New Innovation Using Silicone Printing Paste Technology in Artificial Intelligence (AI)

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ABSTRACT:

This study aims to apply artificial intelligence (AI) in the field of textiles by adding textile accessories printed with prints containing a barcode that Stores a huge amount of information about the wearer. The wearer could be a patient, student, or even a package made of cloth.

Where the barcode is a modern means through which a huge amount of information can be stored that can be used to know some data such as sick history, especially if it is for a person with a chronic disease, or it may contain age, job, school or club name, and this accessory can be in the form of a cap bracelet or a sticker that is attached to clothes.

Silicon and pigment printing paste were used in the application of these prints, Silicon printing paste was found to be characterized by many good qualities such as its stability to washing, and friction due to its effectiveness without compromising the textile characteristics.

1- INTRODUCTION

1-1-What Does (AI) Mean?

It stands for Artificial intelligence which is an application that simulates man᾽s intelligence in smart machines which are programmed to think like humans, and mimic their actions. (Hassanein and Yousef, 2022).It is enormous branch of computer technology which interesting in making machines have the ability to perform missions that typically require human intelligence. It is applied to a machine that displays traits related to a human action or thoughts such as problem-solving and learning. (Sikka, Sarkar and Garg, 2022)-(Grewal, Roggeveen and Nordfält, 2017)

1-2-The Importance of AI in Textile Industry

The more needs for the quality in textile industry increased the more leading to apply automated systems as artificial intelligence nowadays. In textile production, the application of AI is becoming much needed because of the use of simulation of modeling of technical developments. (Gong and Chen, no date)

Over the last twenty years, (AI) is acquiring momentum in the textiles machines. The automation of different machines by the using of AI in all textile and garments fields such as dyeing, printing, cutting, sewing, and handling of materials can increase the production with minimum errors and reduce the cost in the all textile production.(Hassanein and Yousef, 2022)

1-3-The Most Common Applications of AI in Textile Manufacturing

The industry of textile is becoming more automated to achieve the increasing the needs of the market. Using AI reduces the defaults, and reduces the cost of production. It aids in all the steps of production of textile Industry.('Application of Artificial Intelligence in Textile Industry', 2021)

1-3-1-Table (1) : Important Applications of AI in Textile Manufacturing :

Determine Fabric defect	Fabric must be inspected to reduce any defects which may lead to reject from the customer, it is very essential to check the quality of fabric before the manufacturing. Fabric is been inspected manually by worker using lighted tables, this inspection take a lot of time which allow faults to pass. With AI system, this process goes more faster with no minimum defects
Inspection of Pattern	Fabric pattern such as weaving, knitting, dyeing, Printing and finishing, etc. using vision-based inspection in those patterns instead of visual inspection helps avoiding man faults.
Color matching	AI helps to solve color problems such as being (too dark, too light, too green) by helping improving the efficiency and accuracy
Sewn seem	Sew- ability means the seam formation and performance where fabric mechanical properties like tensile, elongation, shear, and etc effect in the quality of it. This technology is used to determine the sew- ability of fabrics in factory.
CAD systems	It is used for making the pattern, digitizing, grading and maker planning which improve achieving high quality of production and good productivity. (Guo *et al.*, no date)

PPC	It means Production planning and control which goes with different production departments such as delivery orders on time, solving machine problems, etc. AI helps achieving the main aim of PPC
Final inspection	It is necessary to inspect textile products to minimize rejections. This inspection can be done by exerted inspectors but it may influenced by their physical or mental condition. AI automated inspection achieves accuracy and efficiency of inspection so that provide the high quality of production lines.
SCM	Supply Chain Management includes providing fibers, yarns, fabrics, and accessories to various production pointes SCM creates value for the consumer and can manage the cost and business competitive.

AI also has a lot of benefits for the consumers (retails) that it helps by the aid of computers to determine images and products which can be bought on line (E- commerce) so that facility to customer to choose. AI is capable to provide the manufacture or the retail all the information about the customers and their inclinations and the production the looking for and also create a different shopping experience.(*Application of Neural Networks in Fabric Engineering - Fibre2Fashion*, no date)

Computers can be used in garment sector to take decisions according to the suitable situation which AI can be used in cutting order, line balancing, inspection, etc.

AI decreases the manual efforts and helps to flow the production with low human faults. Artificial inelegance can help in Data analysis by predicting consumer trends, which makes marketing operations free of errors and more compatible with the customer.

