ST VITO at Deutsche Telekom Fashion Fusion 2017

White Paper: from Christmas Tree Lights to Contemporary Art - the Aesthetics of Wearable LEDs

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Abstract

The dream of clothing which can take on any pattern, a "screen suit", has been constant across many cultures. However, we are still far away from what is possible with commercially available materials and technology. We must make do with the promising, yet far from perfect, technology of LED strips. These are becoming increasingly more affordable, easier to control, and more commonplace.

Full-color, individually addressable LED strips and controllers have been available for over 5 years, yet the development of new concepts has largely stalled. This is due to some peculiarities of the technology which make it challenging to move beyond "robot dance" shows, which are the most obvious performance candidate for LED costumes. However, with some changes to the software and costume design, the technology is ripe for wider artistic and aesthetic possibilities.

ST VITO (James Hudson and Alma Edelstein) has been developing contemporary, organic performances with LED costumes for 3 years. The directors have built up some expertise and technology in this area, and bring their prior career experiences of media arts, engineering, and dance to the aesthetic development of LED costumes.

There are several limitations which stand in the way of fully flexible, fully durable, and high-definition illuminated clothing, and this white paper outlines some mitigation approaches. These are: less grid-like LED strip placement, more advanced non-linear texture-mapping software, and carefully chosen patterns. The main problems, and some possible solutions, are outlined below.

Goodbye, Mr LED robot! Lulu Schmidt and ST VITO, Fundamental Monodrama Festival, Luxembourg.

Low pixel density

LEDs on strips appear as individual points, so motion and shape patterns are hard to produce. When more than 50% of the LEDs are lit, the strip geometry becomes very obvious, and the illusion of the motion of patterns over the surface of the body is broken. It is better to use light sparingly, and have waves of darkness and brightness passing over the body.

Masking the lights with a separate "top layer" of fabric diffuses the light, and reduces pixelation. Also, the reflections and shadows through different materials are often more aesthetically interesting than the bare lights. Masking layers also allow more varied themes than "Tron" and "robot"; the layers can change according to the theme, and a single under-layer of lights can be reused under all of them.

Obvious "matrix" LED grids

Live visual generation software and LED driver hardware is typically based on an inflexible "matrix" pattern (fig 1(a)), which is suited to flat screens and matrix displays, but not to texturing arbitrary 3D objects, let alone human bodies. Grid layouts produce a retro pixel-art effect, limit the sort of patterns that can be used, and cannot properly follow the curves of the human body.

Fig 1(a) "matrix" LED layout

Fig 1(b) non-linear LED layout
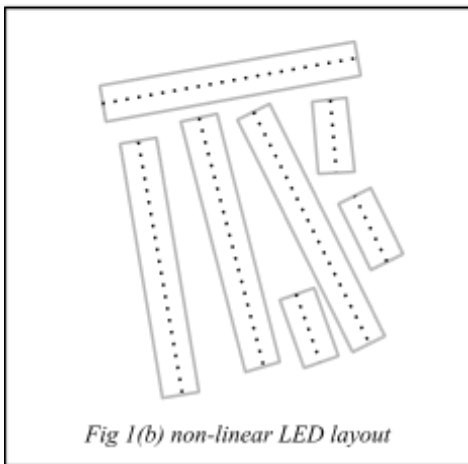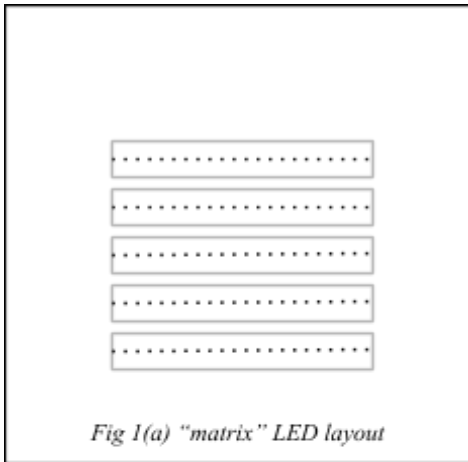
A more flexible approach is to place the strips in arbitrary directions (fig 1(b)). Then, non-linear texture-mapping can be used to apply patterns to a 3D body, as is typically done by 3D engines such as Unity. This can effectively hide the linear geometry of the LED strips, and more closely match the shape of a performer's body.

Fragility

LED strips can be bent at extreme angles, but are not designed for constant flexion, which will cause them to break eventually. This means that the strips must be mounted on rigid surfaces, which leads to a "cereal-box armor" appearance, which also greatly limits movement. Dancers and choreographers prefer to have access to the full range of motion of the human body, so any extra flexibility in costumes greatly expands the creative possibilities.

Once again, one partial solution to this problem is non-grid light strip positioning. Using arbitrary strip directions means that strips can follow lines perpendicular to the direction of flexion, and be mounted on much more flexible costumes. However, this is not a solved problem, and strips still break occasionally. With current consumer light strip technology, there is always a tradeoff between durability and full creative freedom for choreographers.

Poor color choices

The kitschy "chicken-shop sign" and "angry fruit salad" effects come from using every colour and style of pattern within a performance. Patterns are more palatable when colors are limited to consonant palettes, which suit the themes of the piece. For example, the collaboration with Ensemble Menajiri, *Liquid Rainbow,* relies on heavily restricted colour palettes, which suit the theme and title of each orchestral piece.
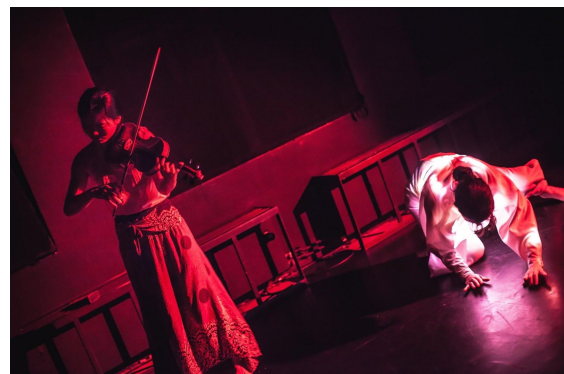
(fig 2) Ensemble Menajiri and ST VITO - "Liquid Rainbow - Red"

Always using lights at full intensity

Always using lights at full intensity tires the audience, and loses its impact quickly. It also

betrays the underlying light strip structure (fig 3). Traditional lighting design applies here - use periods of relative darkness contrasting with bright, intense passages to use the full dynamic range of the lights, and to "dazzle" the audience before their eyes adjust.

Even with parsimonious lighting design, the impact of LED costumes tends to wear thin in about 5 minutes, so it is better to alternate sections of light performance with periods completely without light.

(fig 3) Lulu Schmidt performance, with overly-lit LED strips.

(fig 4) Lulu Schmidt and ST VITO - Waves Festival Vienna

Conclusion

These technical principles guide ST VITO whilst developing performances using LED costumes. They have allowed the same technology to be used for a wide range of performance styles: from acrobatic stage spectacles and rock arena shows (fig 4), to experimental gallery installations.

The modular approach to costume design, attention to aesthetic principles, and the hiding of the structure of the LED strips, has allowed collaboration with fashion designers Greta Melnik and Jasmin Lepore to produce very different costumes with no change to the underlying technology.

The use of addressable LED costumes, or "screen suits" in artistic performance is still largely uncharted territory, with lots of room for future refinement and exploration.