Innovative Möglichkeiten der Sticktechnologie für Smart Textiles

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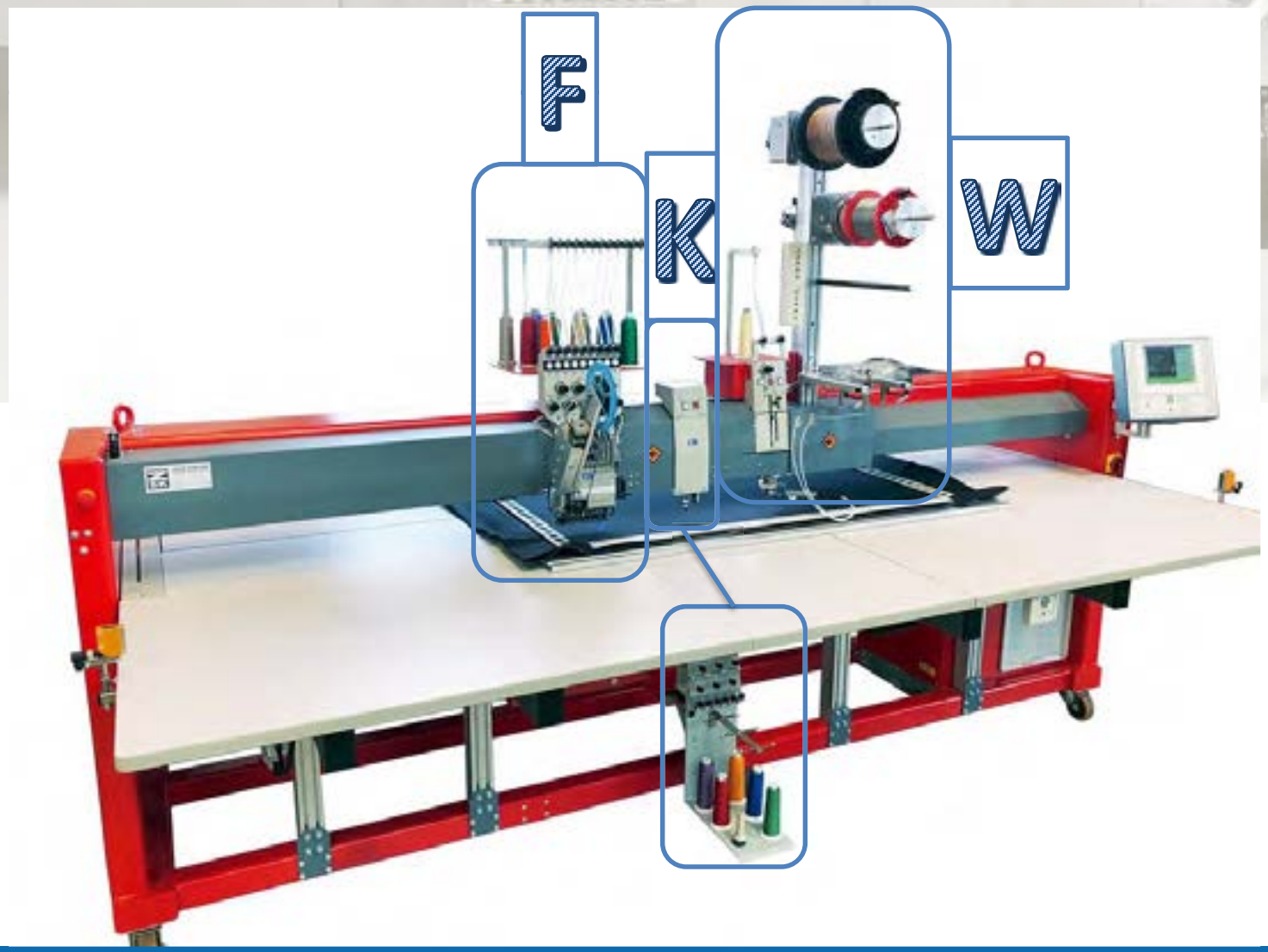
ZSK Stickmaschinen GmbH – Technical Embroidery Systems

