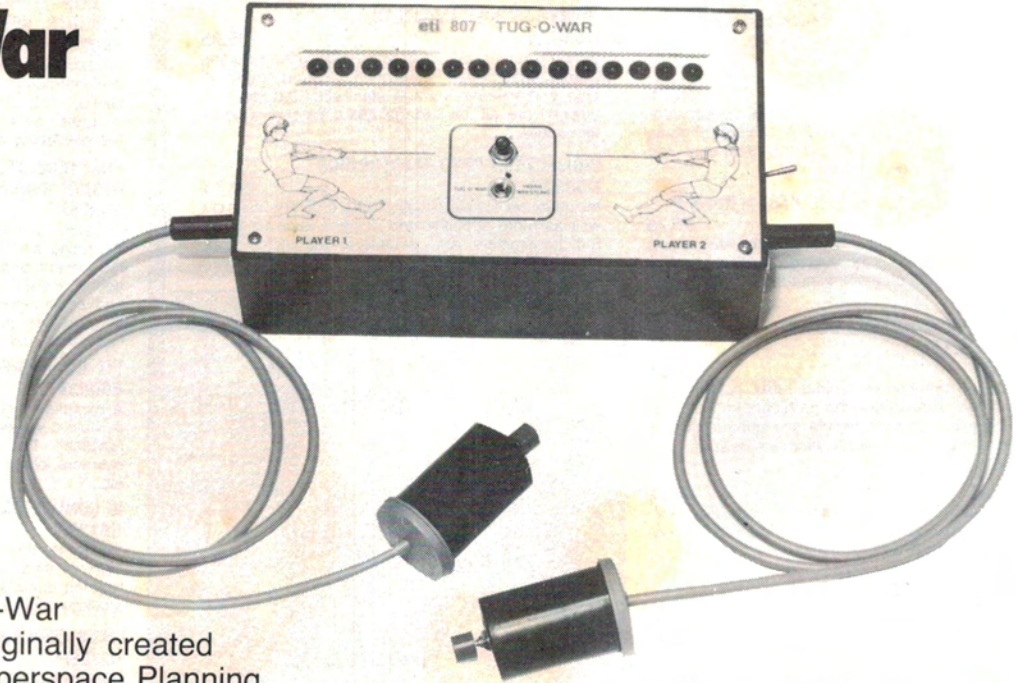


HOURS OF FUN!

Tug-O-War Game

Peter Ihnat



Try our electronic intergalactic Tug-O-War decision maker! Originally created for the Galactic Hyperspace Planning Council, you can build and use it right in your own home.

IT'S BEEN SOME TIME now since we published a simple row-of-LEDs type game. This project is quite simple to build and play but has a special challenge all its own. The Tug-O-War consists of a row of 15 LEDs, one of which is lit at any time. To start a game, press the reset button and the middle LED will come on. You and your opponents are each armed with a pushbutton. By rapidly and repeatedly pressing your button, you try to 'pull' the LED which is on towards your end of the unit, as does your opponent. Each pushbutton press causes the LED on your side of the LED currently on to light. So with no opponent, the LED closest to you will light after seven presses. The same goes for your opponent. The aim of the game then is to win by 'pulling' the lit LED down to your end of the unit by pressing your pushbutton as fast as possible.

Easy, I hear you say. Don't be fooled by the apparent simplicity! After many battles fought in the ETI lab, we noticed that intense concentration is required to win — a laugh, cough or any distraction can lose you some LED positions which are hard to regain (a jab in the opponent's ribs usually distracts them long enough for you to catch up). Another observation was that anyone who plays arcade video games regularly has a noticeably higher button-pushing speed and can maintain it over

relatively long periods of time (i.e: Geoff Nicholls wins most times!).

Extra features

Three minor additions to the basic game are incorporated in this project. Firstly, I have included a 'game select' switch for those who would rather *push* the lit LED away from their side instead of *pulling* it towards them. In one position, the game played is *Tug-O-War* (pull towards you); in the other position it is *Indian Wrestling* (push away from you). But note that the direction of LED movement is the only difference between the two games.

