A fairly cheap, reasonably simple do-it-yourself lightboard project for remote teaching

Dan Quint, June 2020

I recently did a do-it-yourself project that lets me create videos at home (pre-recorded or live) that look like this:

It’s called a lightboard – the basic idea is:

- You record yourself through a sheet of glass
- The glass is lit from the edges by LEDs; you write on the glass with neon whiteboard markers, and the ink glows brightly
- You use software or a physical mirror to horizontally flip your video feed so that people can read your writing (I’m right-handed, I look like a lefty in the video, but on the plus side, I didn’t have to learn to write backwards)

Beyond that, you need a black background, dark clothing, and a dark room with lights on you that don’t reflect off the glass.

There’s lots of information about lightboards online, for example:

https://lightboard.info/
https://flippedlearning.org/how_to/how-to-make-a-lightboard-for-less-than-100/
https://revolutionlightboards.com/collections/all

The third link shows some professional-quality ones available for $2,000 to $9,000, depending on size. My whole setup cost about $550 (including webcam but excluding a “podcasting microphone” I had already decided to buy), plus some time, tools (but not a ton of skill), and some trouble-shooting and iterating. More detail below.
I started with a cheap but well-reviewed webcam (Anivia 1080p HD Webcam W8, chosen because it wasn’t out of stock on Amazon) and a webcam stand that clamped to my desk. After some estimation of how big a field the webcam was capturing at a reasonable distance, I decided on a 44” by 26” sheet of plexiglass. (Based on what I found online, best practice is to use tempered ultraclear glass, ideally 10 mm (3/8 inch) thick – Starphire is a particular brand name of what you want. Regular – i.e., non-ultraclear – glass doesn’t transmit the light well enough. But I was intimidated by the weight and shatter potential of real glass, so I decided to use plexiglass instead, at least for “version 1.0”. What I found online suggested that polycarbonate plexiglass isn’t transparent enough to work, while acrylic plexiglass is clear enough but scratches easily. I went with acrylic, and if it picks up scratches, I’ll eventually replace it with ultraclear glass of the same size.) A 44” x 26” sheet of ¼-inch acrylic plexiglass cost $150 at a local glass shop.

I built a very basic wooden frame to attach the whiteboard to. I’m not much of a craftsman, so I went with the simplest design I could come up with. I started with three 8-foot boards of two-by-two, cut into eight pieces (lengths below), and put it together so that the plexiglass sits on one board, and is held to the rest of the frame by clamps at each corner. The frame has “feet” as long as my desk is deep, which are clamped to my desk at each corner with a C-clamp.

Specifically, I used:

- Two 31” long pieces of 2x2, to form the vertical sides
- Two 45” long pieces of 2x2, to form the horizontal sides
- Two 29” long pieces of 2x2, to form the feet
- Two pieces of 2x2 approximately 30” long, with edges trimmed at a 45 degree angle, to serve as cross-braces between the vertical part of the frame and the feet
- A bunch of 2.5” long wood screws
- Four 3-inch C clamps and four 4.5-inch bar clamps
This all came from Home Depot. I had a friend with a table saw cut the two-by-two to the right lengths. After screwing everything together, I spray-painted it black, then clamped it to my desk with a C-clamp at each corner.

(I wanted the glass to be several inches above the desk surface, so that I could still reach underneath it to get to my computer. This also lets me clamp a microphone stand to the edge of my desk, and sneak it through the gap to hold the mic right below where I’m talking. The cross-braced feet give the whole thing a very solid feel when you press against the glass, which is what I was hoping for.)

Next, I got two rolls of cheap dimmable LED strip lights on Amazon, and some foam insulating tape (sticky on one side). My plan was to use white LEDs to light the glass from below, and to use the second LED strip to light myself. I laid down a length of the white LED strip on the horizontal board the glass would sit on, and secured it with the tape every couple of inches – this held it in place, and gave the glass something to sit on besides the LEDs themselves. (I definitely regret using gray rather than black tape.) I also put foam tape along the other boards where the glass would be held against them. Then I gently set the glass on top of the LEDs, and clamped it in place with four adorable little bar clamps from Home Depot.

To light myself, I used two-sided mounting tape to attach some long strips of triangular foam to half-inch square dowels (all from Amazon) which I attached to the frame, then attached the second set of LED lights to those, so they were above or to the sides of the glass and angled in toward me.

It turns out, the white LEDs along the bottom are too bright (even at their dimmest setting) and make the plexiglass look cloudy; the yellower LED strips along the top and sides, angled at about 45 degrees, at their dimmest setting, gave enough light to light me and to light up the glass.

Finally, I got a cheap photo backdrop stand setup from Amazon, along with a large black piece of cloth, to put behind me; as well as another black cloth to cover the windows in the room, and another backdrop stand setup and cloth to block out glare coming down the hallway. This ended up being pretty vital — the glare off the glass from the camera side is brutal otherwise. (I have to turn off my monitor to record videos, and move my laptop to where the screen doesn’t reflect to the camera.)
Below are front and back views of the whole setup. The LEDs along the top and sides of the glass are beyond the edge of the glass. The gap between glass and desk allows me to work on my computer without removing the whole setup, and lets me sneak a microphone through. Note that you really need to black out the room on the camera side of the glass, as the glare is really bad otherwise, and you want a black background behind you as well.

The markers I’m using are Expo Neon dry-erase markers, but I also have some Expo Brightsticks arriving next week (technically wet-erase), which I’m hoping will have a finer line and therefore allow more lines of writing on the board at once. I got a dozen cheap microfiber towels for erasing/cleaning the board.

I had assumed I’d flip the video horizontally after recording, but I later discovered that I could do it in real-time, which will allow me to use the lightboard live as well as pre-recorded, e.g., for synchronous lectures or office hours. I’m using software called ManyCam, which costs $30 a year. (In addition to flipping your video feed, it lets you output to multiple sources at once – in case you wanted to stream to BBCollaborate and also record to Youtube, or something – and to insert additional “layers” – as I did in the original picture, with text of the result I’m proving.)

Anyway, I’m pretty happy with the outcome. It would be nice to have a larger board that I could write on while standing up, but my basement office doesn’t have space for it (and building it would have been much harder). But for something that sits on a desk, I think the results are pretty good – for me, at least, I think teaching technical material (PhD core micro) this way will work much better than slides.