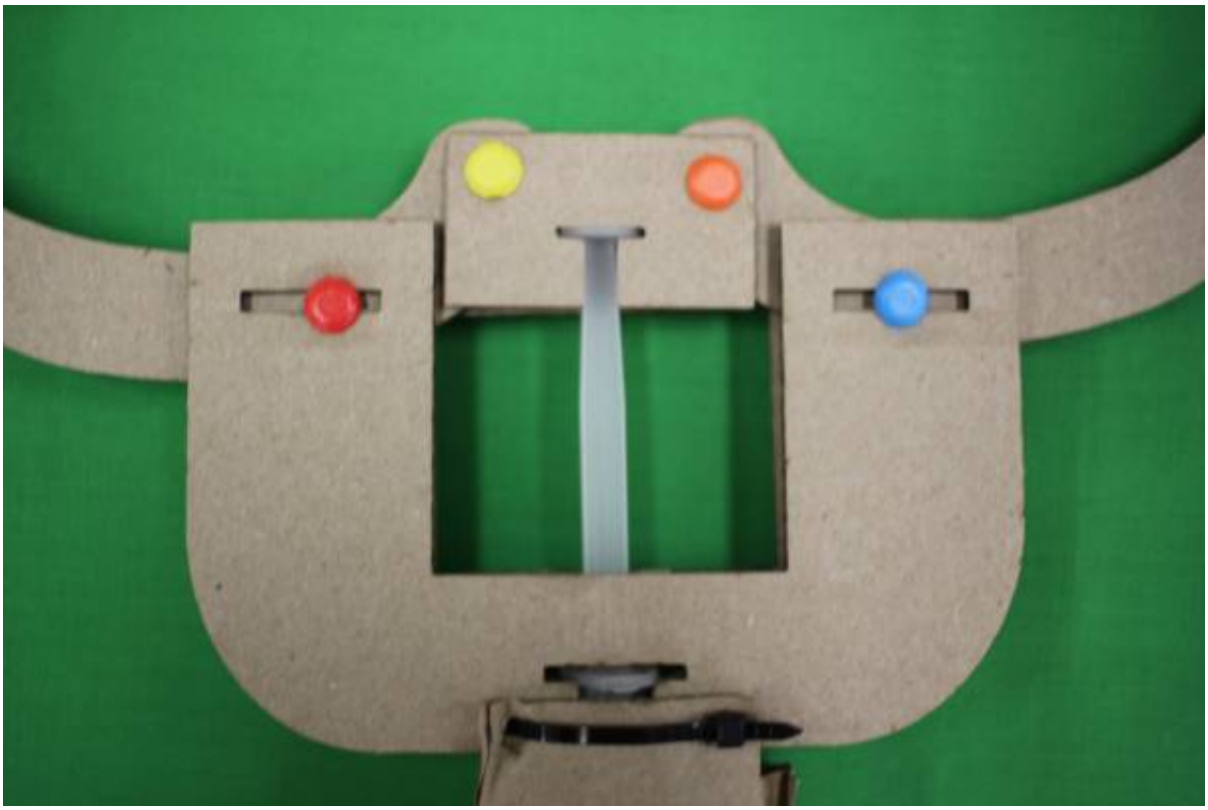


Push the split pins (or paper brads) through the slot in the yoke, and the inner holes in the claw arms.

Bend the ends of the split pins apart and down to lock them in place.

These pins will need to slide along in the slot, so do not press too hard - if they end up too tight to move freely, you can open the split ends, and try again.

Step 9: Join the end pieces to the claw arms



You can now fix the claw arms to the end piece with the last two paper fasteners.

Align the holes in the ends of the claw arms with the holes in the end piece (making sure the plunger flange is fitted into the slot provided), push the split pins through and bend the legs down as before. Thus time making a tight fit is preferred.

Step 10: Operational tips

When you have finished assembly, the claw arms will be wide apart. Pulling down on the syringe at the end of the handle will pull the end piece towards the handle, and bring the claw arms together.

If things get stuck

- check the pins that go through the slots in the yoke can move freely - the less binding here, the better.
- after a while, the claw arms might not move as far as they should - this is a sign that a n air

bubble has formed in the system. Unfortunately, the only way to fix this is to cut the zip ties, and remove the bubble. Sometimes this will mean disassembling and re-fill the tubing and syringes with water. The quicker you push the syringes, the more likely this will happen - slow and steady is best.

Files

Cutfiles:

cardboard_claw.zip

Instructions (word doc handout):

cardboard_claw_assembly_instructions.docx