Krefeld, Germany

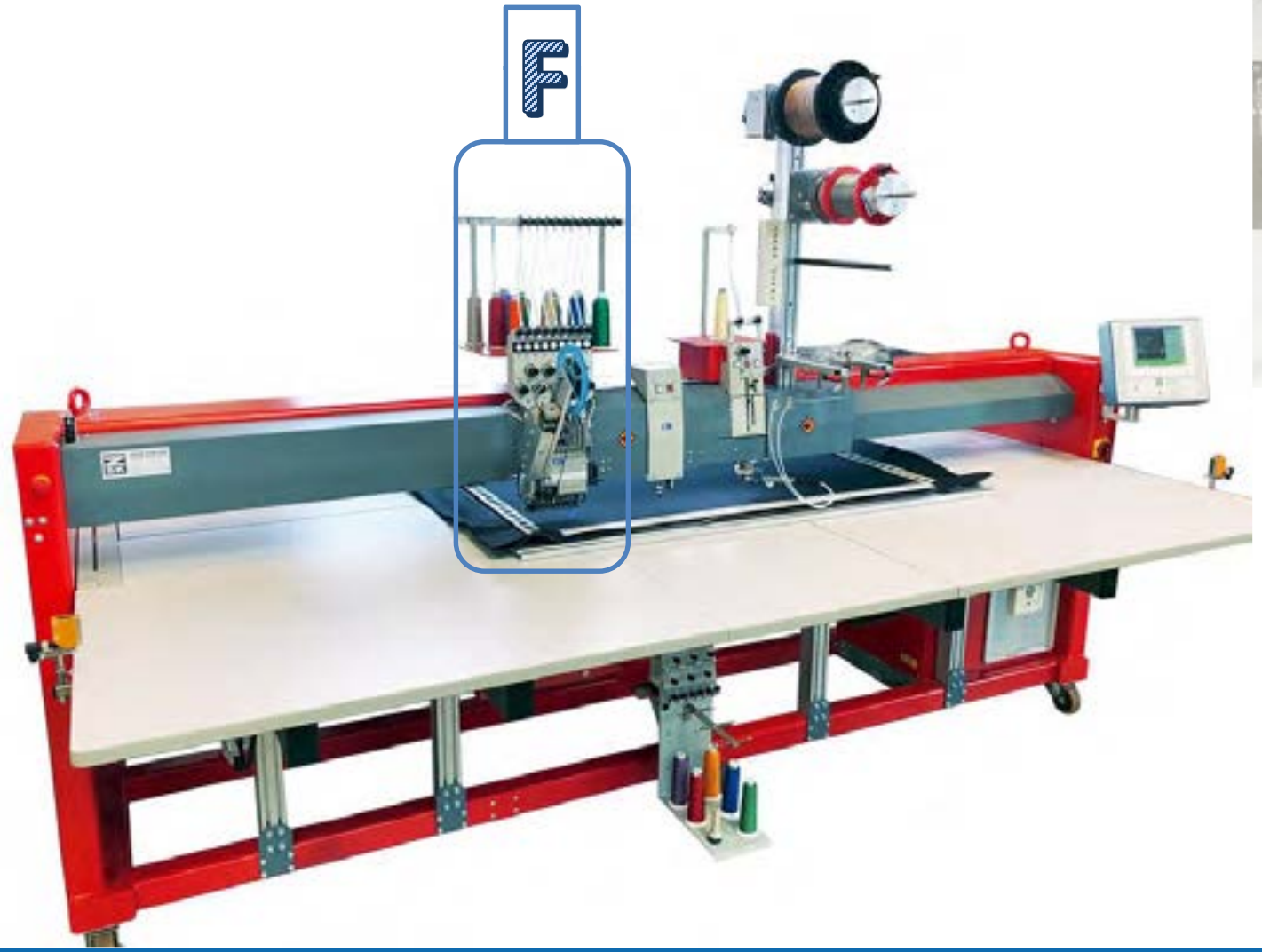
SmartTex Netzwerk Workshop, 30.09.2021, Weimar

ZSK E-Textiles Embroidery Machine JGVA 0109-550-700 with all different embroidery technologies in one machine

