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Improving the appearance of all textile products from clothing to home textile using laser technology

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Abstract

Denim trousers, commonly known as ''blue jeans'', have maintained their popularity for many years. For the purpose of supporting customers' purchasing behaviour and to address their aesthetic taste, companies have been trying in recent years to develop various techniques to improve the visual aspects of denim fabrics. These techniques mainly include printing on fabrics, embroidery and washing the final product. Especially, fraying certain areas of the fabric by sanding and stone washing to create designs is a popular technique. However, due to certain inconveniences caused by these procedures and in response to growing demands, research is underway to obtain a similar appearance by creating better quality and more advantageous manufacturing conditions.

As is known, the laser is a source of energy which can be directed on desired objects and whose power and intensity can be easily controlled. Use of the laser enables us to cut a great variety of material from metal to fabric. Starting off from this point, we thought it would be possible to transfer certain designs onto the surface of textile material by changing the dye molecules in the fabric and creating alterations in its colour quality values by directing the laser to the material at reduced intensity.

This study mainly deals with a machine specially designed for making use of laser beams to transfer pictures, figures as well as graphics of desired variety, size and intensity on all kinds of surfaces in textile manufacturing such as knitted—woven fabrics, leather, etc. at desired precision and without damaging the texture of the material.

In the designed system, computer-controlled laser beams are used to change the colour of the dye material on the textile surface by directing the laser beams at a desired wavelength and intensity onto various textile surfaces selected for application. For this purpose, a laser beam source that can reach the initial level of power and that can be controlled by means of a computer interface; reflecting mirrors that can direct this beam at two axes; a galvanometer which comprised of an optical aperture; and a computer program that can transfer images obtained in standard formats to the galvanometer control card were used.

Developing new designs by using the computer and transferring the designs that are obtained on textile surfaces will not only increase and facilitate the production in a more practical manner, but also help you to create identical designs. This means serial manufacturing of the products at a standard quality and increasing their added values. Moreover, creating textile designs using laser will also contribute to the value of the product as far as the consumer is concerned because it will not cause any wearing off and deformation in the texture of the fabric unlike the sanding and stoning processes.

Another advantage of this system is that it gives a richer look to the product by causing the textile surfaces to get wrinkled and become three-dimensional by deformation as well as enabling you to create pictures and patterns on leather and synthetic fabrics by means of heat.

As for the results of the study, the first step was to prepare 40 pairs of denim trousers, half of which were prepared manually and the other half by using laser beam. Time studies were made at every step of the production. So as to determine the

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abrasion degrees of the trousers in design applications, tensile strength as well as tensile extension tests were conducted for all the trousers.

Keywords: Laser beam design; Apparel; Faded denim; Denim design; CAD; CAM

1. Introduction

Perhaps no other piece of clothing caused as much status confusion and ambiguity as blue jeans have, since the beginning of the western fashion about seven hundred years ago. These trousers, introduced by a Jewish vendor named Morris Levi Strauss from Baviera, who had settled in San Francisco a short time ago, were being made from strong cotton fabric dyed by indigo just like today.

Blue jeans were a very good idea for promoting the faded and torn look, which was a way of expressing the poverty that catches the eye image. Thus, jean manufacturers started fading and tearing applications. Faded blue jeans that looked strikingly poor and those with torn legs and knees became very popular in a short period of time among young customers than bright blue jeans that looked brand new. They were even sold at a higher price in certain areas.

If the popularity and the demand for faded, worn out and torn blue jeans were to be considered, it would not be difficult to predict the development of the market that followed. Jean manufacturers started making jeans that looked faded and worn out after going through a washing process with stones and acid.

Changing the visual characteristics of fabrics by applying certain designs to the texture and surface of textiles according to the expectations of consumers and thus increasing their added value is a desired effect in the textile industry. One of the areas of activities involves creating designs by fading the colours in certain areas of the fabric using processes such as sanding or stoning. However, the following problems are encountered when these methods are used:

- difficulty in application and time consumption due to problems in work flow,
- decrease in the resistance of the product,
- inability to create standard designs,
- successful application is not possible on the surfaces of all textiles except for denim,
- inability to create shade differences at desired levels,
- inability to come up with identical designs on both sides of the product,
- visual effects,
- loss of quality,
- inability to apply the original forms, writings and designs on the product.

These time-consuming and out-of-standard procedures create a significant setback for serial production and increase the cost while decreasing the quality and added value of the product. Consequently, companies eventually lose their competitive advantages in the market.

As can be seen, use of technology is insufficient in creating a faded effect, which is in great demand in the denim market. In order to cope with these problems, a novel system which is not affected by drawbacks involved in the stoning and sanding methods has been designed. The laser design device is expected to fill in this gap in the related technology.

Known applications of the laser beam in the apparel sector have been limited to marking textile surfaces and cutting. Even in these activities, the desired level of productivity could not be achieved for every fabric. Especially while cutting synthetic fabrics with the laser beam, the heat effect often melts the fibres, and the fabric plies stick together or piling occurs on the fabric.

In this study, successful results were obtained in designing the surface of fabrics such as drapery, 100% cotton denim and even leather by controlling the power of the laser beam.

So as to investigate the effect of the "laser design machine" that was developed on the quality and the added value of the product, the tensile strength of the fabrics designed by manual and laser methods was examined.

2. Material

2.1. Specifications of laser surface design machine

(1) The laser surface design machine includes a laser source operating along a wavelength selected according to the surface to be designed, a galvanometer consisting of a mirror and a computer operating a program that controls the galvanometer mirrors and the power of the laser beam.
(2) The laser beam strength is adjusted to an impact width within a range of 0–500 μs, preferrably within 0–200 μs, and this method enables the user to make 2–1024, preferrably 256, grey toning applications.
(3) The laser beam impact frequency is used within 0–100 kHz range, preferrably within 0–5 kHz.
(4) In order to achieve a constant initial laser power, a period of 1–50 pixel, preferrably 4–10, is considered