# The Construction Of A Rigid Dance Pad Using Common Materials

October 2006, First Edition
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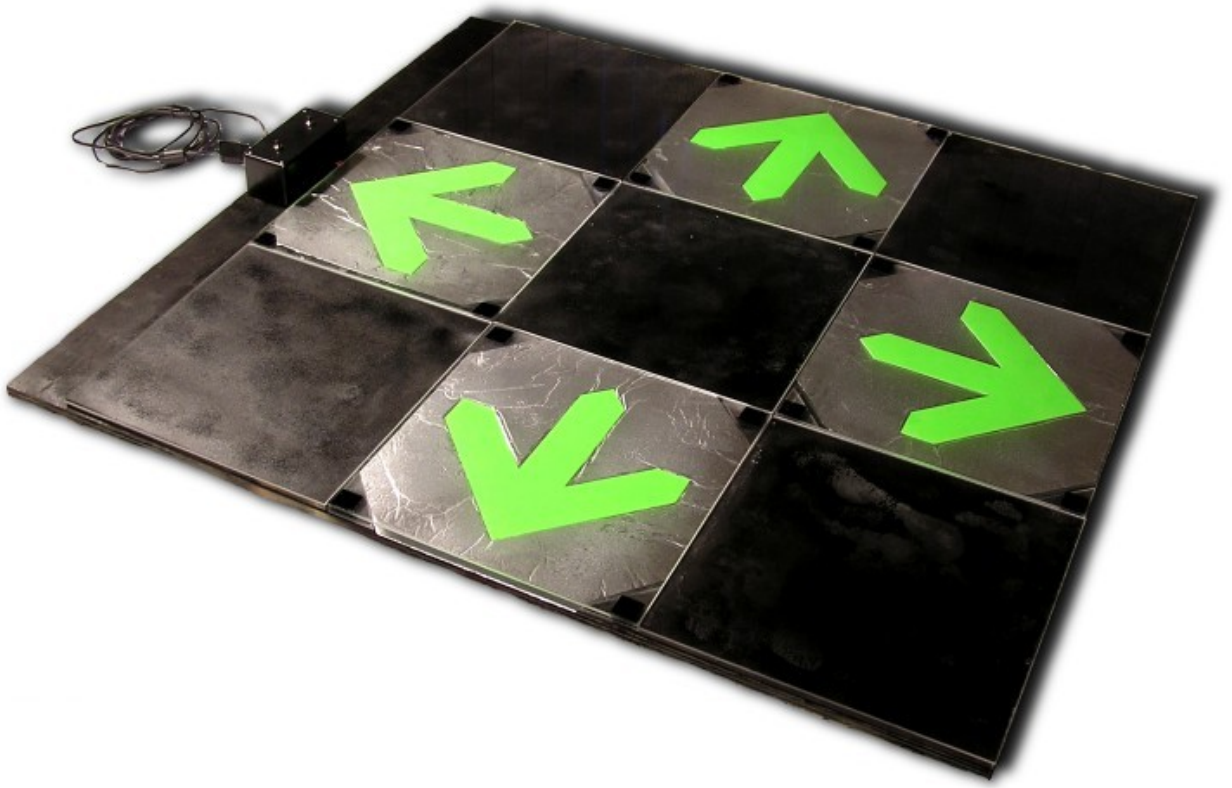


**DESCRIPTION:** A custom built Stepmania compatible dance pad designed for high reliability, low maintenance, easy repair and rapid response. The purpose of this project is to create a rigid dance pad similar to an arcade DDR machine or a more expensive “hard” pad. The mechanics of this dance pad are quite simple. Four air-gap switches are wired to a disassembled USB gamepad which are both attached to a rigid substrate such as wood. The air-gap switches have a conductive material (aluminum foil or sheet metal) on both interior surfaces. When pressure is applied by the foot of the player, the acrylic bends, pushing the two metal contacts together and a button press is registered on the controller.

