

Adding a Gripper to your TRaCY:

By Justin R. Ratliff 3/13/2000

Building a gripper powered by an unmodified servo is pretty simple and can be done a number of ways. However, for the TRaCY robot I wanted to make my gripper as small and as simple as possible.



To make a servo controlled gripper like mine you'll need the following items:

A standard unmodified servo like the BP 147 from <http://www.balsapr.com> cost is about \$8

1/8th of an inch thick piece of wood at least 4" by 5 1/2" in size for making the two gripper fingers

Bond527 Multi-Purpose Cement or similar (as pictured to the left) The glue is used to glue a stationary finger to the servo case. You'll also use this to glue your servo horn to the movable finger. You can use just about any sort of glue you wish but I recommend this brand. It's very strong and works on almost anything! You can pick it up at most craft stores. Cost is about \$3.50 and it'll last you a long time! Crazy glue would work just fine as well.

You'll also need some masking tape (for holding the finger to the servo case while the glue dries), a jig saw or rotary tool with cut off disk for cutting out the fingers

Drill with a 3/8 inch drill bit or close to that size

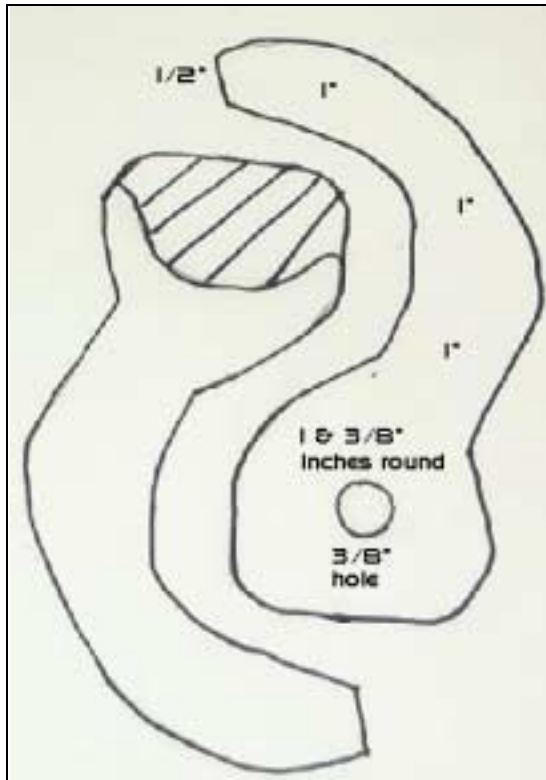
Painting the gripper is your choice, as you'll see from the picture below I painted mine black.

Most grippers move two fingers that make up the gripper together so that the tips of the fingers meet. They can then hold objects with compression. This gripper moves only one of the fingers. See the picture below:



The stationary finger is glued onto the servo case in a permanent position. This finger is positioned so that when the moving finger is in an open position, the gripper has the best possible opportunity to grasp something. Notice that the finger on the case has a hole big enough so that it does not interfere with the way the servo horn connects to the servo.

The movable finger has a hole drilled in the middle of its base so the servo horn goes through it. The hub of the servo horn is then glued to the finger. The top finger (which is the servo controlled finger) will travel over top of the stationary finger. You can add little tips to the ends of the fingers so that the fingers meet. I like to leave them so that the top fingers goes over top of the stationary finger. Much of this design can be played around with, you can make the fingers longer or shorter and you don't need to make them round as I did. You could make them square, it really does not matter. You can tailor the design to what ever you want your gripper to pick up. I do suggest that you take some scrap cardboard from a box and practice making your finger designs on it to see how the fingers work on your servo before you glue anything to the servo case! Below is the completed gripper shown from the side:



The servo horn by the way is the round disk or X shaped thing that came with your servo. Also when you glue the stationary finger to the base use masking tape to hold the finger in place. Leave it set a few hours to make sure it stays in place!

This is the cut out of the fingers. The finger to the left was drawn upside down to save space. Make sure you orientate the fingers correctly on the servo.

This cut out diagram may not come out to size so see the dimensions below to alter the print out if the dimensions are not correct. Or design your own fingers for the gripper.

