

SOCCKER 'BOT – NO SOLDER

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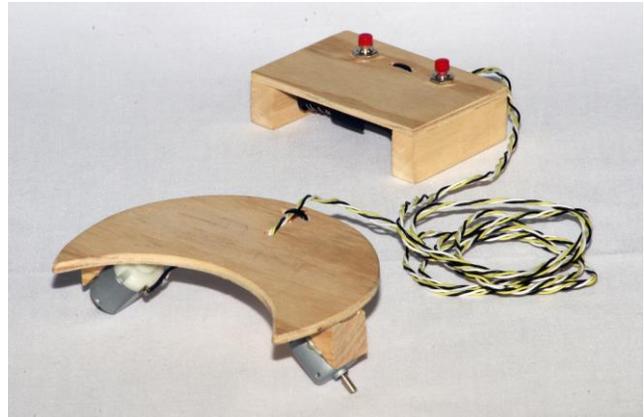
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DESCRIPTION

The SOCCER 'BOT is a simple electro-mechanical device that responds to a wired hand held controller, which is used to steer the device, using two push button switches to move forwards, left or right.

SOCCKER 'BOT can be used to play a game of soccer between two or more participants.



The front of the SOCCER 'BOT has a "scoop" (a crescent shaped cut-out), that enables a tennis ball to be "captured" and pushed towards the goal. The scoop is shallow enough to allow a competitor to knock the tennis ball out of control, then capture the ball and try to score.

SECTION 1: GENERAL AND PLANNING INFORMATION

1. DESIGN CONSIDERATIONS

1.1 GENERAL

The major aspects of this project are the design, construction and assembly of the device. The design stage is crucial. At this stage the location of all the components is worked out. It is best to do this by laying all of the components on a sheet of graph paper. The layout affects the size and shape of the device's platform, as well as the ease of assembly.

There are two parts of the SOCCER 'BOT to design:

- The SOCCER 'BOT itself.
- The hand held Control unit.

The isometric drawing shows our prototype, but there are many other possible body shapes, and a few motor mounting options (more on this later).

1.2 MATERIAL SELECTION

The first thing to define is the various materials for the different parts of the device. For our prototype, 3mm Plywood was used for the SOCCER 'BOT's platform and the Control unit's base. This material was chosen as it is easily cut, shaped, drilled and glued. Thin plastic sheet (PVC or acrylic etc.) could also be used. 12mm x 18mm timber was used for the sides of the control unit.



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1.3 DESIGN

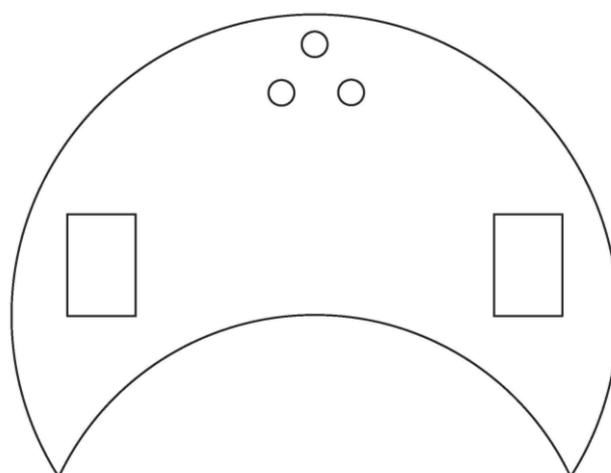
The student must design the platform to accommodate the two motors, motor mounting blocks and a trailing support (we used a small bolt). The design can take whatever shape is preferred, but with a scoop at the front. The scoop should be shallow enough to allow a competitor to knock the tennis ball out of the scoop, and then capture the ball.

The illustration shows an example of a design.

The device is driven by 2 motors, and the motor mounts must allow the motor shafts to meet the floor, at not less than a 45 degree angle.

