Construction Manual Solar Mario

👉 Note

These instructions show how to build the glasses and controller for the Solar Mario game.

Material

For the construction, you will need the following materials:

- 1 pair of VR (virtual reality) glasses; choose an "empty" model with space to insert a mobile phone (available for example from AliExpress etc.)
- 1 base plate of the size of a mobile phone, for example made of aluminium, 2 mm thick
- Plywood board for controller, approx. 12 cm x 10 cm, approx. 8 mm thick
- 10 m fibre optic cable made of acrylic glass with 2 mm in diameter, or 30 m of 1 mm in diameter (for 6 "commands")
- 2 m flexible cable duct/cable sheath (from car electrics), black, 10-15 mm in diameter
- Two-component adhesive
- Black insulating tape
- Printed drawings of fruit, laminated
- Acrylic paint for controller
- Waterproof marker pen
- Small cable ties
- Smartphone or MP3 player with active speakers, "Super Mario Theme.mp3" from YouTube
- Clothes pegs

Tools

For the construction, you will need the following tools:

- Saws for aluminium and plywood
- Files for aluminium and plywood
- Sandpaper for wood and metal
- Brushes
- Compass
- Scissors, utility knife or something similar
- Drill with drill bits in the diameter of the acrylic glass fibres[1]
- Jigsaw
- Ideal: A Dremel micro drill with a small cutting disc, otherwise wire cutter or nail clipper

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[1] If we use three thinner fibre optic cables instead of one thick fibre, for example, we need a drill with the diameter of the three cables combined.

🖼 Step by step instruction

Step 1: Prepare the base plate

We saw the base plate to the size of a mobile phone (a size that fits well in the glasses), file the corners round and blunt all edges. We mark the drill holes according to the following instructions: The left eye sees only half of the light points, the right eye sees the other half. In the VR glasses, the areas visible to each eye are separated by a few centimetres. Without having to move the eyes much, each eye can comfortably see a round area of approx. 3 cm in diameter. We use a little more than the left half of the left circle for the left eye and a little more than the right half of the right circle for the right eye. This avoids 3D effects. The following drawings show an example with 6 "commands" on the left and the image that "Mario" sees in his glasses on the right.
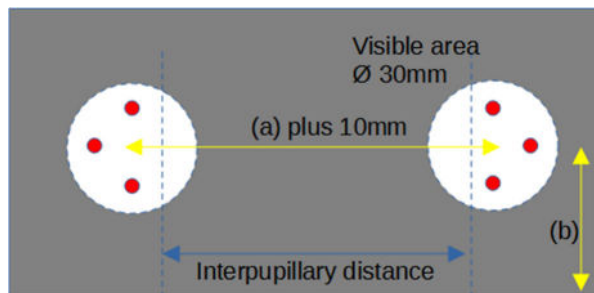
The left eye sees slightly more than the left half of the left white circle.
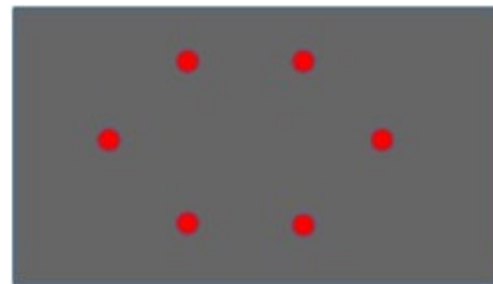
Our brain puts the two images together like this.

We measure the interpupillary distance (a) of our VR glasses[2], e.g. 58 mm, insert the aluminium plate into the glasses and measure the height from the lower edge of the plate to the centre of the lenses of the glasses (b).

We use the compass to draw two circles with a diameter of 14 mm on the aluminium plate. The centres of the circles have a horizontal distance of "(a) plus 10 mm" and are vertically "(b)" millimetres above the lower edge of the plate. In each semicircle, we mark the drill holes for 3 or 4 light points (these are located on the circle with a diameter of 14mm, according to the sketch below) and, at the same time, draw the symbol (arrow, etc.) that belongs to each light point. In one corner of the plate, we note the orientation, for example "inside, right, top".