| **MATERIALS:** | **COST:** |
|---|---|
| 1 x Logitech Precision Gamepad | $9.99 @ Target (less online) |
| 1 x (36inch x 39inch) wood base (plywood or melamine) | $17 @ Lowe's Home Improvement Center |
| 5 x (12inch x 12inch) squares “hardboard” aka high density fiberboard | $6 @ Home Depot |
| 4 x tagboard arrows | $1.50 (sheet) @ Michael's Craft Store |
| 8 x (11.75inch x 11.75inch) squares heavy duty aluminum foil or thin sheet metal | Foil – free<br>sheet metal - $20? |
| 10 x (12inch x 12inch) squares .125inch acrylic sheet | $40 @ Tap Plastics |
| 16 x adhesive velcro squares | $6 @ Joann Fabric & Crafts |
| 1 x plastic enclosure (5inch x 2.5inch x 2inch) | $4 @ Radioshack |
| 2 x momentary (N.O.) pushbutton switches | Approx. $1 each @ allelectronics.com |
| spray adhesive | $3 @ craft store |
| contact cement | $3 @ Michael's Craft Store |
| black paint | $2 @ hardware store |
| wire | Free – probably stolen |
| junk CDs | Free – America Online |

**PROCEDURE:**

1. Cut wood base to size. For this project, 36” x 39” was used to accommodate increased tile size for large feet. This makes each tile on the playing surface 12 inches square with 3 inches left at the top for the control box. A more typical tile size is 11.25 inches. Adjust measurements accordingly if a smaller tile size is used.

2. Cut hardboard to size (12” x 12”). Make 6 tiles of this size. Only 5 are needed, but hardboard can be ruined if mishandled.

3. Cut acrylic sheet to size (12” x 12”). Make 10 tiles of this size. Only 9 tiles are needed. A replacement tile is a good thing to have on hand. Acrylic is usually best cut on a table saw. Most suppliers of plastics will cut the material to size upon request.

4. Lay out the base, hardboard and acrylic on a flat surface according to the picture below (**Fig. 1)**, but do not glue anything. Mark the intended paths for the wires using a pencil. Refer to **Fig. 2** for the wiring layout. Use a rotary hand tool (Dremel) or a router with an appropriate bit to trace paths for the wire to be inlaid into the wood base. It is important to use thin wire (24 gauge or so) to insure the paths in the wood base are not too deep as this could lead to breakage of the wood base when weight is applied.

*Fig. 1. A layout of the dance pad. The acrylic squares are not pictured and are only used at this time for spacing the components.*

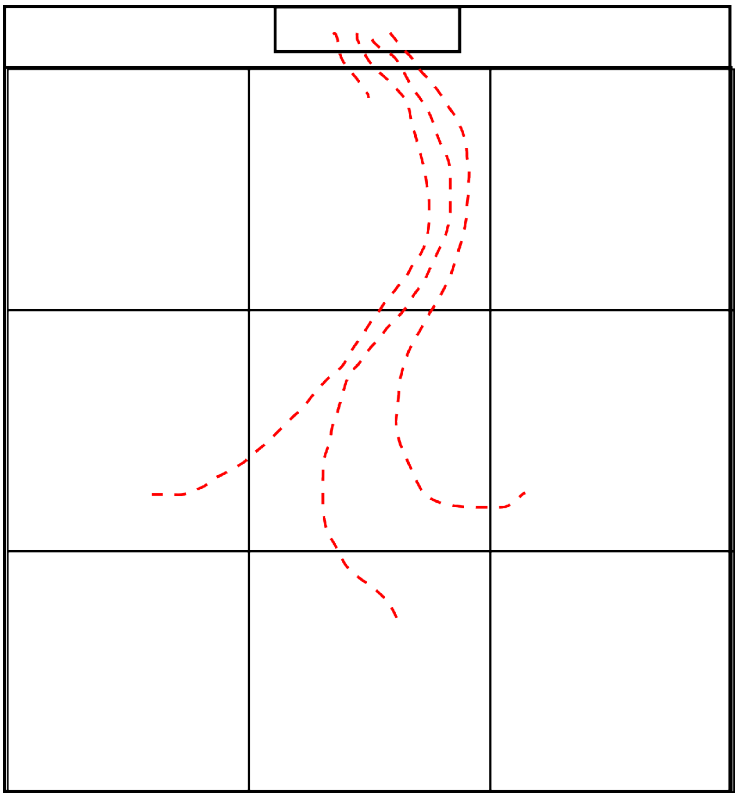


*Fig. 2. Dance pad wiring schematic. Wires are shown in red. Note: the paths are deliberately curved so as not to create any weak areas in the wood base. The four active regions (up, down, left, right) must also connected to each other as they will be wired to a common ground (to be discussed later).*

*Wire spacing has been exaggerated for clarity. The wires shown will be connected to the upper contact of the buttons. The lower contacts should all be wired to each other.*

5. Secure the wire into the grooves made by the rotary tool using tape or glue. Make sure the wire does not protrude above the surface of the base as it could interfere with the gluing of the hardboard and make the playing surface uneven. There should be a separate wire going to each of the four active buttons on the pad.

