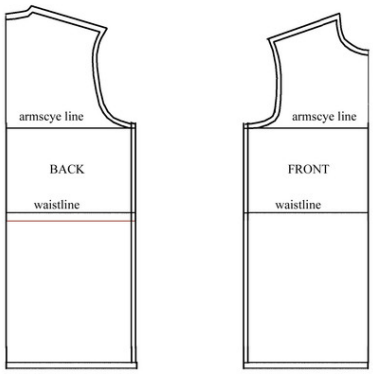
Making an e-Vest (electronic vest)

By: gedwoods

http://www.burdastyle.com/techniques/making-an-e-vest-electronic-vest

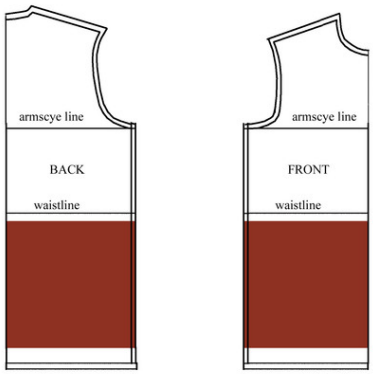
Here are detailed instructions for putting electronics into a specially designed vest, along with several examples of projects that incorporate active lighting within the vest. I started this project while on sabbatical at Bloorview Kids Rehab, a hospital for children with a range of disabilities located in Toronto, during the fall of 2008. The project was designed to experiment with and showcase the incorporation of electronics into clothing. My first project with the vest consisted of developing a Christmas scene using fiber optics cable. My second project, realized in the late spring of 2010, was to incorporate a sequential band of LEDs (Light Emitting Diodes) into one of the side seams of the vest. Both projects are shown and explained in detail. I also provide ideas about additional projects that can be done, and discuss the advantages and disadvantages of this particular design, with a view to proposing several improvements.

Step 1 — Drafting the vest pattern



Begin with the Easy-Fitting Overgarment Block, or, alternatively, the Men's Shirt Block (to which you may need to add a little bit of ease, however, as the vest needs to be large enough to accommodate the batteries sewn in near the hem line - I'd go for at least ten centimeters or four inches of overall ease if you are using the shirt block. If you are using the Easy-Fitting Overgarment Block, this amount of ease is already built in to the Block, so no additional changes are required). In the diagram, I have separated the block into its front and back sections. Note that no sleeve is needed for the vest. Note that if you are adding ease to the shirt block, you must divide the total ease into four, as each of these blocks is a quarter of the final garment. Hence you would add 2,5 cm ease to the middle of the front and back blocks. You also need to ensure that there are seam allowances on all sides (including the hem) except the center back and center front (well, actually you need a seam allowance at center front as well - we're going to add it in a few steps).

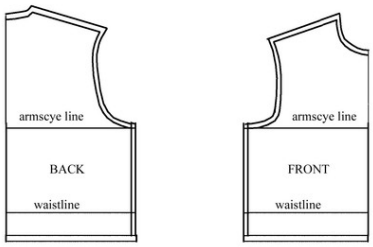
Step 2 — Shorten the below waist distance



I shortened the below waist distance to a few centimeters. You could shorten the vest to the waist line, but I find that the waist line is a bit too high to place the batteries, as I often need to

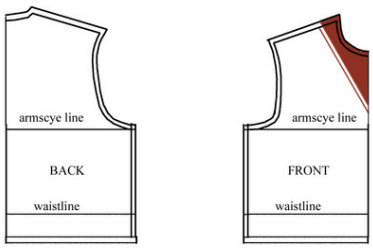
manipulate elements and having the batteries below the waist line works better for me. However, too far done and they create other problems. In the diagram, the red area shows the part of the original block that I cut out to make the vest pattern.

Step 3 — The shortened vest



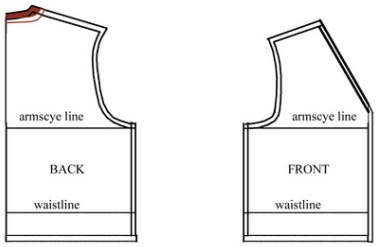
This figure shows the results following the shortening of the blocks.