The finger to the left is the stationary finger, which is glued to the top of the servo case. You'll notice a half circle is cut out of the base with lines thought it. You'll want to cut the lined part off so that it does not interfere with the servo shaft that attaches to the servo horn. The lines also show you one way to cut the round part out, by making small cuts on the lines you'll be able to break the pieces off. You can then sand the rough edges.

The hole in the middle of the base on the right finger is for the attaching end of the servo horn to fit though. The outer part of the horn is called the "hub" or at least that is what I call it. That is what you glue to the base of the finger. The hole I drilled is about 3/8 of an inch.

The base of both fingers (before the left finger was modified) is about 1 and 3/8 inches round. Each finger is about 3" long from the tip of the finger down to the round base. Each secession of the finger is about 1" inch in length.



To the left is a picture of the gripper closed, which better show what the gripper looks like and how it will function once complete. The top finger (the one controlled by the servo) closes just slightly over the bottom stationary finger.

If the servo were mounted straight forward on TRaCY the gripper would look off center once closed. This is fine for the light duty nature of TRaCY or similar robots. Obviously though for a heavy-duty robot this servo gripper would not be appropriate.

Because an unmodified servo has a limited range of rotation the gripper has predefined limits of range with regard to how far it opens and closes. You can adjust this by changing the position of the top finger. For instance if I were to take the top finger and rotate it further towards the stationary finger I could change how small the circle is that the fingers make when they come together. This would be useful if the gripper were grabbing round objects.

Below is a picture of the gripper at its open most point:



You could add another servo to rotate this gripper up and down or side to side or you could just mount it right on to your TRaCY in a fixed position. It's all up to you and what you want. You might want to add a second level to your TRaCY for the purpose of mounting the servo, or if you build yours just like mine your gripper should be able to fit under the main deck of your TRaCY. However, if your TRaCY is going to go over rugs or carpet you'll not have enough clearance with the gripper attached under the bottom deck. Unless you were to cut a hole in the deck so the servo could stick up through the deck. This would create other problems, for one you could only have the servo go up so far before it ran into the controller board!

Mounting the gripper is a problem I have not solved yet. It would be very easy for me to add a second deck to TRaCY and mount the gripper onto the front of that and have plenty of room for other electronics or sensors, however I have not done so yet. I'll probably end up adding the second deck and adding a second servo to rotate the gripper up and down so it can pick up objects off of the ground. Once complete I'll update this file with further info on mounting along with a more useful code.

You'll also have to be careful where you place the gripper on your TRaCY. If you place it too far forward you can render your bumper sensor useless. You also want to make sure the fingers do not interfere with the operation of the IRDP navigation sensor on TRaCY.

Now the fun begins. You have the gripper built and mounted; now you need to see what you can do with it! Below is a simple test program so you can see how your gripper is going to work. You might notice this looks a lot like the code from the servo calibration program, and you'd be right. Copy and paste the program text into a file called Gripper.bs2

```
'Gripper.BS2
```

```
'Gripper test program for the TRaCY
```

'Stamp II version
'TRCY 3/14/2000

'Generic values

i	var	byte	'loop counter, whatever
tmp	var	word	'tmp var, many routines
ltmp	var	tmp.byte0	'use these tmp variables
htmp	var	tmp.byte1	'be careful with them
SPKR	con	15	'Speaker port

'For testing I disconnected the left and right servos so TRaCY would stay stationary
'I then connected the servo to the right servo port, which is con 13
'For permanent placement on your TRaCY you'll need to run wires from the main power
'to your gripper and connect the gripper to one of the open i/o lines, but do not
'use the power on the 5 volt lines that run along side the open i/o lines.

'These are for the servo routines

GRIP	con	13	'gripper port
SACT	con	5	'times through act routine
drive	var	word	
rdrive	var	drive.byte0	

'troubleshooting routines

```
debug "TRaCY Lives!",cr  
freqout SPKR,500,2000,4000  
debug "Run this program untill you get",cr  
debug "the gripper to the closed and",cr  
debug "open points that you want.",cr  
debug "You'll then have the values",cr  
debug "that you need to control your",cr  
debug "gripper in other programs.",cr
```

'my open value is 800 and closed value is 1100

GRIPPER:

```
pulsout GRIP,1100  
pause 15  
goto GRIPPER
```

end