6. Lay out the hardboard and acrylic on the wood base once again making sure everything fits squarely. Apply contact cement to five of the hardboard squares, doing so one at a time. Then place a weight on the freshly glued panel to ensure good contact with the base. The idea here is to glue down the five inactive regions of the dance pad (upper left, upper right, lower left, lower right, middle) to the wood base and have the wires between the layers, safely inlaid in their own paths. The hardboard panels are prepared individually so that each one can be removed and replaced while still maintaining the proper placement with the other tiles. See **Fig. 1** for what this procedure should look like when finished. Again, the acrylic is just used in this step for proper spacing and not yet glued down.

7. After the contact cement has dried, painting may begin. For this project black spray paint was used, but it may be advantageous to use liquid paint.

8. After the paint is thoroughly dry (24 hrs minimum), strip the wires that have been inlaid into the wood base so that there is approximately 1/8” to 1/4” bare wire exposed at the end. This will be soldered onto the foil (or sheet metal).

9. Clip the corners of the foil squares as shown in **Fig. 3**. Using spray adhesive, apply four of the foil squares to the recessed areas that will become the dance pad buttons. See **Fig. 4** for a diagram of the completed process. See notes at the end of this document for information on sheet metal contacts.

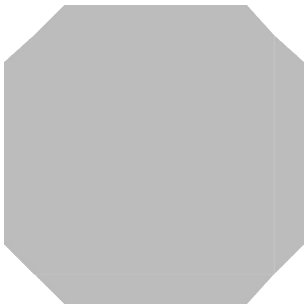


*Fig. 3. A foil contact that forms one half of the air gap switch for each button.*

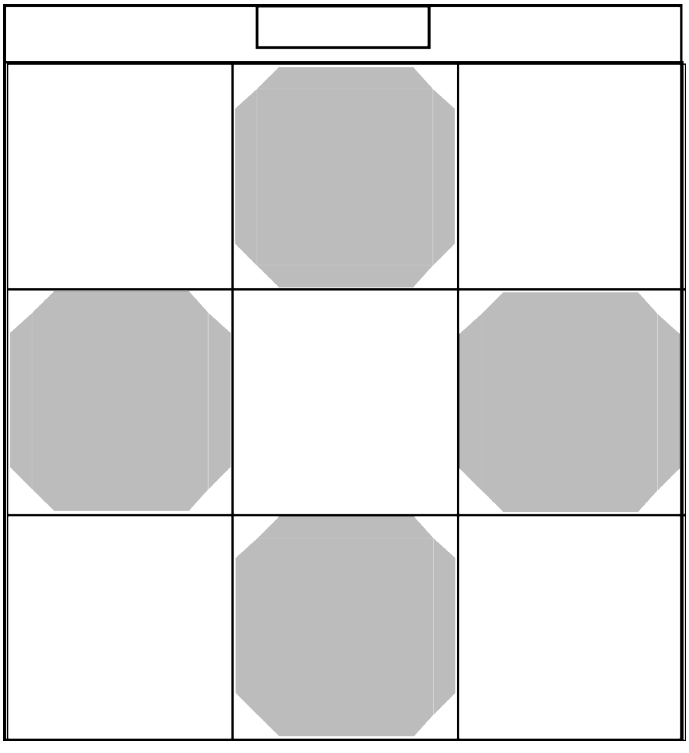


*Fig. 4. The foil contacts that will make the bottom half of the air gap switches. All four contacts will be wired together.*

10. Solder some wire to the top of each foil contact so that the panels are connected electrically. Note: Soldering to foil may require light sanding of a small area and/or the use of flux for the solder to properly adhere. Use a continuity tester to make sure that all connections are secure.