Step 4 — Modify the Front Neck Line



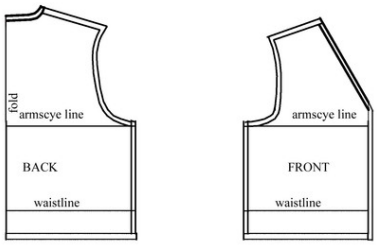
Now we modify the front neckline to give the vest some "style". Although I've shown this as an oblique line with sharp corners, you may want to round out the connection to the center front edge. I've added a 1,5 cm (5/8") seam allowance to the new neckline. In red is shown the elements removed to form the new neckline.

Step 5 — Modify the Back Neck Line



Because the front of the vest is left open, you will need to add a seam allowance to the center front line if you haven't already done so. You will also need to modify the back neckline slightly to conform to the changes made to the front neckline - essentially, broadening the "dipped" region so that the shoulder seam is the same length as found for the front block. Here, I've also added in the seam allowance.

Step 6 — The Basic Vest Pattern

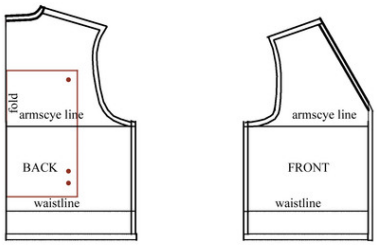


We have now arrived at the basic vest pattern. It should be noted that I lined the vest - this is a good idea, as we want to pack the electronics into the space between the lining and the outer material. So you will need to cut the vest pattern, front and back, out for both the outer fabric and the lining fabric.You might want to do this now, and sew the vest and lining together.

Step 7 — Constructing the Vest

Normally, you would do this by sewing the shoulder seams of the vest together, then the sides of the vest under the arms. Proceed to sew the lining together in the same order. Now put the lining right side against the outer fabric right side, and sew the two together at the neck and armholes. I also sew the hem seam joining the front piece to the lining, but leave the seam between the back piece and the lining open. Press the seams open. Now pull the two layers through the opening left between the back piece and the lining, You now have a vest that is almost completed. We will leave the back hem open, as we will install all the electronics through this opening.

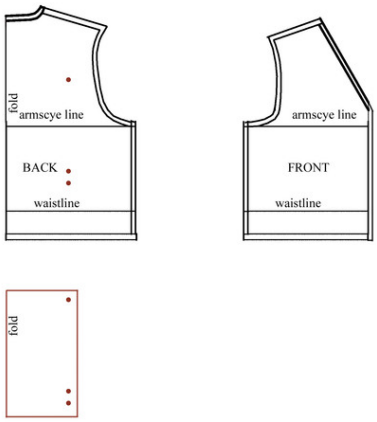
Step 8 — e-Variant #1 - An illuminated scene - 01



As a first project, I decided to construct an illuminated scene that could be worn on the back of the vest. My idea was to build this as a replaceable scene, so that I could replace the scene at the back with another scene at will. In order to achieve this, I came up with the following design. Essentially, the fiber optics cable is installed on a cloth panel that is snapped onto the back of the vest. The batteries, on the other hand, are built into the vest itself, along with an on-off switch that would allow me to turn the scene on or off at will. The current is passed from the vest to the panel through its metal snap fastenings. To begin developing this design, the diagram shows the placement of the metal snap fasteners on the back pattern piece. I planned on three snaps on each side, two at the bottom for carrying the current, and one at the top which is used uniquely for

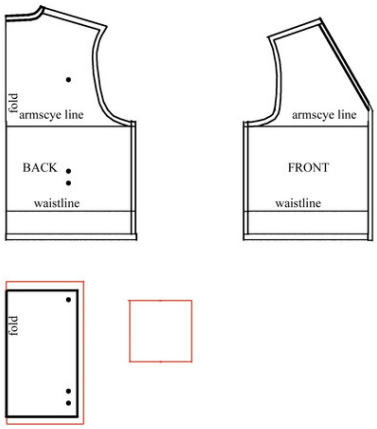
attaching the panel to the back of the vest. For the fiber optics cable I used, I needed the positive and negative wires to be placed fairly closely together. Potentially, for other applications, the wires could be separated and one could use the top snap fastener combined with one of the bottom two to carry the current. Both are possibilities with this design. Shown on the diagram, in addition to the three snaps, is the outline of the panel that will be snapped into place. Note that the panel, like the vest back, is folded along the center back line.