There are 2 alternative ways to mount the motors and motor mounts:

- DESIGN 1: The motor mounts are mounted underneath the platform (as shown in our drawings). Thus the platform's height is approximately at the same height as the tennis ball's middle.
- DESIGN 2: The motor mounts are mounted above the platform, and the motors go down – either through or past the platform. This puts the platform quite low to the ground, and the scoop may need a vertical extension.



NOTES:

- If mounting the motors inboard of the platform's outside edge (i.e. the motors do not extend past the platform), you will need to make cut-outs for the motors – that is, 2 holes in the base approx. 16 x 20 mm.
- If mounting the motors outside the platform's edge, the motors will extend down and outwards, thus giving a wider and more stable device.
- The device needs a 3rd "leg" to support it. A simple way to achieve this is to drill a hole as shown at the rear of the base. This hole is for an M3 bolt, to be locked in place with 2 nuts (as supplied). Another option is a bent wire "leg". Regardless of what is used, make sure that the platform is level.

1.4 CONTROL UNIT DESIGN

The student must design the unit to accommodate the two push-button switches and battery holder. Items to consider, when designing the hand held Control unit:

- Ergonomics – it should be comfortable to hold, and easy to use the 2 push-button switches
- The simplest shape is a square or rectangle. However, the Control unit may be any size and shape desired (how about a scaled down version of the SOCCER 'BOT itself?).
- Supports: Our prototype used 12mm x 18mm pieces of wood to provide sides, so that, when put down, the switches were not touching the table top. However, if using an unusual shape, a couple of supports on the sides, together with the battery holder, will protect the switches

SECTION 2: COMPONENTS & MATERIAL REQUIRED

2.1 COMPONENTS SUPPLIED

The following components are supplied in the kit:



2.2 ADDITIONAL REQUIREMENTS

The following items are required and are available from Scorpio Technology:

- Battery – AA, 1 required (BATTAA)

The following material is to be supplied by the student / designer:

- Material for the components (PVC or acrylic sheet, plywood, etc.)
- Electric hook-up wire – Multi-strand in assorted colours
- Cable ties

2.3 TOOLS REQUIRED

The following tools are required:

- Assorted hand tools
- Soldering equipment and solder
- Drill Bit – 3.5mm (DB3.5)
- Scroll and hand saws
- Knife - "box cutter"
- Hammer
- Wire stripper
- Hot glue gun
- Hairdryer or hot-air gun

NOTE: At various stages of construction, items need to be glued together (and sometimes removed and relocated!). We have found hot glue guns to give good results, but extreme care needs to be exercised when using hot glue as it really burns if it gets on the skin.

HINT: It is useful to have a hair dryer available during construction work. Using the hair dryer on its hottest setting will allow students to heat up the hot glue to soften it, and will allow students to reposition or remove incorrectly positioned or faulty components.

SECTION 3: CONSTRUCTION

3.1 MAKING THE PLATFORM

- Cut out the platform's designed shape (a photocopy of the designed shape can be used as a template), and – if required - cut-outs for the motors.
- Drill three 3.5mm holes as shown at the rear of the base. The single hole is for a 3mm bolt, the other two holes are for a cable tie to secure the control cable in position.

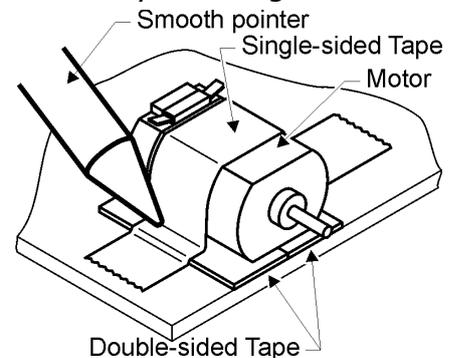
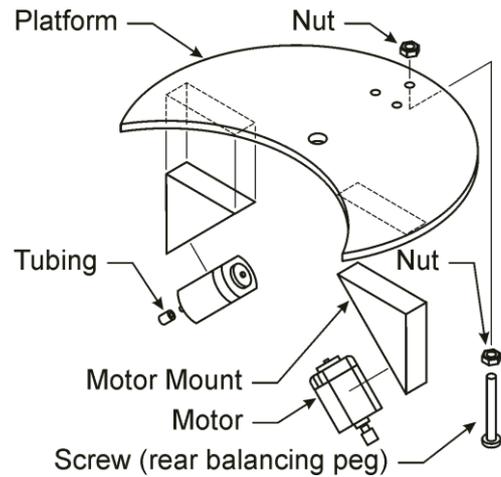
3.2 ASSEMBLY