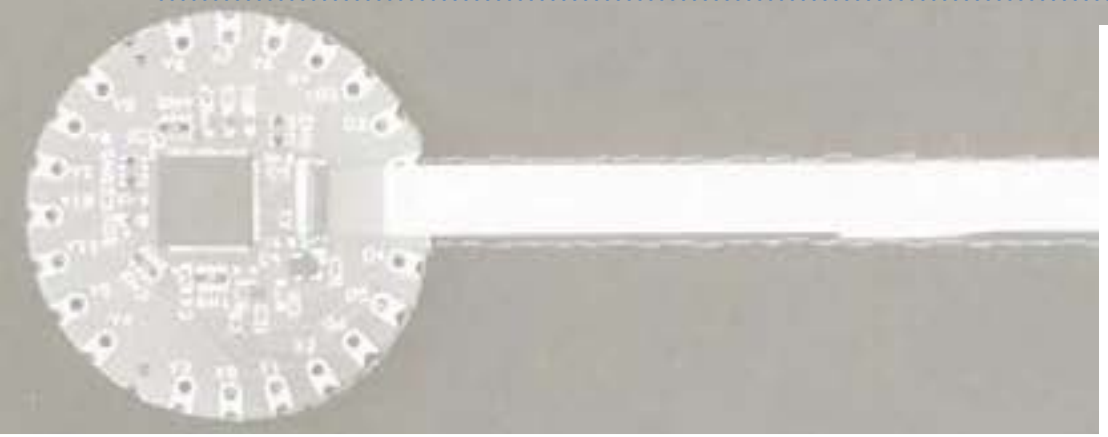


- F-head for traditional and conductive yarn embroidery (E-Broidery)
- K-head for chenille (moss & chain stitch) embroidery for electrodes
- W-head for wire placement
- All technologies can be combined in one embroidery design

ZSK F-head for traditional embroidery



ZSK Embroidery Machine Sprint 6



- Smart Textiles with conductive yarns can be embroidered on every F-Head embroidery machine starting with the smallest ZSK embroidery machine Sprint 6

(Minor) Mass Production Example:
6-Head Embroidery Machine for E-Textiles presented at the Smart Textiles Micro Factory at techtextil 2019 in Frankfurt

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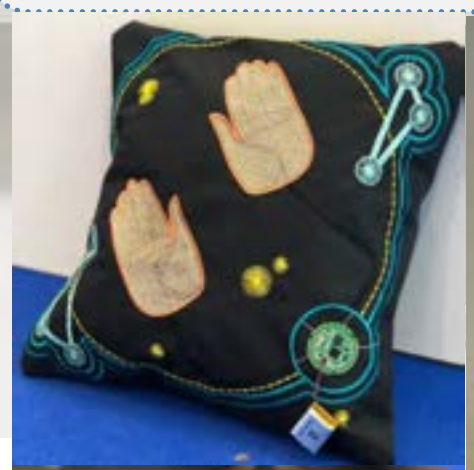

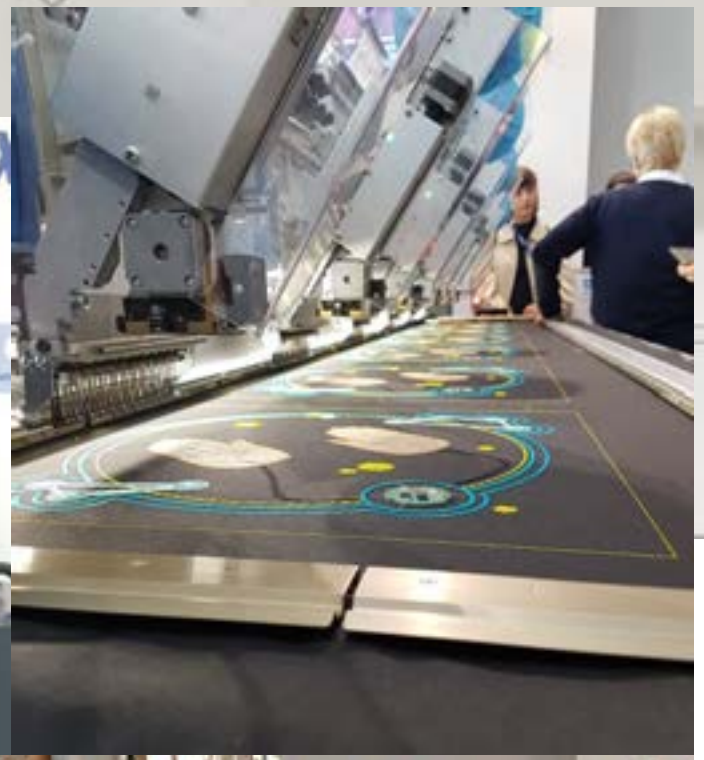

Production of LED-Smiley

ZSK 15-Head Embroidery Machine

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Up to 56 embroidery heads mounted to one embroidery machine

XCFB 1512 - 400

Multi-Head Flat System
15 heads / 12 colours
With 2 Sequin devices per head

How do we use embroidery for E-Textiles?