1-3-2-The effect of AI in the Industry of Textiles

AI can provide customers with notifications of advertisements related to their concerns to announce them of prices, new outfits of fashion brands which meet their aim of elevating customer experience. Also fashion brands can launch their new trends with artificial intelligence by tracking the latest fashion trends lines. (*AI in The Textile Industry - Applications and Impact | Analytics Steps*, no date)

1-4 - QR Code as Examples of AI

Quick response code (QR) is one of the most popular types of 2D matrix bar code. It was invented in 1994 by engineer Masahiro Hara who was working for automotive company (Toyota Denso wave) where located in Japan. It is designed to allow a lot of data and information to be decoded in short time. QR code is designed by keeping two points under consideration and can be read by software on smart phones. It has been used in wide rang and spread rapidly. QR can store large amount of information more than to 1D parcode these encoding modes such as numeric alphanumeric, byte/ binary and kanji codes. It also provides high data storage capacity, fast scanning, error correction that the damaged par code can be read successfully.   The code includes black modules organized in a rectangular sample on a white background..(*History of QR Code | QRcode.com | DENSO WAVE*, no date)

The data stored and encoded may be text, photo, URL or other data. In addition, there are different verities of QR codes such as logo QR, encrypted QR, I QR and the user can select among them due to his demands. Nowadays we see QR code everywhere due to the large

application of it. This application may relate to market to in-store product labeling, academic, etc. (*Information capacity and versions of QR Code | QRcode.com | DENSO WAVE*, no date)-(Kumar, Kumari and Student, 2017), Users scan QR code to compose an e-mail, receive a text, v card contact to devices, and open a form. Man can print its own QR code for people to scan and use by visiting QR code generating sites or applications. Google has the program application to bring QR code. The usability of QR code sustainability has been oriented to industry reports. (*Applications of AI in The Textile Industry | DMI Blog*, no date)

1-4-1- Table (2): QR code uses

Distribution	receiving goods- Putting goods in store- Shipping inspection - Stock taking - Shipping requests- Delivery management- Receiving parcels
Manufacturing	Putting parts or products in store - Picking parts or products – Packing- Charging parts - Process management- Stocking - Equipment managements
Retail sales	Receiving goods – Coupon- Stocktaking/order placement
Medical / pharmaceutical	Introduction /sale of medicines- Prescription
Leisure	Admission control - Mobile membership card

1-4-2-Table (3) Advantage of using QR code

1- Readable from any direction 360º	
2-High capacity encoding of data	
3-Small printout size	
4-Kanji and Kana capability	
5-Damage and dirt resistance	
6-Structured Appending feature	

(*Information capacity and versions of QR Code | QRcode.com | DENSO WAVE*, no date) -('QR Code ® Essentials', 2012)

1-4-3-How to Create QR Code

To create QR code software and printer are need and scanner and application programmers to read them. (*The QR-code reorganization in*

illegible snapshots taken by mobile phones, no date) -(Ozyazgan, Uzun and Bilgin, 2016)

1-5- QR Code in Textile Printing

QR code in textile filds supplies the customer with detailed data about the products when scanned via smart mobile instead of asking for help from the seller and wanting to shop alone. These customer's recorders can be stored in the computers of the store which is help to promote their products by connecting with them**.**

Now QR code is supplied to most of products of the production in textile and fashion such as Victoria secret, H&M, Zara, American Eagle, etc. QR code can be added in many styles such as printing, knitting, embroidery, patchwork, etc.(Kumar, Kumari and Student, 2017) -(*8 Top Applications of Artificial Intelligence (AI) in the Textile Industry | LinkedIn*, no date)

Fig. (1) : Examples of QR code in textiles

A woven or printed QR code label can be used to identify the personal identification of their users. This implementation may be useful to identify the person in special cases such as business purpose, accidents, etc. A wide range of possibilities of identification can be applied such as pathological case for people having chronic disease like diabetes, blood pressure, allergy or senile dementia as Alzheimer's, etc and also this identification for children may help if they lost. QR code label is permanent and can't be erased or eliminate when washed, for all of mentioned before QR code identification allowing immediate data in critical cases.(Baum, 2019)

Table (4) : Examples of data stored in a QR code .