- Cut the rubber tubing neatly in half with a sharp knife.
- Slide the tubing onto the motor shafts. Cut it to length. Make sure the tubing does not rub against the motor's body - it should finish level with the shaft's end.

NOTE: The tubing provides grip, so the shafts do not spin uselessly on the ground.

- Glue or screw the motor mounts in position.
- Attach the motors onto the motor mounts. Make sure the motors' terminals are facing outwards (ie are accessible).

NOTE: If using glue or hot glue, apply the glue to the motor mount and then press the flat side of the motor onto the glue. Alternatively, you could use single and double-sided foam tape.



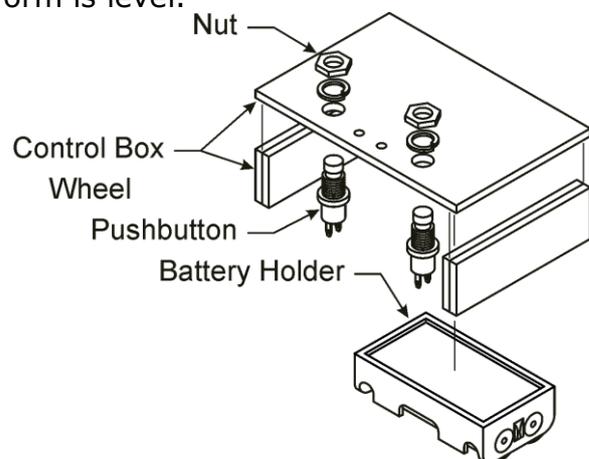
WARNING: If using hot glue, be very careful, as it can burn you, if you get it on yourself.

- Repeat for the other motor, making sure that the platform is level.
- Screw a 3mm nut, about 6 mm along the 3 mm bolt. Put the end of the bolt through the single hole at the rear of the base. Use the remaining nut to fix the bolt to the base, making sure that the platform is level.

3.3 HAND HELD CONTROL UNIT

The last item to be made is a small hand held Control unit.

- Cut out the designed shape.
- Drill two 7 mm holes in the material to allow the mounting of the push-button switches.
- Drill two 3-3.5mm holes in the centre, towards the top, to allow a cable tie to clamp the control cable in place.
- Cut the side pieces (we used 12 x 18 mm timber).
- Glue or nail the side pieces in position along the edges so the control unit's platform is raised. This allows the unit to be put down, without damaging the switches.



- Glue the battery holder in position under the control unit's platform, or inside the unit (if it is fully enclosed).

NOTE: The battery compartment's surface may need to be roughened with sandpaper if using glue, to get the glue to stick to it.

- Fit the push-button switches, and attach them using the washer and nut.