Secondly, I've connected each of the end LEDs back into the circuit so that when either is reached, the circuit latches and further presses of the pushbuttons are ignored. If flashing LEDs are used in the end positions, then a very effective 'win indication' will result!

The final addition is a sound option. Using a low cost buzzer, the game 'beeps' with increasing speed as the lit LED approaches either end of the unit. This type of aural stimulation is quite effective in such a game since it induces the player to press his pushbutton faster as he draws closer to winning.

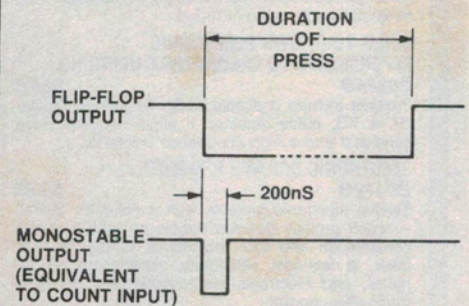
Any of the three additions just discussed can be left off the current project. Including them, however, doesn't increase the

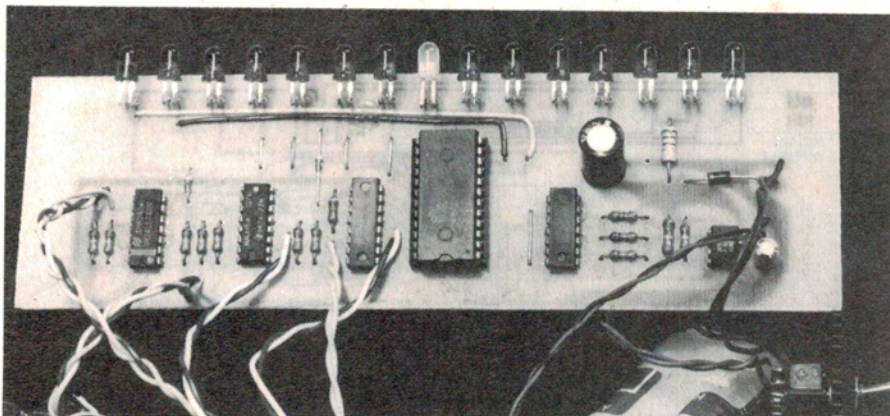
HOW IT WORKS ETI-807

The heart of the game revolves around IC3 and IC4. IC3 is a binary up/down counter which has two clock inputs — count up and count down. Its four outputs feed IC4 which is a 4-to-16 line decoder. Its 'truth' table, showing its complete operation, is given in Table A.

Only one of its outputs will be low (0) at any time — which output depends on the value applied to its four inputs. For example, 0000 on the inputs causes output 0 to go low; 0111 on the inputs causes output 7 to go low. Here, 15 LEDs are connected to these outputs and their common side goes to +5 volts through the current limiting resistor R9. The state of the counter determines which one of the LEDs will be on.

In basic terms, a player feeds pulses into either the *up* or *down* count input of the counter. This causes the next LED either left or right of the lit LED to light, depending on which player pressed his button.





cost of the unit too much but makes the game just that much more exciting.

Construction

I constructed the project on a printed circuit board. While it's not essential, it does markedly reduce the amount of wiring required and the possibility of wiring errors, especially if you're new to this hobby. I recommend you either purchase a ready-made pc board (or a made-up kit, saving all the bother of chasing parts), or you can make your own. The board artwork is reproduced elsewhere if you want to copy that, or artwork is available through out artwork service (see the 'Shoparound' page this issue).

The front panel I 'dressed up' with a plastic Scotchcal label. Like pc boards, these are quite easy to make (see ETI September 1977, Photostats of this article are available through ETI Reader Services, see page 3 this issue). If you purchase a made-up kit though, a Scotchcal label will likely be included. The box I used is a common plastic 'zippy' box.

Begin construction by first checking the pc board, whether you bought it ready-made or etched it yourself. Make sure that there are no broken tracks, small links between close tracks or incorrectly drilled holes. If all is well, then mount and solder the seven wire links as shown on the component overlay diagram. Note that the five short links can be bare wire, whereas the longer two should be insulated hookup wire as a precaution against shorts.

Next, insert and solder the resistors, capacitors, diodes, and finally the ICs.

