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Instant Thread Dyeing Using Neural Networks for Machine Embroidery for Sustainable Practices

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ABSTRACT

Like dying and printing, embroidery is an ancient art technique that has been used for hundreds of years to decorate clothing, bedding, and household products. Embroidery is a type of surface ornamentation. The history of creating patterns with colorful threads began in ancient Egypt, when ladies stitched metallic threads into their garments as decorations.
The top three countries for embroidery research are China, the US, and the UK. The concept of this paper is instant thread dyeing using neural network machine embroidery for sustainable development. A printer for an instant direct-to-embroidery thread dyeing machine can offer unlimited color options for each embroidery, or produce multiple personalised designs without downtime. It's just one thread, one needle, and as many colors as you want. Which gives quicker production and faster turnaround times for Sustainable embroidery. Reduce water consumption and thread waste. Thread dyeing time, cost, pollution for land, and water pollution can be completely controlled. Perfect finishes of designs and single thread installation help time consumption in the Industry. Often thread changing can be avoided.

Keywords: Instant thread dyeing, Single thread, Machine Embroidery, Sustainable, Reduced water consumption, Reduce Land and Water Pollution.

1. INTRODUCTION

The quantity of threads that can be used while using the traditional embroidery process limits the color design. Having to maintain a sizable inventory of threads is another problem. The innovative company created an on-demand thread colouring device in order to address these problems. The device uses inkjet printing technology to color a thread. The new technique significantly increases color expression and enables the creation of original designs. Additionally, the unit permits a decrease in thread inventory.

Throughout history, a wide variety of materials. India produced some of the first known examples of needlework on cotton clothing, which dates to approximately 2000 B.C. Sericulture (silk production) began in China around 3000 B.C.E. and by the 4th century B.C.E., many beautiful silk embroideries were being produced in China (Leslie, 2007)
New technologies like Artificial Intelligence specifically developed to realize a high-quality thread colouring system are also introduced, including a highly accurate carriage stop position mechanism that differs from that of a conventional printer. Stitching is the technique of drawing coloured threads with an embroidery needle and stitching the cloth in a predetermined pattern to create a pattern or text with the stitched marks. It is feasible to use globalisation as a vehicle for promoting national culture and developing a national visual identity.

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2. TRADITIONAL DYEING

The dyes were obtained from natural sources like roots and minerals, and the permanency of colours was achieved by the use of alum while dyeing the silk threads (Aryan, 2010). Some of the dyes used were manjisth (madder) for red, neel (indigo) for blue, rab (molasses) for blackish brown, naspal (tree bark) for light brown, kusumba (flower) for orange, kesoolphool (flower) for yellow, kai (moss) for green and iron scrap for black colour (Grewal, 1988). According to other authors, various species of ratanjot and kashmal were used as dyeing and tanning material by the local inhabitants to obtain purple, red and yellow colors on woollen garments and fibres[1][2]

3. MACHINE EMBROIDERY

Every basic stitch in embroidery is simple. Rich embroidered pieces can be created by combining several basic stitches. One lovely way to describe it is like a needle-and-thread painting. Nowadays, computer-controlled embroidery machines produce the majority of embroidery. Utilizing tools that profited from playing with various colors, textures, patterns, and sketch backgrounds to create an engaging, unique, and dynamic design without the need to create articles by hand[3]. Researching the segmentation and synthesis of embroidered art photos is recommended using deep-learning convolutional neural networks. founded on the semantic image segmentation technique of deep learning.
The method of computerized embroidery can be divided into six useful tasks.

1. Interpret artwork and use specialized software to digitize the design.
2. Save the design so that the embroidery machine can understand it as a stitch file.
3. In the embroidery machine, read the stitch data file.
4. Instructions for the machine to embroider the pattern
5. Place the cloth you want to embroider on into the machine's arms after framing or hoops it.
6. Once the machine is up and running, begin stitching until the embroidery pattern is finished.

NeedlePaint uses a variety of computer software techniques, including image processing, computer-aided design, artificial intelligence, and more. It also incorporates vast embroidery knowledge and rules, as well as extremely effective inference processes. Stitches are automatically arranged, and a variety of input techniques for unique patterns are available. NeedlePaint covers the integrity and automaticity of embroidery punching, including data transformation, image processing, stitch organization, stitch optimization, and original design input.