SECTION 4: WIRING

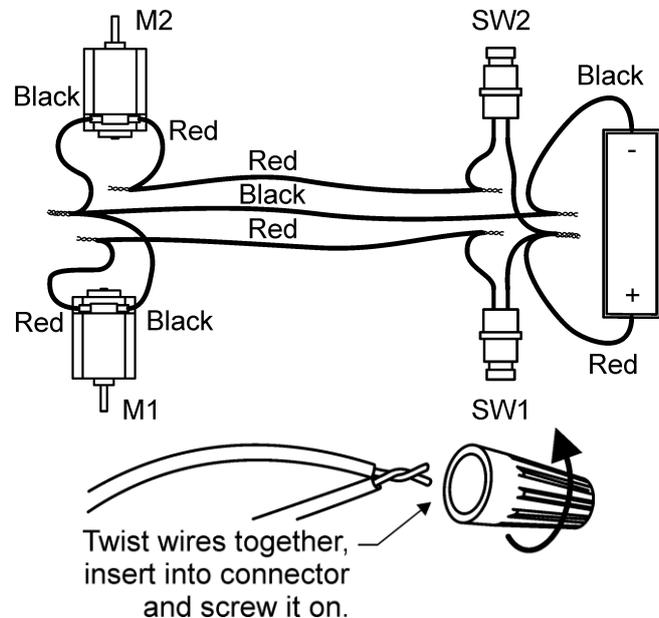
4.1 THE WIRES BETWEEN THE CONTROL UNIT AND SOCCER 'BOT

NOTE: The first step is to decide the length of the wires between the Control unit and the SOCCER 'BOT. We suggest that about 1 metre long may be suitable – if too long, the likelihood of the wire tangling increases, while staying close to the SOCCER 'BOT provides better control.

- Cut three fine flexible wires of different colours, of the desired length.
- Place one end of the wires into a vice, or clamp them to a bench.
- Place the other end of the wires into the chuck of a drill (a hand powered drill allows good control of the speed).
- Operate the drill slowly, and twist the wires until they are tightly wound.
- Carefully release the wire from the drill chuck and carefully remove any kinks that may be present in the twisted wire.

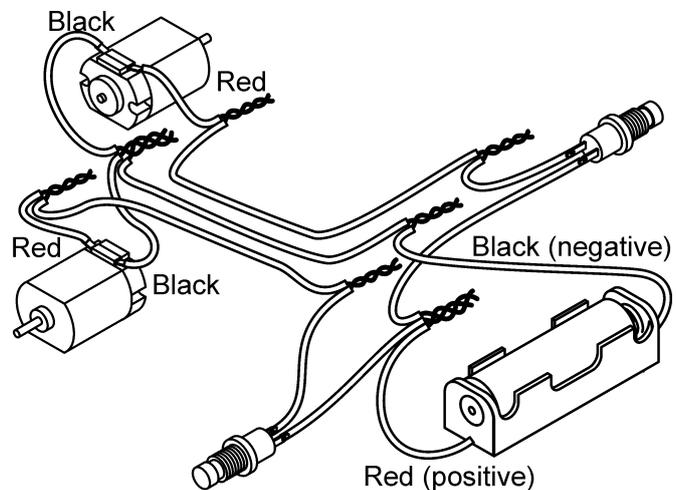
4.2 WIRES TO THE SOCCER 'BOT

- Twist together the two black wires of both motors and a black wire of both motors and a black wire (that will be connected to the battery holder). Finish by screwing on a screw-on connector.
- For one motor, twist the red wire to a red wire (that will go to a switch). Finish by screwing on a screw-on connector.
- Repeat for the other motor.
- Use a small cable tie, or hot glue, to hold the cable in place, to both the SOCCER 'BOT and the Control unit.



4.3 WIRES TO THE CONTROL UNIT

- Twist the red (positive) wire of the battery holder to a wire from both push-button switches. Finish by screwing on a screw-on connector.
- Connect the remaining two wires from the switches, to two of the wires from the twisted cable. Finish by screwing on a screw-on connector.
- Connect the remaining twisted wire to the black (negative) of the battery holder. Finish by screwing on a screw-on connector.
- Tape all the wires in place.



NOTE: This kit has components that allow this to be assembled without soldering. However, the connections will be more effective and permanent if they are soldered.

SECTION 5: TESTING

- Insert an AA battery into the Control unit. At this point, SOCCER 'BOT should be stationary.
- Press the right-hand-side push button – the right hand-side motor should spin and the SOCCER 'BOT should turn anti-clockwise.
- Press the left-hand-side push button – the left hand-side motor should spin and the SOCCER 'BOT should turn clockwise.
- Press both push buttons – both motors should spin, and SOCCER 'BOT should go straight / forward.
- If the motors are turning in the wrong direction, reverse the wires connected to the motor(s).
- Finish by screwing on screw-on connectors.