11. Use the supplied template at the end of this document (or design your own) to cut out 4 tagboard arrows.

12. Center the tagboard arrows on the acrylic squares and mark their locations on the opposite side with dry-erase marker. Apply spray adhesive to the non-marked side of the acrylic and place the arrows using the dry-erase marks to center them. Apply more spray adhesive on top of the arrow's back side and place a foil contact on top. Smooth out any wrinkles or air bubbles in the foil before the adhesive dries. Repeat for the remaining arrows. Note: Sheet metal contacts will require a different procedure. See notes at the end of this document.

13. Cut numerous small triangles from old, junk CDs to fit the corners that were removed from the foil. These will form the non-conductive spacers that separate the top and bottom foil contacts and create the air gap. Alternately, any thin, non-conductive material may be used for the spacers. The material must be able to withstand significant abuse as it will have the full weight of the player on it at various times during game play.

14. Laminate the triangles together with super glue and apply an adhesive velcro square to the top, but leave the “backing” on the top piece of velcro. The desired thickness for the spacers will depend on the thickness of various materials as well a personal preference. Hardboard can vary widely in thickness even on the same board. This particular project left the active regions of the dance pad partially recessed by about 1/32 inch. This serves to help the player locate and center himself/herself without looking down. It can also be a distraction if playing with bare feet. The best method is to try various thicknesses of spacers before gluing them to the base. Attention must also be paid to the width of the air gap. Too great a thickness will increase response time. Too small a thickness will result in accidental button presses. Again, personal preference also plays an important role depending on whether the player is accustomed to arcade pads or soft pads. This is arguably the most important step of the entire construction. Make sure to spend adequate time on this step.

15. Glue down the spacers. After the glue is dry it is time to glue down the acrylic to the inactive regions. Lay out all the acrylic squares in their proper locations and check for squareness. Use spray adhesive or screws to secure the acrylic to the inactive areas of the pad. If using spray adhesive, lightly sand the painted hardboard surface to ensure proper bonding. If using screws, pre-drill and counter-sink all holes. To secure the active regions, simply remove the velcro “backing” and drop the tile onto the sticky back. The active regions should be similar to **Fig. 5**.

16. The dance pad should now look nearly complete except for the absence of the control box and four wires that are not soldered to anything. Solder one end of each of the four wires to the foil (or sheet metal) on the back of the acrylic squares. The active squares are removable by separating the velcro that holds them to the spacers. Try to use enough wire that the solder point is not ripped off accidentally if the tile has to be removed, but not so much wire that it interferes with the switch. The excess can always be taped down.

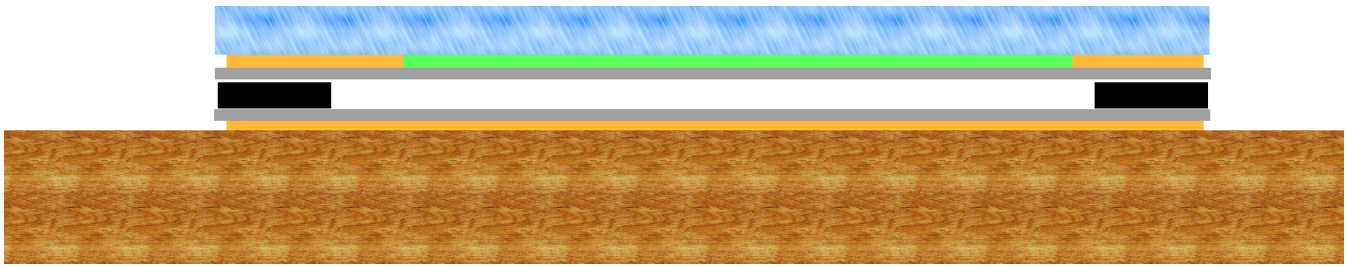


*Fig. 5. A cross-sectional view of the air-gap switch on an active tile. Starting at top: 1. acrylic sheet 2. adhesive (orange) and embedded arrow (green) 3. upper foil contact (gray) 4. spacers with velcro on top (black) 5. lower foil contact (gray) 6. adhesive (orange) 7. wood base*

*An inactive tile (not pictured) would have the following cross-section: 1. acrylic sheet 2. adhesive 3. hardboard 4. contact cement 5. wood base*

# Assembling the USB Control Box

This section assumes a Logitech “Precision” USB gamepad is used. While other gamepads can be used (see notes at end of document), the Logitech “Precision” has some design characteristics that make it extremely convenient to use. Also it is quite inexpensive.