Step 9 — e-Variant #1 - An illuminated scene - 02



Here we have slid the panel drawing down below the back vest pattern piece along with a copy of the snaps (essentially, the other half of the snap fastener). On the diagram, the fold line that corresponds to center back is clearly marked.

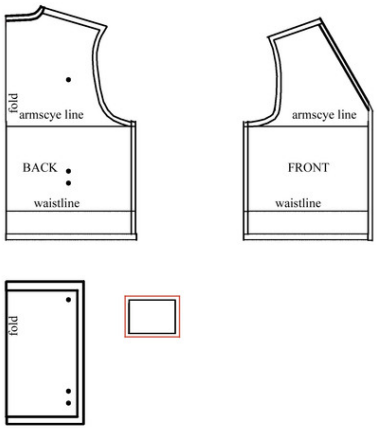
Step 10 — e-Variant #1 - An illuminated scene - 03



To complete the drafting of the pattern pieces, we add the seam allowances to the panel piece and introduce a rectangular piece of cloth for the battery holder. The size of this second piece is determined roughly by the size of the batteries we need to use. For the fiber optics cable I used, I

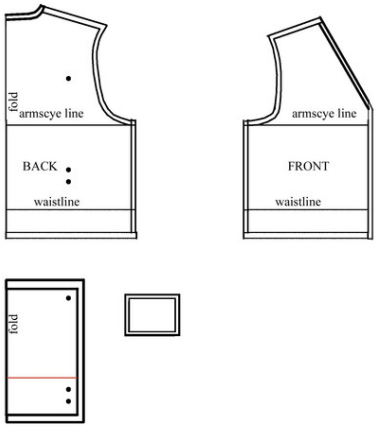
needed two 9-volt batteries. Each 9-volt battery could be used to energize two fiber optics cables. So I used the small rectangular 9-volt batteries you can buy at the local grocery store (see step x below). These batteries are 1,6 cm x 2,6 cm x 4,7 cm (5/8" x 1" x 1-7/8"). Therefore I made the battery holders 7 cm x 6,5 cm (2-3/4" x 2-5/8"). The logic is that 7 cm is long enough to be able to close one end beyond the 4,7 cm length of the battery, while 6,5 cm is wide enough to wrap around the 2,6 cm width (i.e. folded down) and sewn into the seam allowance at the bottom of the vest.

Step 11 — e-Variant #1 - An illuminated scene - 04



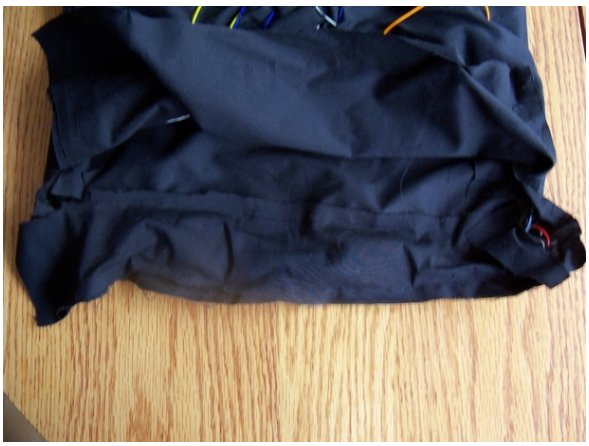
Now add the seam allowance onto the battery holder rectangular pattern piece.

Step 12 — e-Variant #1 - An illuminated scene - 05



A final element to be drafted - I designed the back panel (see next step) to include a fabric "conduit" within which the fiber optics wiring is contained, running along the bottom of the panel. The seam line for this conduit is now shown in the diagram, slightly above the higher of the two snap fasteners located near the bottom of the panel.