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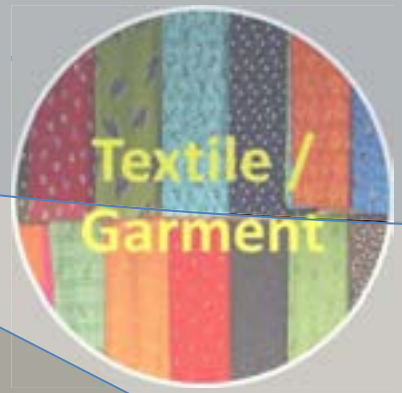
By using traditional embroidery threads

And adding conductive threads

Silver coated embroidery threads

Stainless steel embroidery thread

Components of embroidered E-Textiles



Techniques for the Integration of Electronic Components

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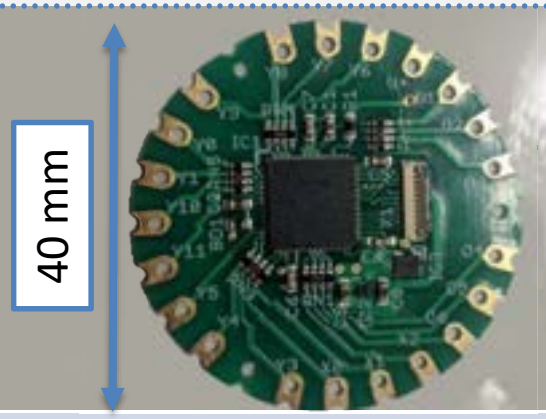

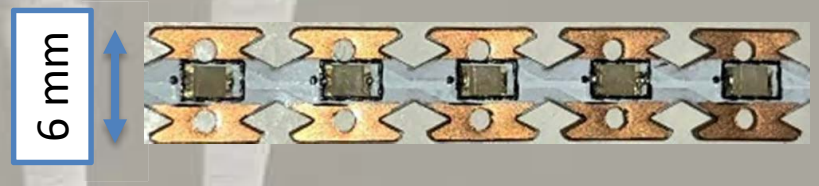

Technique of Integration	by using the embroidery machine without additional device	by using the embroidery machine with a functional sequin device
Automation Level	semi automation	full automation
Placement of electronic components	by hand	by machine
Fixation & Electrical Connection	by machine (embroidery)	by machine (embroidery)
Electronic components	Single PCBs, chips, and boards with holes for the connection optimized geometry increases reliability	LEDs, Sensors, and small electronic components mounted to a endless tape of sequin carrier
Size of components incl. carrier	> 15 mm	< 21 mm
Number per product (design)	few: 1-3 (depending on design size)	few to many (1 - ∞)

Techniques for the Integration of Electronic Components

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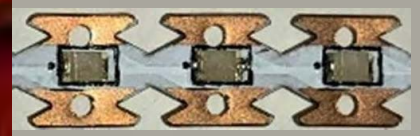
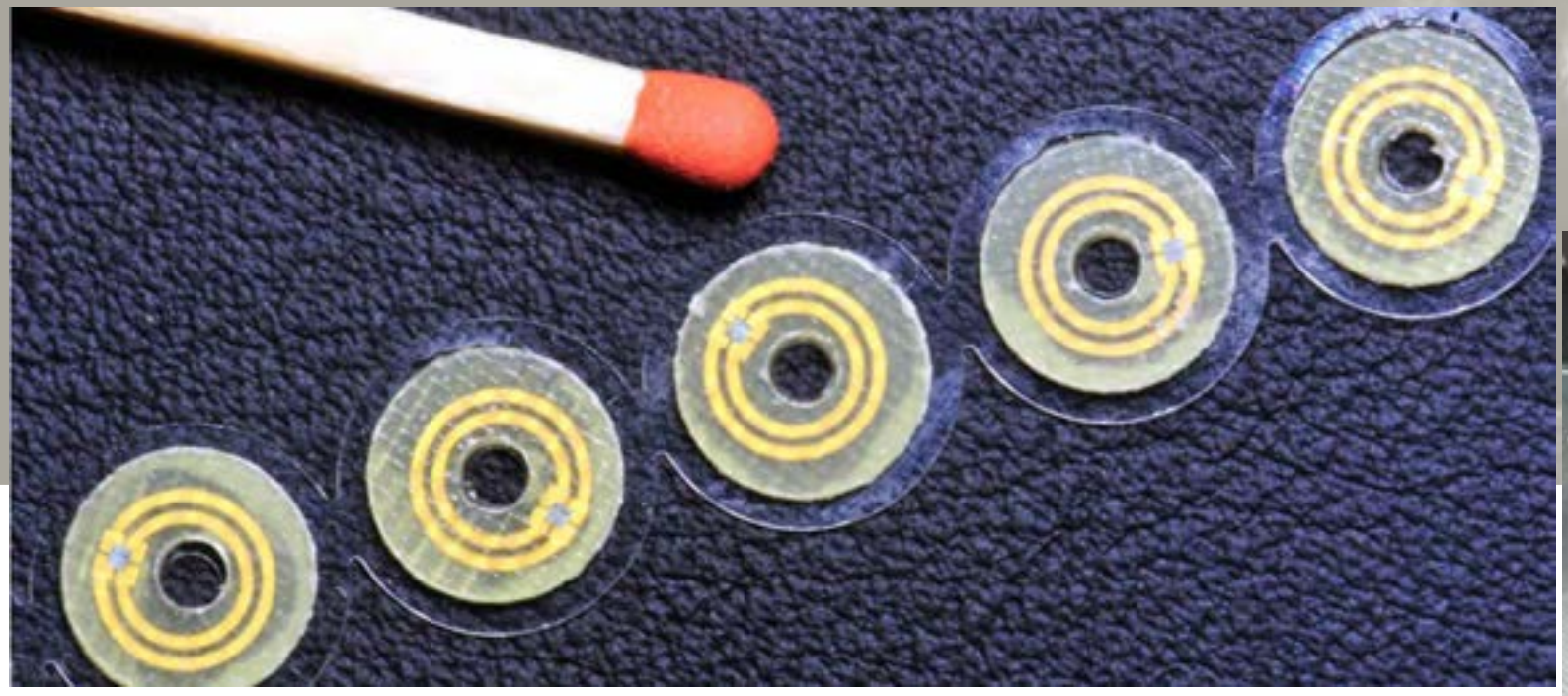