1. Remove all screws from the gamepad and separate the top and bottom pieces of the (blue) shell.

2. Detach the right and left “trigger” buttons (see **Fig. 6**) on the front of the controller from the housing. Remove the circuit board from the blue housing.

3. Set aside the blue housing as it is no longer required. There should now be only a circuit board, USB cable and the right and left trigger buttons. The trigger buttons are connected to the circuit board via 3 wires. Snip the wires where they attach to the trigger buttons (**Fig. 7**).


*Fig. 6. The right-side set of trigger buttons separated from the controller.*

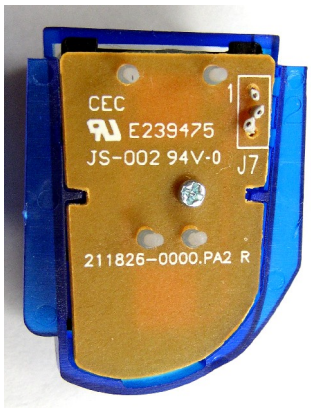



*Fig. 7. The back side of the trigger buttons with the 3 wires in the upper-right corner (already cut).*

4. Pull the strand of 3 wires apart so there are 3 individual wires. Strip the ends to prepare them for splicing to the wires on the dance pad.

5. Use a continuity tester to determine which wire is the common wire. It will be the only common wire to both the left and right trigger buttons. Mark the common wire.

6. Solder the common wire (both ends) to the edge of the lower foil contact of the “up” button on the dance pad. As all the lower foil contacts are wired together, they now all form a large “common contact”.

7. Solder the remaining 4 wires from the circuit board to the wires that are connected to the upper contacts of the dance pad. Order does not matter since the buttons will be mapped in the game software. All wires should be connected to either a foil contact or the circuit board at this point.

8. Choose two other buttons on the circuit board and solder two wires to each of the traces of these buttons on the circuit board. Use a continuity tester to make sure the solder is making good electrical contact with the traces of the button. Attach (solder) the momentary switches to the free ends of the wires. These will become the “Start” and “Select/Back” buttons.

9. Drill or cut appropriate holes in the plastic enclosure for the “Start” and “Select” buttons. Avoid placing them where they might be accidentally struck during vigorous gameplay.

10. Before fitting the circuit board into the enclosure, check to make sure all buttons are functional by plugging the USB cord into the computer and launching “Control Panel” in Windows. The “Game Controllers” utility will show which buttons are functional when pressed. Linux users may have a similar utility depending on the distribution, or may need to use the “cat” command on the appropriate device.

11. Assuming all buttons function properly, the circuit board may now be placed into the enclosure. It should just fit if oriented diagonally. Secure the “Start” and “Select” buttons as appropriate.

12. Place the lid of the enclosure onto the wood base and mark the screw holes with a pencil. Drill 4 holes through the wood base and make them large enough that the screws may be removed from the bottom side of the base. Glue the lid of the enclosure to the top of the wood base making sure to line up with the holes. Toothpicks may prove useful in lining up the holes. Use a strong adhesive such as two-part epoxy to adhere the lid to the wood base.

13. Once the epoxy has cured, place the enclosure onto the lid and secure the screws from behind. The dance pad is now completed.

# Notes

The program Stepmania, for the PC, allows the player to map any button on the controller for any function on the program. If the intent is to use this dance pad on PS2 or Xbox, a suitable controller must be obtained for disassembly and specific buttons must be wired to specific locations on the dance pad.

Sheet metal is perhaps a better choice for the contacts on the air gap switches. Also it may prove easier to solder. However, using sheet metal will require a small re-design of the active areas of the pad as spray adhesive will not adequately hold sheet metal to bending acrylic. A suggestion would be to use screws instead of velcro at the corners and separate the sheet metal contacts using a nylon washer (available at hardware stores) or two. Such a system might be used in the next generation of this dance pad.

Originally, a Playstation controller was used for the control box of the dance pad. This choice proved quite troublesome and was replaced after a short time. The analog switch required extra wires to turn off and the analog sticks themselves seemed to interfere with some signals from the buttons. It is also difficult to solder to. A PStoUSB converter is also required for such a setup which adds unnecessary cost.