Step 13 — e-Variant #1 - An illuminated scene - 06



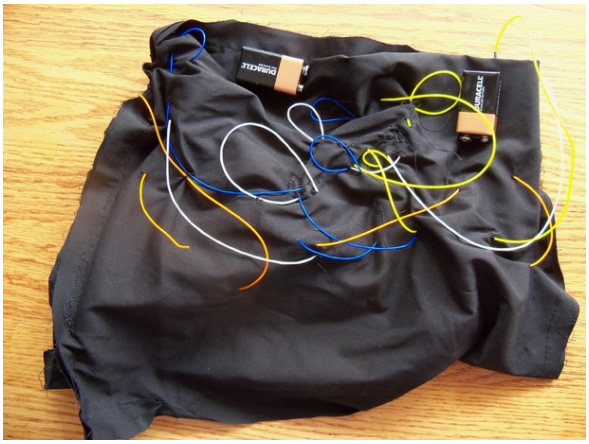
Now we construct the back panel. I found after some experimentation that the light from the fiber optics cable showed through one layer of black fabric, and that I needed two layers to completely obscure the light. Furthermore, I wanted to hide the fabric cable conduit from the back of the panel. So I used three layers of fabric to make the back panel - that is, I cut out the pattern piece three times. I then sewed two of the layers together, right sides together, around the outside seams. I also stitched across where the conduit seam is, to close off that piece, leaving a couple of centimeters open on each end of the conduit seam so I could pass the fiber optics cable around into the panel scene area. I then sewed the third piece of fabric to the now combined cabling sheets, leaving the sides open from about half way down. Shown is the finished back panel - the front flap is turned up, showing the back panel and the fiber optic conduit sewn along the bottom.

Step 14 — e-Variant #1 - An illuminated scene - 07

As indicated earlier, the fiber optic cable I used require 9 volts for each pair of cables. I ordered the fiber optic cable from "www.fiberopticproducts.com". I used their EL wire ("electroluminescent wire", also called "Lighteningwire"). The side-glowing fiber optics cable they sell required too much power to be incorporated into clothing, whereas the EL wire was much more effective for a reasonable power supply. Note that the wire requires that one buy an "inverter" to power the cable. I ordered a kit with 8 colors and then selected four colors for my Christmas scene. I ordered 3 feet of each cable - it sounds like a lot for this little scene, but in fact I was a little tight. The total cost for the fiber optics cable, including the converter, was about 8$US per cable, hence about 35$ for the whole shebang (including wiring and batteries). Shown in this diagram on the left is the scene I had selected as a source of inspiration to develop into a fiber optics variant. On the right is a simplified

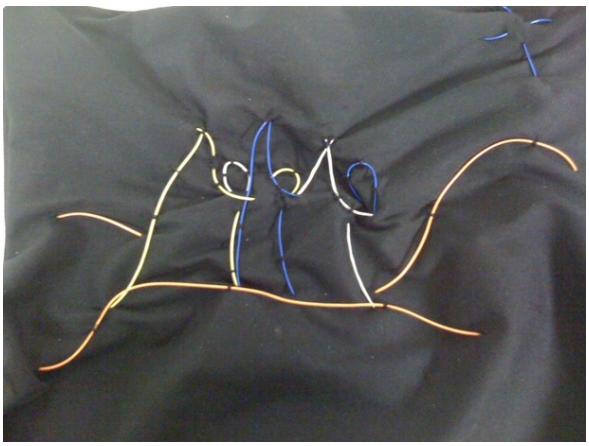
sketch I made of the scene as a guide to developing the fiber optics variation. I was convinced that I could develop a "line-based sketch" that would capture the essential forms using these first attempts as a rough guide.

Step 15 — e-Variant #1 - An illuminated scene - 08



The trick of developing a scene using the fiber optics cable is to pass the cable above the fabric where you want the line to be seen, then pass the cable behind the two layers of fabric where you want it hidden. While it is hidden, you can loop it around and then pass it back through a small hole in the two layers of fabric so that it starts a new line segments. In this way, passing the cable back and forth through small holes, one can build up a scene. The process is tricky and somewhat frustrating - as the complexity increases, it becomes harder to think about where the cable needs to pass in front, and where behind, and the cable tends to slide around about through the holes. Note also the ends of the cable hang loose on the back side - you need to leave enough cable here so that the end doesn't creep back to the front side. The diagram shows the back side of the finished panel (I've turned the panel inside out so you can see the chaotic structure more clearly). Also shown are the 9-volt batteries, although these are not placed within the panel, but within the vest.