Product data	Q R code
Field : Factory **Product** : Chemical **Production date** : 12/1/2022 **Expire date** : 12/12/2023 Store at room temp. Flammable	
Field : School, club **School** : Misr school **Student name** : M. Omr **Grade :** 4 **Parents mobile** : 012345678 **Note** : Allergy to penicillin	
Field : Market, Hospital **Patient name** : Salwa Ali **Date of birth** : 11/11/1950 **In emergency call** : 01264598 **Note** : Alzheimer's - diabetic	

Scan QR code

1-6- Silicone printing paste

Nowadays, there is a new trend in printing technology; it is silicone which is used in the clothing industry. Which transfer one color or multi color silicone shaped patterns to clothing, shoes, hats, and logo of sports ware. The thickness of the silicone pattern can reach 0.5 mm -2 mm.(Mahmud *et al.*, 2015)

Table (5) : **Advantage and disadvantage of silicone printing paste**

silicone gel	
The advantages	Disadvantage
Strong 3D effect	cannot be washed off by very hot water
good elasticity	
environmental protection	
good adhesion	
easy process	
Convenient operation	
The beautiful effect	

Silicone is distinguished from other kinds of synthetic rubbers by its odorless, not toxic, and resistance at high or low temperatures without changing its color, and without losing its flexibility and strength. It also has good insulation to electricity, can resist oxygen, and light resistant stable to most of, chemical. It is safe to contact the skin due to its non-toxicity and ecofrindly subject. So that it is convenient to increase and improve the value of brands.(Raza Miah, 2016)

Fig (2) : Examples of silicone prints on textile.

2- Experimental

2-1- Materials used:

Raw plain Woven cotton fabric was obtained from Misr Helwan spinning and weaving Co. (Egypt)

2-2- Chemical used:

Sodium hydroxide (NaOH)

Triton X-100 (wetting agent)

Silicone printing paste and pigment printing paste were obtained from SPI Company.

2-3- Scouring

Raw cotton was treated by alkaline (NaOH) and wetting agent using liquor ratio (1:50 w/v). At boiling for 90 minute, then it was thoroughly rinsed hot and cold water and dried at room temperature.

2-4- Printing

Cotton was printed by two different printing paste mentioned before using design of QR code.

Pigment paste **Silicone paste**

2-5- Tests and Measurements

2 -5-1- Fastness properties:

The colour fastness properties: washing or rubbing fastness were assessed according to standard methods:

2.5.1.1. Color fastness to crocking: The colour fastness to rubbing Include dry and wet rubbing of the dyed samples was determined according

the AATCC test method 8-2015,

2.5.1.2. <u>Color fastness to washing</u>: The colour fastness to washing was measured according to the (AATCC test method 61-2020).

3- Results

The results indicate varying degrees of performance for different textile printing methods (pigment and silicon paste). Let's break them down:

1. **Pigment Paste**:
   o *Rubbing (wet)*: 3-4
   o *Rubbing (dry)*: 4
   o *Washing*: 3-4
2. **Silicon Paste**:
   o *Rubbing (wet)*: 4
   o *Rubbing (dry)*: 4-5
   o *Washing*: 4

4-Discussion

• **Rubbing Resistance**: The silicon paste outperforms the pigment paste in both wet and dry conditions, with consistently higher scores. This suggests that garments printed with silicon paste would endure handling and abrasion better than those printed with pigment paste.

• **Washing Resistance**: Both types of paste show similar resistance to washing, with the silicon paste potentially having a slight edge. However, the difference is minimal, indicating that both are suitable for textile printing applications where washing durability is crucial.

• **Overall Comparison**: While the silicon paste exhibits slightly better performance in terms of rubbing resistance, both options seem viable for textile printing. However, the choice between them might depend on other factors such as cost, environmental impact, or specific requirements of the final product

5- Conclusion

The main goal of this work is to make it easy to store important and personal data by print QR code of this data. Printing was done using silicone printing and pigment paste.

Based on the results provided, it's evident that both pigment paste and silicon paste offer reasonable performance in textile printing, albeit with some differences in their characteristics:

1. **Rubbing Resistance**:
   o Silicon paste demonstrates superior resistance to rubbing, particularly in dry conditions, suggesting that garments printed with silicon paste would withstand handling and wear better over time.
2. **Washing Resistance**:
   o Both pigment paste and silicon paste exhibit comparable resistance to washing, indicating that they maintain their integrity reasonably well after repeated laundering.
3. **Inference:**
   o In terms of rubbing resistance, silicon paste emerges as the preferred choice due to its higher scores in both wet and dry conditions. However, pigment paste still offers respectable performance.
   o Both options show similar resilience to washing, implying that they are suitable for applications requiring durability against laundering.
   o The selection between pigment paste and silicon paste may depend on factors beyond performance alone, such as cost, ease of application, environmental considerations, and specific requirements of the intended textile product.

Overall, these results provide valuable insights for textile printers, allowing them to make

informed decisions based on the desired characteristics of the final printed product

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