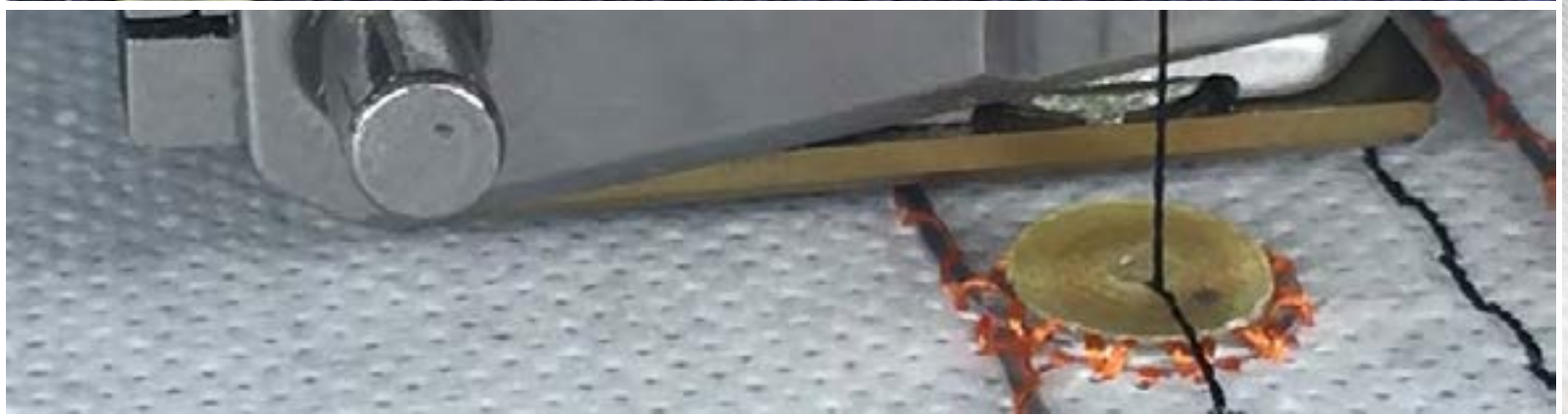
Technique of Inte	dery machine quin device
Automation Leve	
Placement of ele	
Fixation & Electri	dery)
Electronic compo	mall electronic ed to a endless tape
Size of componer	
Number per prod	

How can the integration of electronic components such as LEDs, chips or sensors be achieved?

Application-Sample:
Integration of 14 LED sequins in a sweater

Application-Sample:
Placement of RFID chips for RFID antenna





Why? What can be achieved with it?