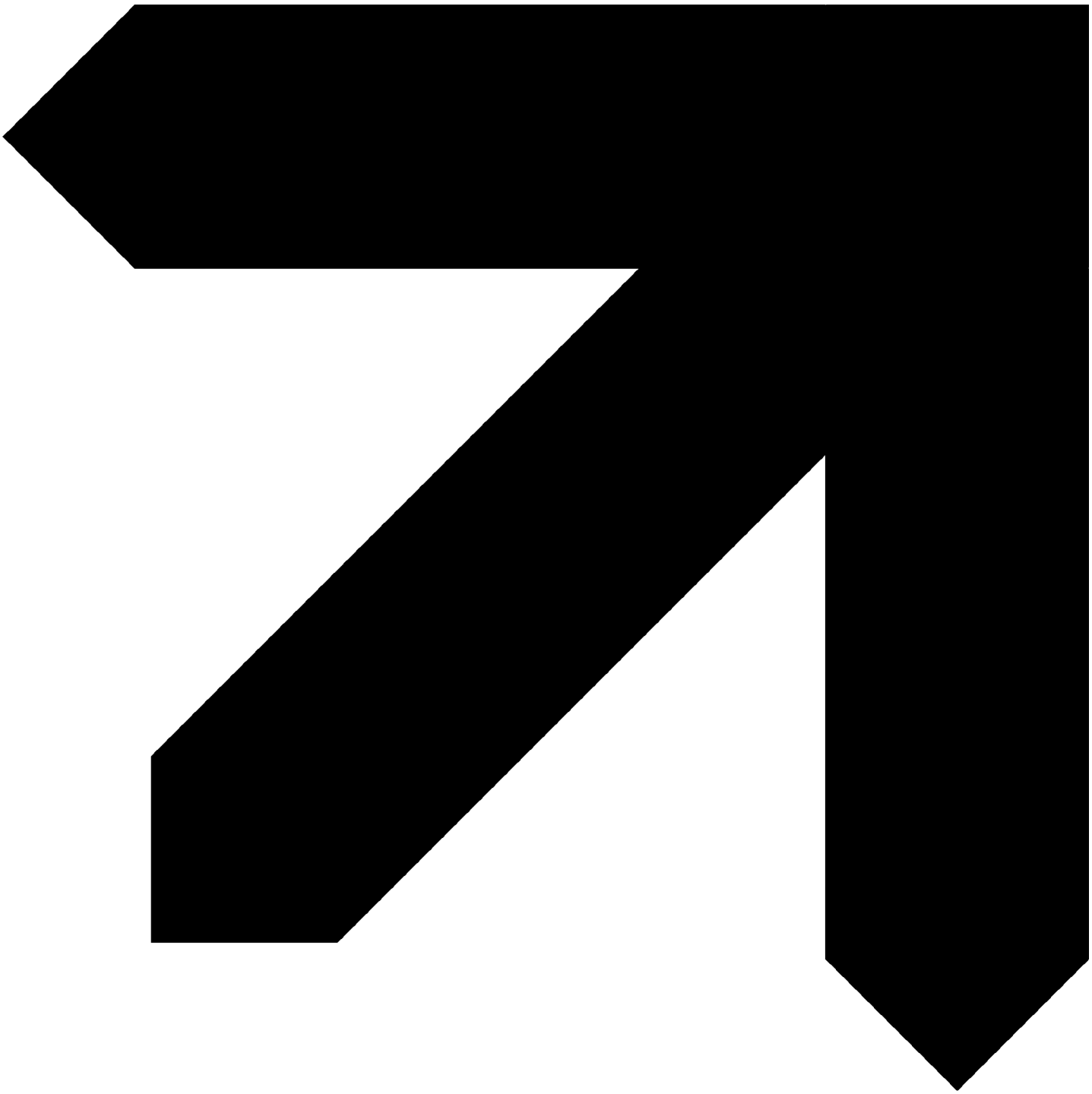
The control box could optionally be attached to the wood base with velcro.

Static discharge could present a problem in certain climates and could possibly damage the control box. Avoid practices that increase static electricity.

Acrylic can melt if in contact with a soldering iron for too long.



dancepad (at) applied-sciences.net



*Arrow Template*