We drill the necessary holes in the aluminium plate. If we are using a thicker acrylic glass fibre, we drill the hole in the diameter of the fibre. For thinner fibres, we insert a bundle of three fibres, for example. In this case, the drill hole must be thicker. Bundles of thinner fibres have the advantage that they do not break so easily.
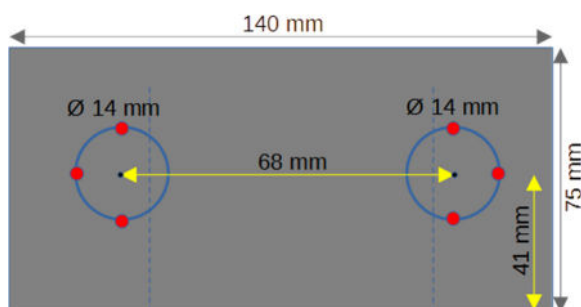
Marking and drilling the holes. The dimensions are to be understood as an example, they apply to the glasses *we* use.
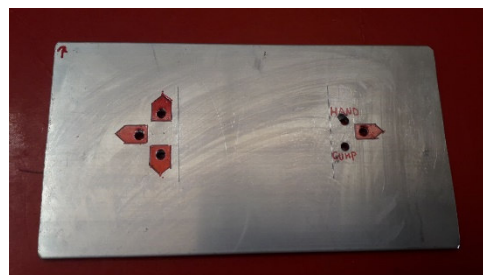
Example of how the symbols can be drawn.

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2   If the interpupillary distance of our glasses is adjustable, we choose 58 mm for teenagers and adults.

Step 2: Prepare the controller

We draw the shape of the controller, the drilling points and the symbols on the plywood panel and saw the panel to the chosen shape, using a jigsaw. We blunt the edges with sandpaper. Now, we drill all the holes in the diameter of the glass fibres (or the glass fibre bundle), paint the controller and draw the symbols on the controller with a waterproof felt-tip pen or a fine brush.

Two examples of Solar Mario controllers.

Step 3: Insert the glass fibres

We insert the fibre optic cables (or bundles of thinner fibre optic cables) into the holes in the base plate from the back, until they protrude a few millimetres at the front. We glue the fibres in this position with two-component adhesive.

Later, we do the same with the controller; inserting the cables from below into the holes. To do this, we place the base plate and the controller on a long table, in the same orientation as both elements will be later on. On the side of the glasses, we run two pieces of cable sheath (approx. 10 cm each) over the left and the right half of the fibres. Behind this, we tie the complete cable bundle together at several points, using cable ties. We now run a piece of cable sheath over the bundle – long enough to protect the entire bundle from light – until right before the controller. Finally, we pull the glass fibres through the holes in the controller, until the shortest cable sticks out at least a few millimetres. **We have to make sure that each cable connects the same symbol in the glasses and on the controller!** (The best way to test this is to hold the base plate into the light and "tap" one fibre after the other with your finger). As soon as a cable is in position, we fix it provisionally with a clothes peg. As soon as all the cables are ready, we glue them tight, using two-component adhesive.

The glass fibres are glued into the controller.

This picture shows how the fibre optic bundles are protected against light: From the side of the glasses, first 10 cm of theleft and right fibres in separate sheaths, then all fibres together until right before the controller.

Finally, we cut off the protruding ends of the glass fibre just 1 mm above the two plates (base plate and controller). To ensure that the light is clearly visible, this cut must be as right-angled and flat as possible. The best way to do this is using a small cutting disc from a Dremel drill. Thinner cables can also be cut with cable pliers or a nail clip; for thicker cables, this will not give a flat cut.

Now we check the quality of the light points and the consistency of the symbols by holding the controller to the daylight and testing each point individually by tapping it with our finger. All the dots on the aluminium plate must light up brightly.

Step 4: Finalise the glasses

If everything is correct, we insert the aluminium plate into the glasses. Probably, we will have to secure the plate with a few pieces of plastic or something similar, as the plate is thinner than the mobile phone, which should actually be in the glasses. We attach the plate with black adhesive tape and, if necessary, tape over the areas where Mario could see out of the glasses. Caution: Some diffuse light is allowed to enter the glasses, so that Mario can see the symbols. Therefore, don't tape everything completely dark.

As our glasses with the cables are heavier than the normal VR glasses, it may be useful to glue a thin piece of foam where the glasses press on the nose.

To prevent the glass fibres from pulling too hard on the glasses (risk of breakage!), we can "somehow" attach the cable bundle to the side of the glasses. The following example (right) shows a possibility with a threaded rod that is screwed to one side of the glasses:

The aluminium plate with glued-in glass fibres in the VR glasses.

VR glasses with a threaded rod to which the bundles of fibre optic cables can be attached.

Step 5: Print out the fruit

We print out drawings of fruit (for example from the internet) in colour, laminate the pages and then cut out the fruit. In the game, they are clipped somewhere with clothes pegs, e.g. on branches or strings.

The pictures of the fruit are printed, laminated and cut out.

Step 6: Provide a musical background

On YouTube, for example, you can find a one-hour version of the "Super Mario Theme" (https://youtu.be/3ijDdxmoiX0). If we play this song with a smartphone or MP3 player, the game becomes even more fun.