Step 16 — e-Variant #1 - An illuminated scene - 09



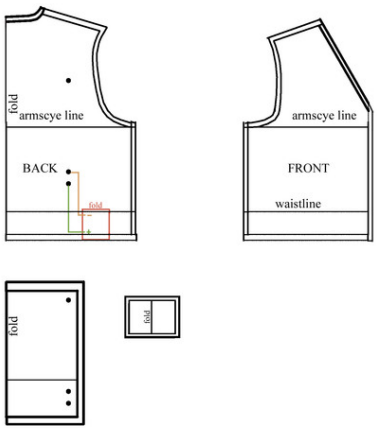
And here is the front side of the finished panel, showing the successful rendition of the nativity scene. Note the way I divided up the colors. I used one color for each of the wise men, and then the yellow color to trace the sand dunes. I re-used the wise-men colors to make the Frank, Myrhh and Incense, and to make the star of Bethlehem in the sky. It may look like much here, but when it

glows (see below), it is really quite spectacular.

Step 17 — e-Variant #1 - An illuminated scene - 10

Here is the back side of the back panel, with the two fasteners located near the bottom. Note that I haven't yet completed the fastener at the top of the panel - I've been using safety pins to keep the panel attached, but I really need to finalize the design with another pair of snap fasteners.

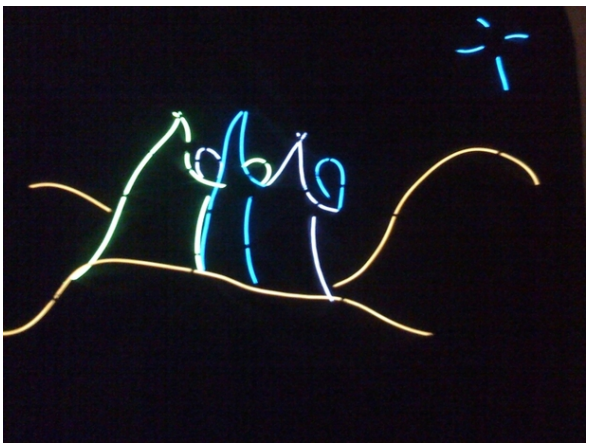
Step 18 — e-Variant #1 - An illuminated scene - 11



Next, let's look at the wiring diagram for the vest itself. I've shown the positive circuit in green and the negative in orange (as my colors red and black are already used and I don't want to confuse things). Note that I have shown where to sew in the battery holders - I found the most effective place was just behind the side seams along the bottom (hem) edge of the vest. I used conductive thread that I obtained from Aniogram, one of the companies that makes e-kits for clothing, but I could have used regular wiring as well as the circuits were hidden away between the lining and the outer fabric (for the second project, I used wiring). Note that it is important to keep the two conductive channels separate - one of the difficulties of working with conductive thread is that there is a danger that folds in the clothing bring the two electric channels (negative and positive) together when you don't want them too. Wiring is safer this way, as it is insulated. With regard to connecting the wiring and/or conductive thread to the snap fasteners, I found it was simpler to do this before

the snap was installed within the fabric. The conductive thread is particularly easy to manipulate, since it may be connected to the snap ring simply by tying and knotting it to the loop.

Step 19 — e-Variant #1 - An illuminated scene - 12



Now you are ready to bring all the elements together. If you haven't already sewn in the battern holders, do so. Slide the batteries in and connect them to either your conductive thread or your wiring. Snap on your panel and put the vest on. If you have done everything correctly, you will have a glowing scene on the back of your vest! Note that a slight flaw in the use of the EL wire is that the inverters produce a faint whine which can be irritating. Also, the EL wire drains the batteries rather quickly - I found that only four hours of continuous operation left the batteries high and dry. For these reasons, it would be useful to install an on-off switch along the bottom hem of the vest at the front and pass the circuits through this switch. Such cloth switches may be readily purchased from Aniomagic (www.aniomagic.com) as well as other companies that sell e-kits for clothing.