The diversity and complexity of embroidery have increased with the introduction of machine embroidery and cross-cultural trade. Big data and artificial intelligence integration in research methodologies have replaced fieldwork and iconographic methods. In addition to helping to spread embroidery and creative innovation, The utilization of robotics and artificial intelligence in embroidery has the potential to greatly boost productivity. This is true even if traditional arts and crafts include needlework as a significant component. The most significant study topics and frontiers must be identified, and the most recent knowledge structure in embroidery must be visualised and analysed.

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4. EMBROIDERY ROBOTICS

A Novel Method for AI-driven Online Education and Image Production An inventive method of using artificial intelligence for online learning activities that involve training dual-arm robot needlework. An online learning algorithm that effectively records and replicates the 2D stitching trajectories of a human expert using the Teaching by Demonstration principle. Both quantitative and qualitative evaluations of the algorithm's performance revealed a promising degree of accuracy in the reproduction of the original needlework patterns. Our approach's viability and potential were further confirmed utilizing a user feedback survey conducted among thirty experienced embroiderers. The excellent feedback we received overall validated the feasibility of our technique, even though several parts were found to require refinement, particularly the finer details in the embroidery. This research indicates an important step toward the automation of complex manual activities and expands the potential uses of robotics and artificial intelligence in a variety of sectors.

5. ADVANTAGES OF INSTANT THREAD DYEING

5.1) 50 times less Water Consumption

The textile sector uses 215 trillion litres of water annually on average. We're pleased that embroidery machines can significantly cut down on wastewater generated during thread dyeing. direct dyeing method, conventional thread dying generates 50 times more effluent, according to a comparison between thread dyeing technology and one of the top producers of thread worldwide.

5.2) Decreased water use by 97%

Water usage is lowered by at least 97% when dying a 100% recycled polyester thread in real-time as opposed to conventional dyeing techniques. This is confirmed by a third party and stated in the thread dyeing environmental product declaration (EPD).

5.3) Decreased wasting of threads

The waste produced by the embroidery industry is enormous: big warehouse spaces are needed to hold all these threads, hundreds of reels of thread are discarded because they are no longer the proper colors, and a sizable logistical operation is required to order and distribute them.You just create what you require when using Coloreel. Using our instant colouring technology, you may precisely color one reel of recycled white thread while you're embroidering. Millions of PMS-compatible, CMYK, RGB/HEX, and other colors are instantly accessible to you, and you may do away with the need to save a ton of outdated threads. The quick Thread Coloring Unit, a special device for on-demand quick thread coloring, is the centrepiece of our product line. Any contemporary single-head or multi-head embroidery machine can be equipped with the product. With its intelligent touchscreen display, it's simple to use, has remote control functionality, and runs at regular thread speeds to keep up with production output.

6. AUTOMATING LASER CUTTING:

Laser cutting is a great tool for fabric cutting. One type of cutting technology that can be utilized for multi-ply cutting of heavy textile textiles is computer-controlled laser cutting systems. They know how to take off their clothes, fold them, and pack them properly. Either a fully automatic or semi-automated system may be included. robots in Nonwovens: Researchers are attempting to create three-dimensional, nonwoven structures for protective apparel using robots. In particular, it is also feasible to integrate robots with a small-scale melt-blowing device.

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7. FABRIC INSPECTION:

The procedure used past for fabric inspections. Examining fabrics has proven to be a particularly difficult aspect of automating textile operations. Automatic fabric inspection may be accomplished by a variety of methods, including the Model-based Approach, the Statistical Approach, and the Spectral Approach. In each of these techniques, a modeling tool or program modifies the fabric picture to extract data on the severity of the fabric issue. The fabric is automatically evaluated for defects, and if there are more problems than a certain threshold, a large amount of the cloth is discarded. AutoCAD and CAM:

Fabric design was previously done by hand. As a result, the design would require extensive time and written documentation. But in any case, today computers are used to generate 3D garment designs with CAD, which transmits the data to CAM. CAM uses that data to regulate and oversee the production process. manufacturing (CAM) within the clothing sector. CAD is a computer program that creates 3D clothing designs and sends the data to CAM. These data are used by CAM to monitor and control the production process. The work is finished quickly by following the operator's instructions to maintain the length and width.

When a defect is detected, a high-quality and effective sensor is used, and the defective fabric is automatically cut. The machine counts the ply and turns off right away when the predetermined amount of ply is reached. This machine can spread any kind of cloth. less money and effort is invested in labor. However, this technology is expensive and requires expertise to operate.