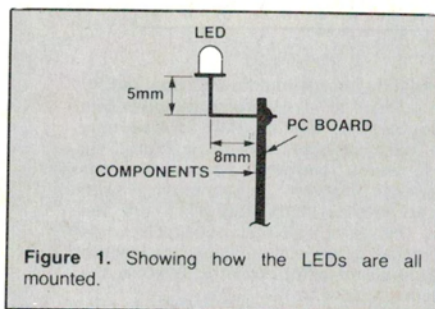


Figure 1. Showing how the LEDs are all mounted.

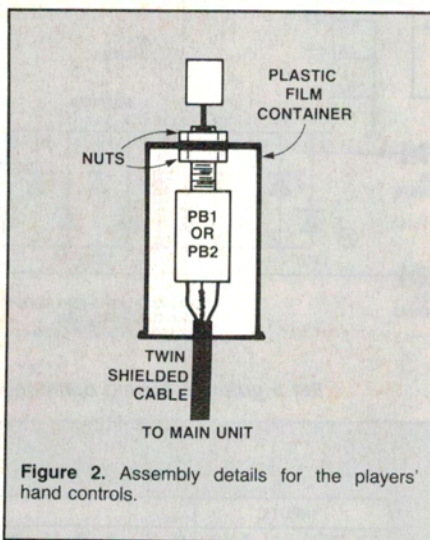


Figure 2. Assembly details for the players' hand controls.

Check the orientation of the two capacitors, the diodes and ICs. IC sockets are not required unless you are dubious about soldering the ICs directly.

The tricky part of construction is mounting the LEDs. Each LED needs to be oriented correctly and its leads bent over 90 degrees about 5 mm from the base. These can then be positioned and soldered to sit approximately 8 mm off the pc board (see Figure 1 and the photos). If you're adding the options, now's the time to do it. Watch component orientation (check with the component overlay).

Drill the holes required in the front panel and sides of the zippy box. Mark out the positions carefully and centre-punch them before drilling. Clean off any burrs afterwards.

To stick the Scotchcal label onto the front panel, use the following technique. Firstly, spray paint the panel with white paint to prevent any imperfections in the aluminium from showing through the thin plastic Scotchcal material. Put it aside to dry. Next, peel the paper backing off the Scotchcal label and soak the label in water. Scotchcal, and most contact-stick plastics, become less tacky when wet and this allows them to be handled much more

PARTS LIST — ETI-807

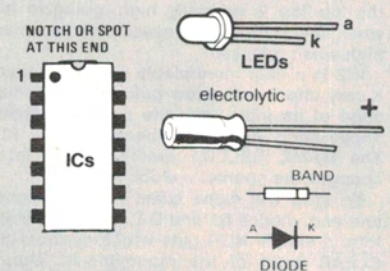
Resistors	all 1/4 W, 5% unless noted
R1-R7, R11*	15k
R8.....	470R
R9.....	220R
R10*	27k
R12*	5k6
R13*	270k
R14*	120k
R15.....	(see text), 1 W
Capacitors	
C1*	1µ/16 V pc-mount electro
C2.....	220µ/25 V
Semiconductors	
IC1.....	74LS74
IC2.....	74LS123
IC3.....	74LS193
IC4.....	74LS154 or 74154
IC5*	74LS86
IC6*	555 timer
D1, D2.....	1N914, 1N4148
LED1, LED15.....	5 mm flashing LED (optional; otherwise as for LED2 etc.)
LED2-LED7, LED9-LED14.....	5 mm red LED
LED8.....	5 mm green LED
ZD1.....	5V1, 1 W zener (see text)
Miscellaneous	
PB1, PB2.....	SPDT momentary-action pushbutton switch (or DPDT type, e.g: Dick Smith cat. no. S-1220).
PB3.....	SPST momentary-action pushbutton (e.g: Dick Smith S-1102).
SW1.....	DPDT ultra-miniature toggle switch (e.g: Dick Smith S-1245), if required.

ETI-807 pc board; 60x113x196 mm zippy box; Scotchcal label; buzzer* (e.g: Dick Smith L-7009); two stereo 3.5 mm jack plugs and sockets (optional); 4xAA battery holder; dc power socket if mains eliminator is used (see text) fifteen LED bezels; hookup wire; two metres of twin-shielded cable; nuts, bolts, film containers, etc.