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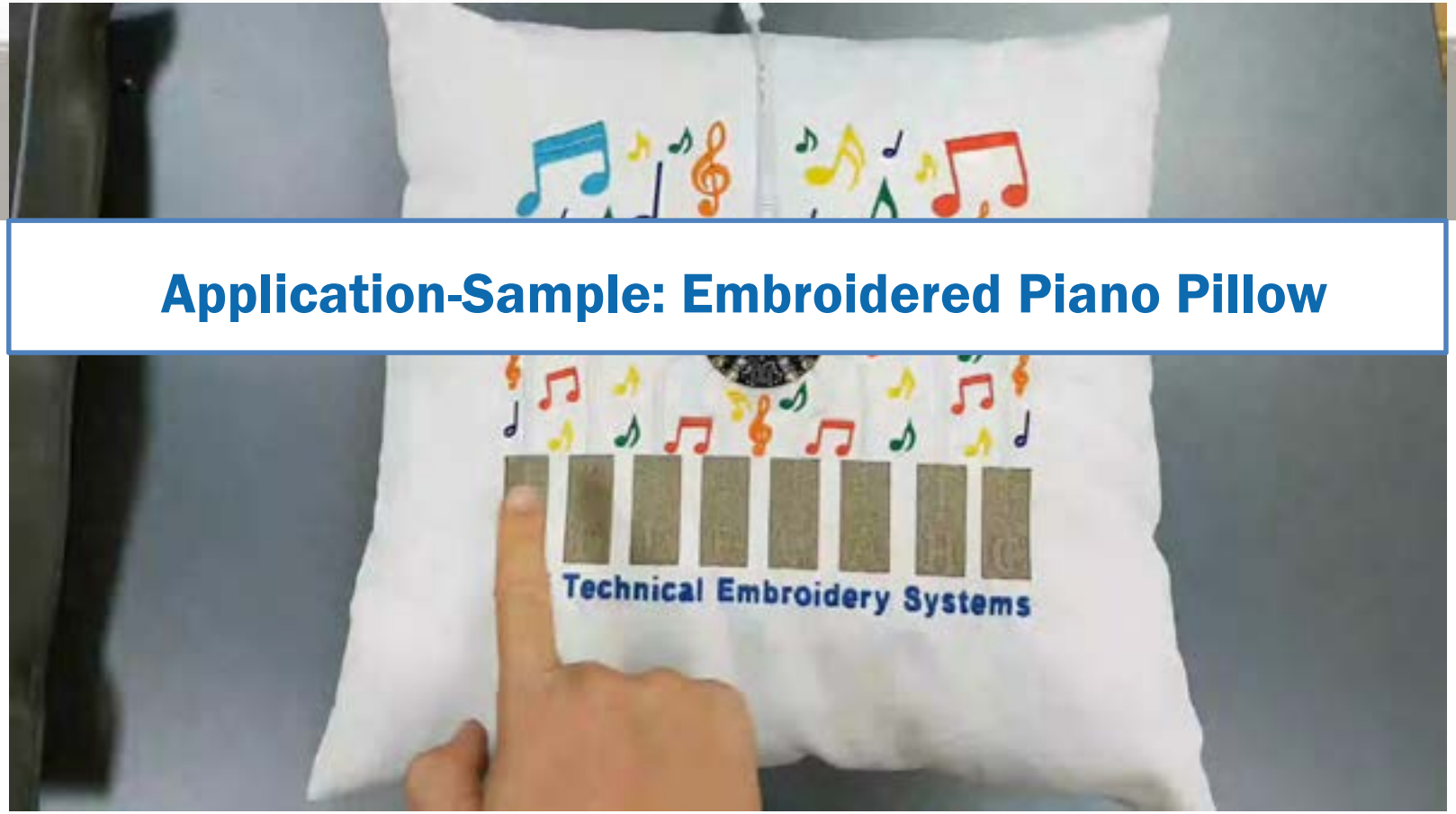

Application-Sample: Embroidered Piano Pillow

Application Sample: Jungle Jacket

What else is possible?

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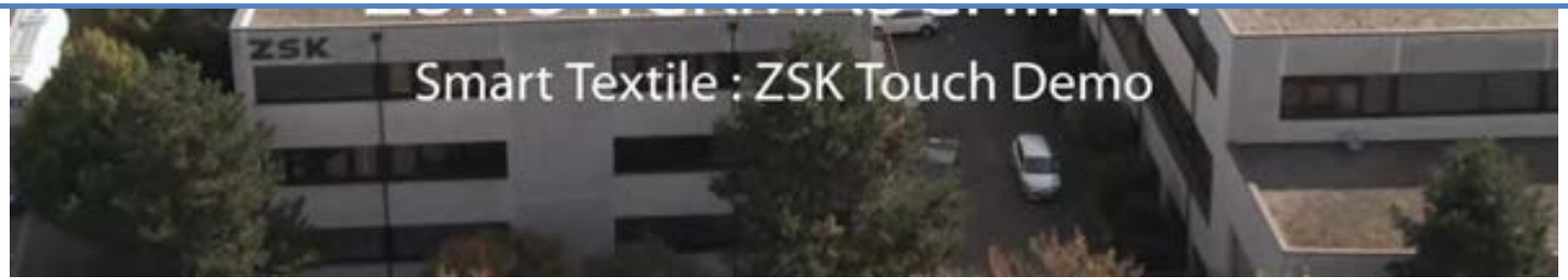
Capacitive proximity sensors:

