Technoculture of Handcraft: Fine Gesture Recognition for *Haute Couture* Skills Preservation and Transfer in Italy

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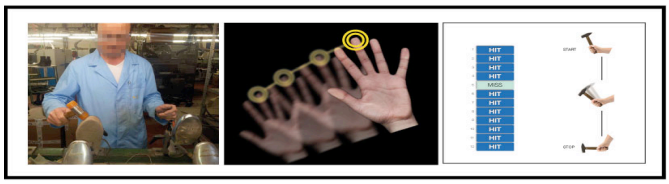

Figure 1. *Left to right: (a) artisan hammering, (b) tracking the position of a hand, and (c) system performance with hammering.*

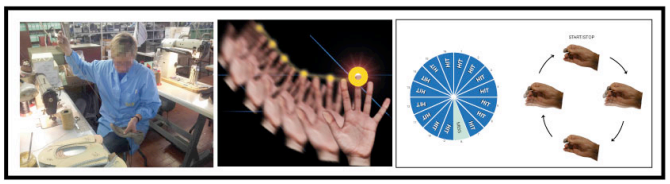

Figure 2. *Left to right: (a) artisan sewing, (b) tracking the position of a hand, and (c) system performance with sewing.*

1. Introduction

In many different fields specialized artisans have become difficult to find, as their knowledge and their practical abilities are anything but easy to teach and transfer with training models that are no longer based on traditional master-apprentice relationships. This situation is particularly exacerbated in all those high-end *haute couture* companies that have built their glory on their style, as well as on their highly specialized craftsmen capable of turning leather, wool and other materials into inestimably valued shoes, bags and clothes. Today, alternative solutions can be found as technology can be put to good use to encode, and thus preserve, all this expertise, providing digital means of passing it on to new generations. Modern technologies have already been experimented with manual craftsmanship, for example, in the context of knitting [Rosner and Ryokai, 2009], although focusing most on its amusement and social aspects rather than on its knowledge encoding ones. Tracking techniques could support, instead, a system capable of digitizing the hand gestures performed by an artisan while handcrafting. However, such proposals very often require users to wear specific garments, not always suiting the scenario, as artisans reluctantly bear the use of invasive modern technologies. We show that noninvasive technologies can be exploited to encode and thus preserve artisanal knowledge by presenting a system based on a set of fine gesture recognition algorithms, as derived by [Roccetti et al., 2010], that require no peculiar attire as they solely utilize a frontal webcam, positioned at a close distance from a handcrafter. We witness the viability of using such system for tracking a handcrafter in two important phases of shoe making: hammering and sewing a shoe.

2. Our Approach

Hammering and sewing (Figs. 1.a and 2.a) are two fundamental processes at the base of footwear crafting. With the hammering phase, an artisan forges a shoe's shape, while with the sewing one it assembles its parts. Both require much attention: mistakes on the former can loosen up leather either excessively or too mildly, whereas wrongdoings in the latter can compromise the beauty of the artifact. In summary, encoding such actions consists in: (i) precisely estimating the number of times a given action (hammering or sewing) is performed along with its relative speed, plus (ii) recording the sequence of positions that have been reached by the hand within that action. Our fine-grained gesture recognition system can support the encoding of such two actions by following the position of an artisan's hand (Figs. 1.b and 2.b). We anticipate our accuracy results representing in Figs. 1.c and 2.c the frames captured by a frontal camera with our system capable of correctly tracking the positions of a hand (i.e., hits) during a single execution of the two types of action. Technically, we capture a frame with the camera, subtract it from the previously captured one and apply a Gaussian filter to the difference, thus identifying the macro area where changes occurred. Given a macro area partitioned into a grid of squares, the topmost square, surrounded by adjacent ones that also fall within the macro area, is chosen to individuate the current position of the hand (Figs. 1.b and 2.b). As such methodology may fail returning discontinuities between subsequent frames, our system embodies a final step with a Kalman filter, whose role is that of keeping the trajectory along which a hand is tracked as consistent. This method is sound as the experiments carried out with an Italian shoe brand reveal. We got an almost perfect score (hand correctly detected) in all situations, with a supporting frame rate as high as 30 fps and a single execution of a hammering/sewing action (from top to bottom) as long as 500 ms on average (Table I). This way, the correctness of the gestures performed by less skilled individuals can be assessed, based on a comparison with the available data [Roccetti et al., 2010].

Table I. *Accuracy Results.*

Distance of cam	Hammering (Hit %)	Sewing (Hit %)
50 cm	99%	98%
120 cm	97%	96%

References

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