Price estimate: \$30-\$40

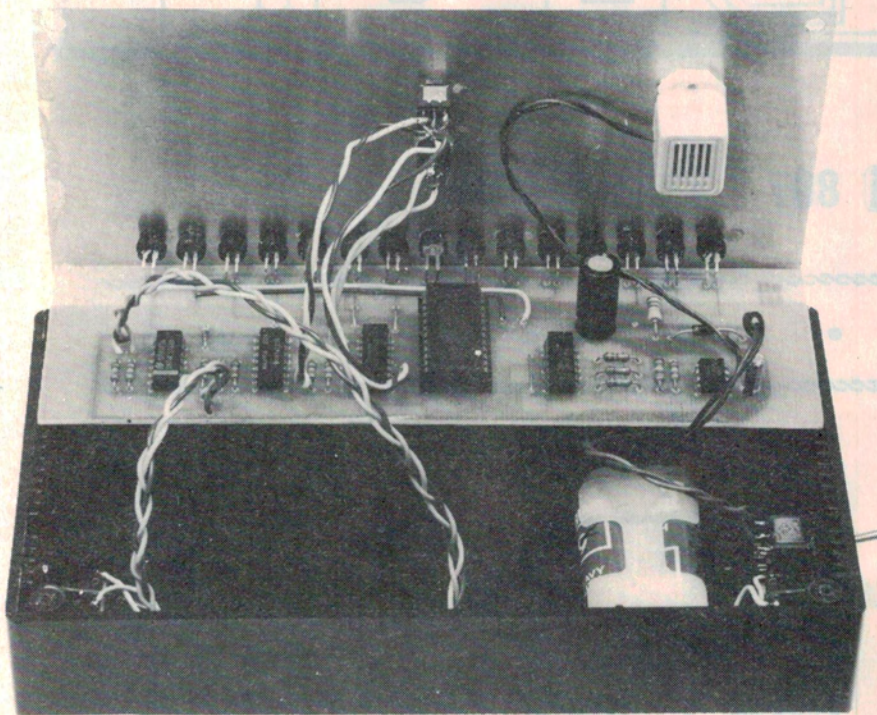
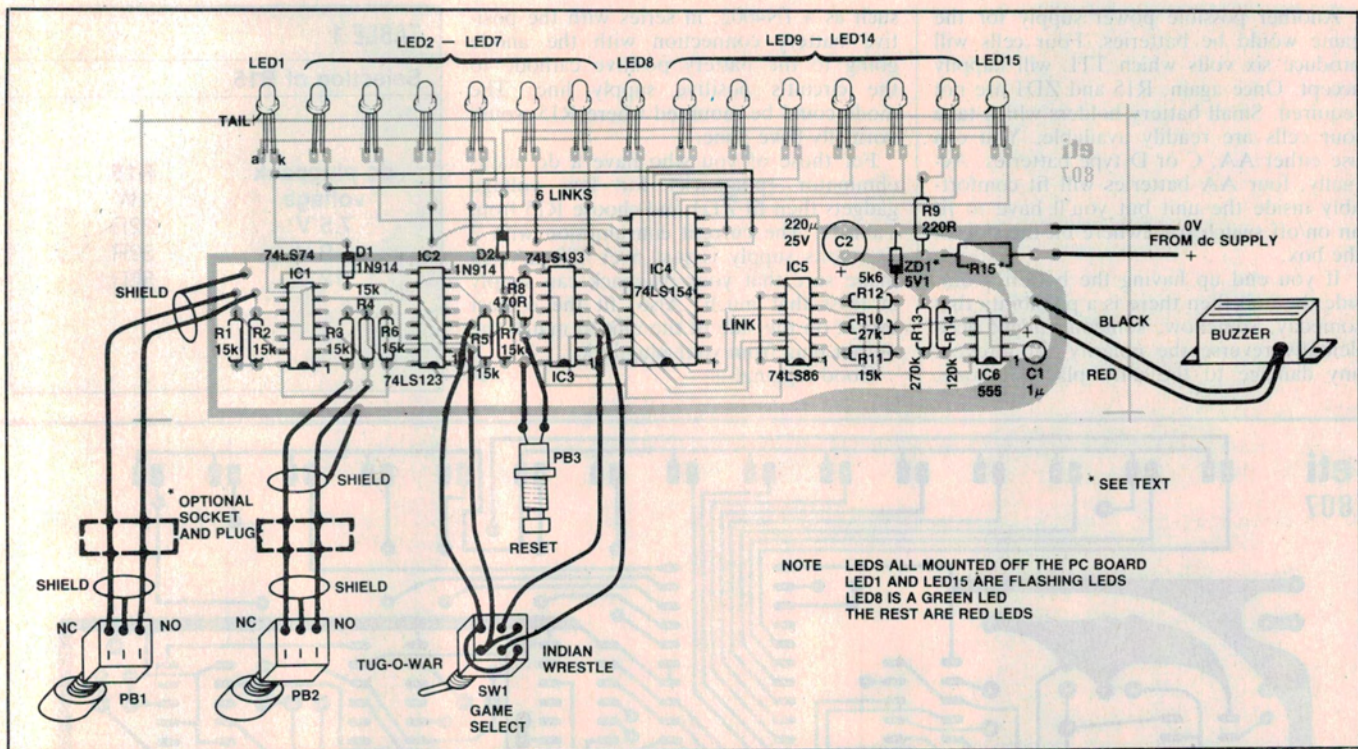
(depending on options)