Step 20 — e-Variant #2 - A strip of scintillating LEDs - 01

For the second project, I wanted to incorporate a strip of scintillating Light Emitting Diodes or LEDs into one of the side seams of the vest. Although the company I bought the fiber optics cable from also advertises LED strips, I bought mine locally, as these and other micro-electronics components are beginning to proliferate. Shown in the diagram is the strip of LEDs, some small cable elements needed to string the lights together with the controller (the cross-shaped piece and the black wire with two ends), the small white controller box, the controller pad, a banana plug, and one of the two 6-volt, 3 amp batteries I ended up buying to support the project. These LED strips incorporate

three-color LEDs at each location and the strip itself includes, therefore, four wires, one for each color and one for ground. The cross-piece allows me to convert a male connector to a female one, as well as allowing several strips to be connected to the same power supply. The controller pad uses infrared to communicate with the white controller box, which in turn plugs into the LED strip itself or into the cross-piece. The LEDs require 12 volts and 2-3 amperes of current (which is quite high as an amperage) - this requires a rather large battery (shown in inset). In actual fact, this battery is a 6 volt battery, and I had to chain two of these in series to get my 12 volt current (meaning I had to connect the positive of one to the negative of the other, and use the two terminals not used by this cross-over linkage to drive the LED strip. Also, although the system worked fine the day I installed it into the vest, the next day the controller pad failed to communicate properly with the white box, so I'm a bit concerned about the overall stability of the system. Costs here are commensurate with the fiber optics - the kit shown cost me about 50$US.

Step 21 — e-Variant #2 - A strip of scintillating LEDs - 02

I didn't want the strip of LEDs to show when turned off, so I stitched the LED strip onto the side seam behind a strip of black fabric. For this fabric I used a stretch fabric with a rather coarse netting - it was dark enough to hide the strip when turned off, but transparent enough to allow most of the light to come through when lit. I had to make a new pair of battery holders, and larger ones because of the size of the new 6 volt batteries - I sewed these into the seam allowances of the hem behind the first set of battery holders. Also, I found the conductive thread didn't work well to carry the current for the LED strips - probably the higher amperage requirement of the LEDs was the source of the problem, but I'm guessing. So I used wiring instead. I sewed the black strip over the hem edge and onto the inside of the vest - this allowed me to embed the electronics (controller, wiring, batteries) between the lining and the outer fabric and let the wire trail across the hem hidden underneath the black strip. I left the infrared antenna (shown as the smaller of the two white wires coming out of the controller box on the diagram for the previous step) trailing slightly below the hem of the vest so that I could still control the LEDs, but, as I indicated earlier, the controller pad failed to perform when I needed it to (I used the vest as part of a more extended performance)! The LEDs did shine, but I had wanted to vary their intensity during the performance which I was unable to do.

Step 22 — e-Variant #2 - A strip of scintillating LEDs - 03

Here you can see the panel working on the vest laid flat on the table. The controller pad, when it's working properly, allows me to change the color and intensity of the set of LEDs on the pads (although not to modify the lights individually). I can also program the way they change intensity and color for a variety of effects. I built this strip into the side seam and used it as a way of representing my "inner self" within a dance performance at a recent conference. I have been struggling to find elegant and aesthetically interesting ways to integrate interactive electronics into clothes, and despite the rather primitive arrangement involved here, the result was effective. I am planning, for the next stage of the work, to incorporate an accelerometer into the control circuits, so that the color of the LED strip changes depending on my orientation and tilt - a more dynamic and directly interactive use of the electronics. Accelerometers for such clothing applications are now available through a variety of suppliers (I bought mine at www.aniomagic.com, but there are several other suppliers available).

Step 23 — e-Variant #2 - A strip of scintillating LEDs - 04

Finally, here is the final product with me wearing the vest. Here are a few final comments about this design. I think when I remake it, I will make somewhat larger top-opening battery pouches with a snap-down top that can accommodate a variety of battery sizes. Where I can get away with it, I will use wiring as this is clearly more robust than conductive thread for many of these applications. I like the snap-down panel principle, but it can make the vest somewhat voluminous at the back - a cleaner look would be achieved by building the circuits directly into the fabric all the way. The use of "fabric conduits" to channel the wiring also seems to be very effective - I expect to systematize the use of such conduits in future incarnations of the vest (or other e-garments). The design also needs to include an accessible on-off switch. Good luck with your efforts - I hope you find my