There is fierce competition in equipment to reduce labor expenses. Recently, industrial robots capable of handling fabric have been developed to automate sewing tasks and do away with the necessity of human labor. These autonomous devices sew in a similar way as traditional sewing machines. A multitude of stitch types, such as double chains, double locks, and overlock stitches, can be produced using robotic sewing machines.

8. AUTOMATION IN FABRIC CUTTING:

An automated fabric cutting machine now performs this previously laborious operation. This makes it possible to cut the cloth more precisely and smoothly than was previously possible. The cutting machine automatically and quickly and correctly connects numerous layers of cloth based on instructions. In addition, instead of being recorded on marker paper, the pattern's design is now instantly preserved in the computer memory. This cutting method involves the employment of a laser somewhere. When compared to manual or operator-operated equipment, the usage of automatic cutting machines has resulted in a reduction of labor and time requirements.

9. SEWING ROBOT (SEWBO):

Robotics, automation, and cutting-edge technology are essential to the garment industry's survival in its cutthroat rivalry. These tools are employed in every process step, from product transportation to design. Automation can lower production costs, boost efficiency, and decrease errors. Automation can help meet consumer demands and the largest obstacle is financial limitations that keep apparel producers from implementing cutting-edge technologies and artificial intelligence. But to stay in business, the clothing sector must be able to create more faultless goods faster and for less money. More than 200 years have passed since the textile industry first used automation and robotics.

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The machine reduced the amount of personnel needed to operate. The geographic distribution of the textile industry has significantly changed. Textile manufacturers have shifted from manual to automated use of robotics and artificial intelligence in certain of their textile production facilities. The employment of robots has increased recently, coinciding with Asia's rapidly growing wages, attracting the interest of some businesses in the robotics production-based business model. Robotics and automation are necessary in the textile sector, and manipulation systems using artificial intelligence (AI) are necessary to make this happen. Automation and robotics are two very similar technologies. Robotics is one kind of industrial automation.

This article will discuss several robotic automation methods used in the textile process, which eventually raise productivity and efficiency—two fundamental needs of the textile sector. Domains of Automation and Robotics in the Textile Sector The manufacturing process for yarn and fabric is one of the many automated processes in the manufacture of textile products. The use of automation and robotics in the textile and apparel industries. These include robots for carding, fabric inspection, CAD & CAM, fabric spreading & cutting, sewing, pressing, material handling, and machine embroidery. The textile sector primarily depends on these robotics.

The apparel industry uses the industrial robot Sewbo to handle and hold textiles. Robots have been used to stitch the entire garment in certain exploratory projects. The "Sewbo" robot from Zornow is one instance of this; it is capable of independently handling fabric components while sewing. Zornow created the "Sewbo" robot in 2015; it is capable of sewing a T-shirt from beginning to end. This accomplishment was a critical turning point in the creation of an entirely automated company. It is possible to program the robot to have a particular size and look. Should the garments alter in dimensions or design, the robot must be reprogrammed.

In everyday life, embroidery is a significant textile decorating method. Stylistic embroidered artworks are culturally significant. Artificial intelligence (AI) and robotics have advanced, and The embroidery technique has made use of several technologies, which have been studied. This study aims to examine the many ways in which these technologies support embroidery.

The use of robots and artificial intelligence in embroidery is examined in this essay. The applications are evaluated based on three main criteria: Modern technology systems and methods have made a major contribution to the creation of smart textiles, and artificial intelligence is a key component in the invention, preservation, and safeguarding of traditional handcrafted artwork in embroidery. Textiles with embroidery have been produced in large quantities using computerized robotic embroidery devices.

CONCLUSION

The manufacture of embroidered textiles is now much more productive thanks to programmable robotic embroidery machines. which has contributed to the development of electronic textiles. Artificial intelligence has a lot to offer the creation of beautiful embroidery, especially with deep learning technology. Technology-based embroidery has become more and more popular as a study topic in the textile industry. Uniqueness and worth This article provides readers with a thorough and structured review of the research development of contemporary technology-oriented embroidery by summarizing the application of robotics and artificial intelligence (AI) in the field of needlework. As a consequence, readers will find the technological points of view more inspiring.

The purpose of this research is to assess the embroidery technique's viability In order to do this, the researchers developed four stitching techniques that gave the flexible POF

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bending degrees between around 90° and 180°. The identical measurement protocol was used for the two types of POFs—flexible and non-flexible. The measurement points were selected based on the needlework's rotation angle and distance from the light source for each embroidered pattern. It was advised to employ the embroidery process to provide the textile display with a noticeably higher degree of brightness.

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