* Parts marked with * only required if sound option is fitted.



easily. Also soak the painted panel (after it has dried!) and apply the label to it.

You'll notice that, as long as both surfaces are wet, it's possible to slide the label around until it is correctly positioned (applying dry Scotchcal gives you only *one chance* to get it right — usually you



miss!!). Then wipe the label with a piece of cloth to squeeze out excess water and wait until the whole assembly is dry. Hey Presto! One correctly attached label.

Now insert the LED bezels and push all the LEDs through. The two front panel switches should be mounted next and

wired to the pc board. Use washers beneath the nuts to save tearing the Scotch-label.

The players' hand controls can now be made. Any type of container can be used; for example a small zippy box. For the prototype, I used two plastic film contain-

Inside-out. Showing the general assembly. The box I used features 'slots' down the sides and the pc board slips into these. The battery holder visible here was held in place with double-sided sticky pad.

ers. I cut a hole in the bottom of each container and mounted the pushbutton switch, as shown in Figure 2, after soldering the connecting cable to the contacts. A small hole in what used to be the film container's lid enables the shielded cable to exit. The other end of the cable can be terminated with a 3.5 mm stereo plug which plugs into a 3.5 mm socket on either side of the main unit or, to cut costs, simply connect it directly to the pc board, passing the cable through a hole drilled in the side of the box.

If a dc plugpack is to be used to power the unit (see later), then the corresponding socket can be mounted in the side of the box and wired up.

The buzzer, if used, can be mounted in any convenient position, either inside or outside the box.

Powering up

Once constructed, the unit will run from a variety of power sources. The ICs used in the game are TTL types and this immediately specifies +5 volts as the required supply. If you have a simple 5 V dc power supply available then the problem is solved. In this case, resistor R15 and zener ZD1 are not required and simply wire your supply to where the zener would have been. **IMPORTANT** — ensure that the supply is connected the right way round, otherwise *all* the ICs will be destroyed.

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Another possible power supply for the game would be batteries. Four cells will produce six volts which TTL will happily accept. Once again, R15 and ZD1 are not required. Small battery holders which take four cells are readily available. You can use either AA, C or D type batteries. Actually, four AA batteries will fit comfortably inside the unit but you'll have to fit an on/off switch somewhere on the side of the box.

If you end up having the batteries outside the unit then there is a possibility that someday, somehow, someone might accidentally reverse the polarity. To prevent any damage to the unit, place a diode,

such as a 1N4002, in series with the positive battery connection with the anode going to the battery positive cathode to the circuit's positive supply line. The diode could be mounted where R15 would normally have gone.