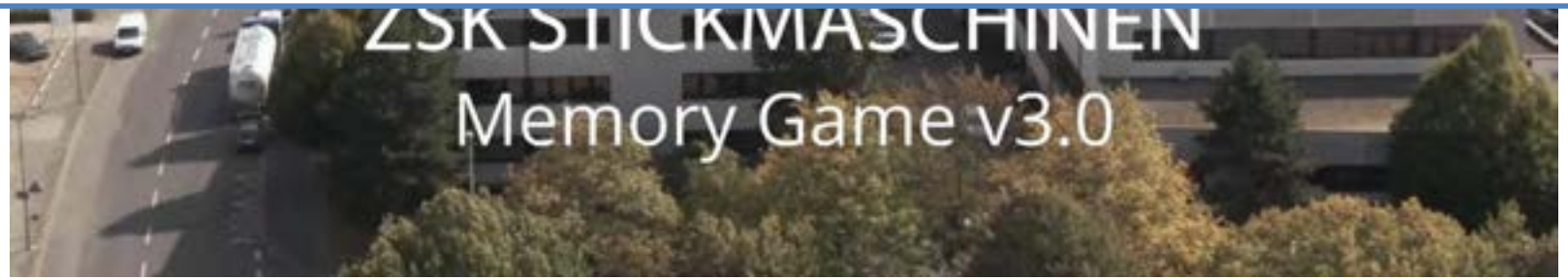
- **Embroidered sensors work even embedded underneath leather, wood, or plastic**
- **Sensitivity can be adjusted to fit the requirements**
- **Technology-Demonstrator: ZSK Touch Demo**



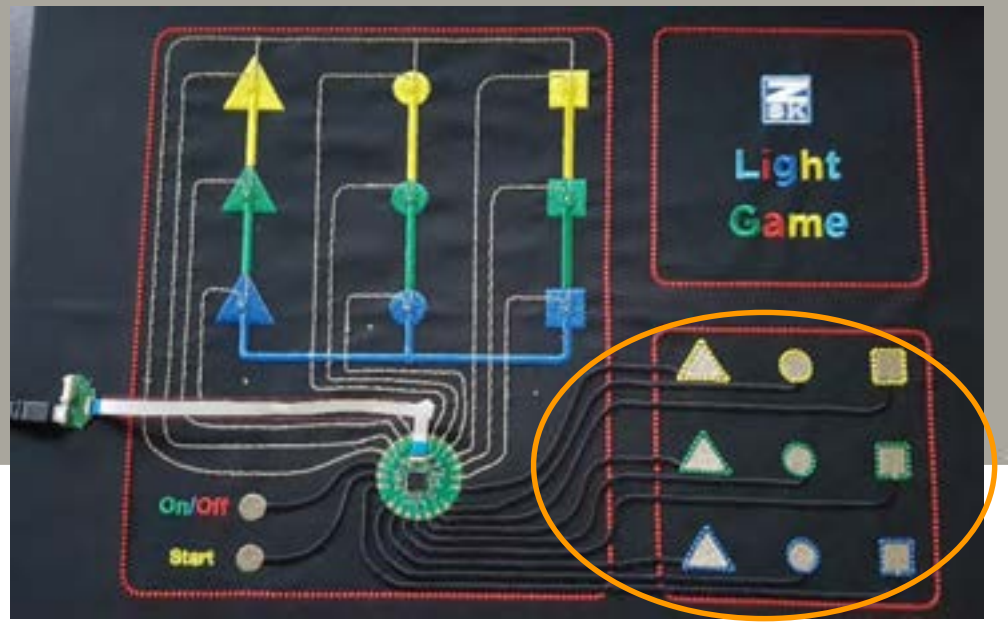
Dashboard with LEDs and capacitive proximity sensors