For those of you who have a dc mains eliminator (plugpack) for low voltage gadgets then fit ZD1 and choose R15 from Table 1. The current consumption with a five volts supply is just over 100 mA, so make sure that your plugpack can supply at least that much. Also, fit the correct socket on the side of the unit to match the output plug from your plugpack.

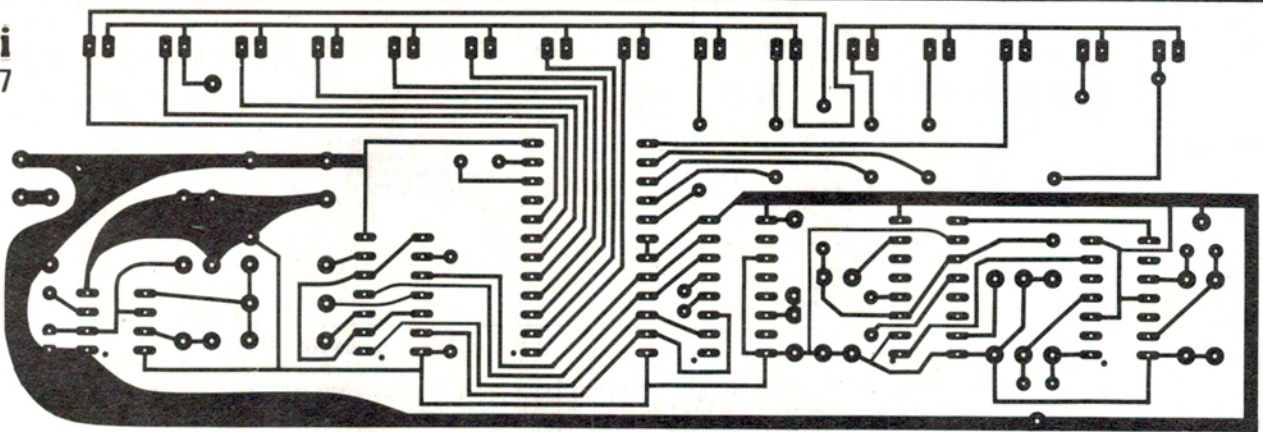
Good tugging!

TABLE 1

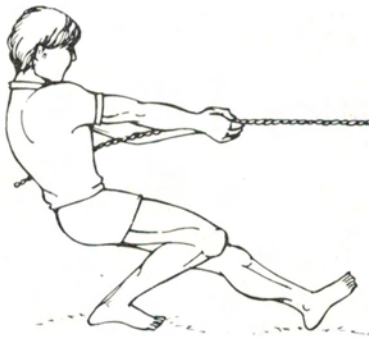
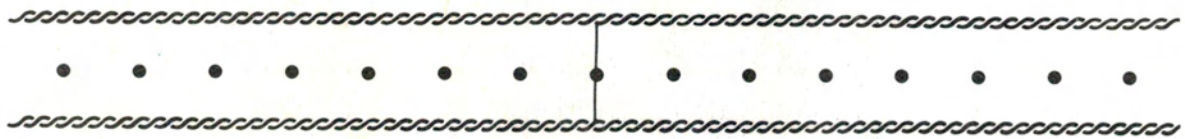
Selection of R15

dc plugpack voltage	R15
7.5 V	1W 22R
9 V	33R
12 V	56R

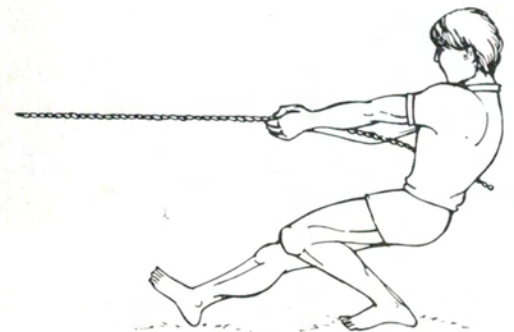
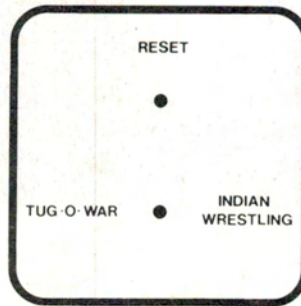
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eti 807 TUG-O-WAR



PLAYER 1



PLAYER 2