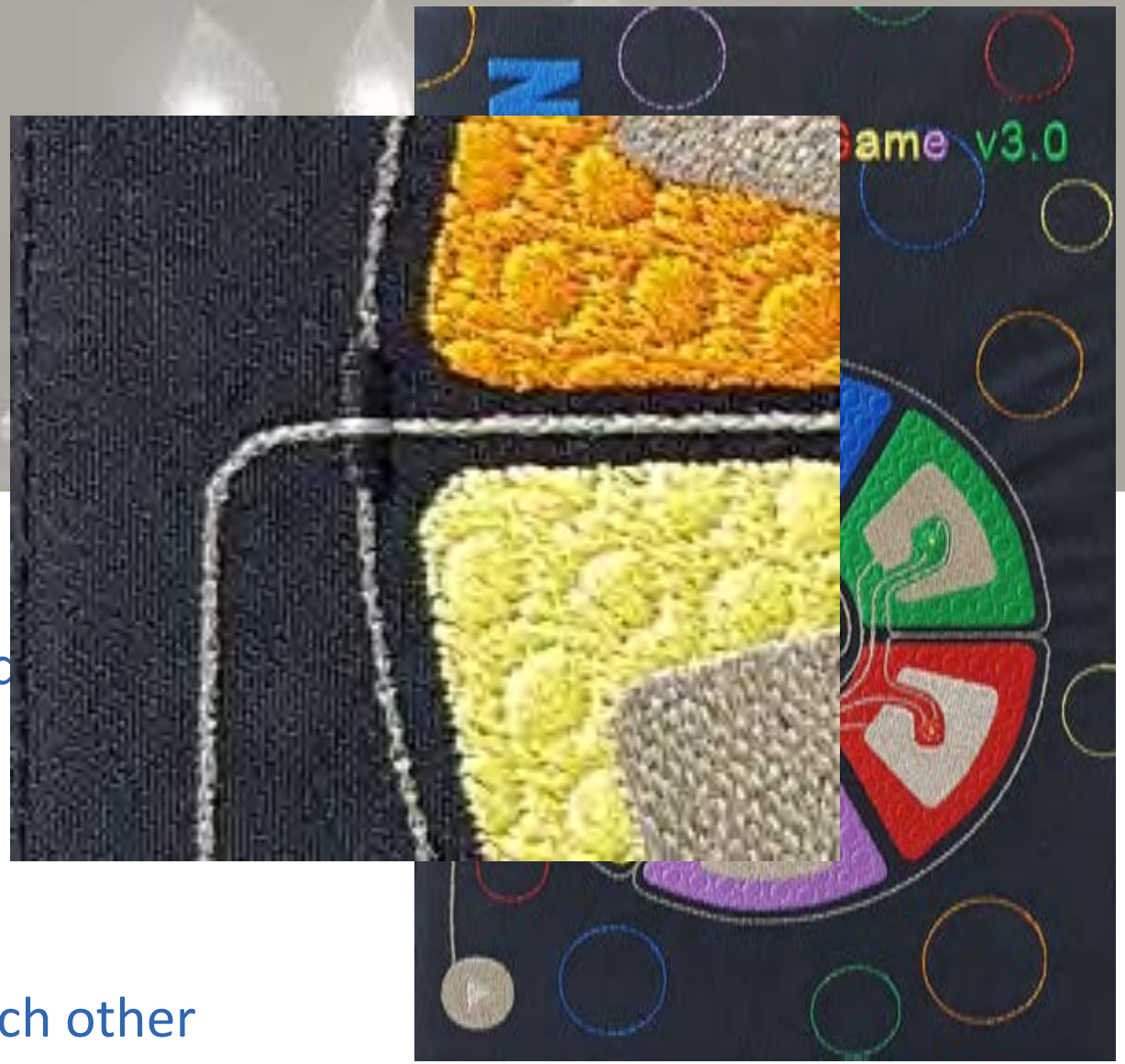
Application-Sample:

ZSK Memory Game - Simon



Covering of conductive paths

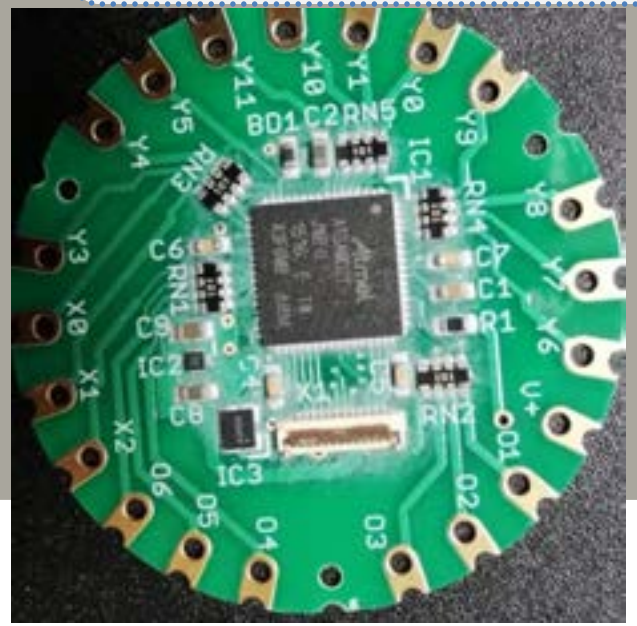




Conductive Paths can be covered by non-cond
coloured embroidery thread

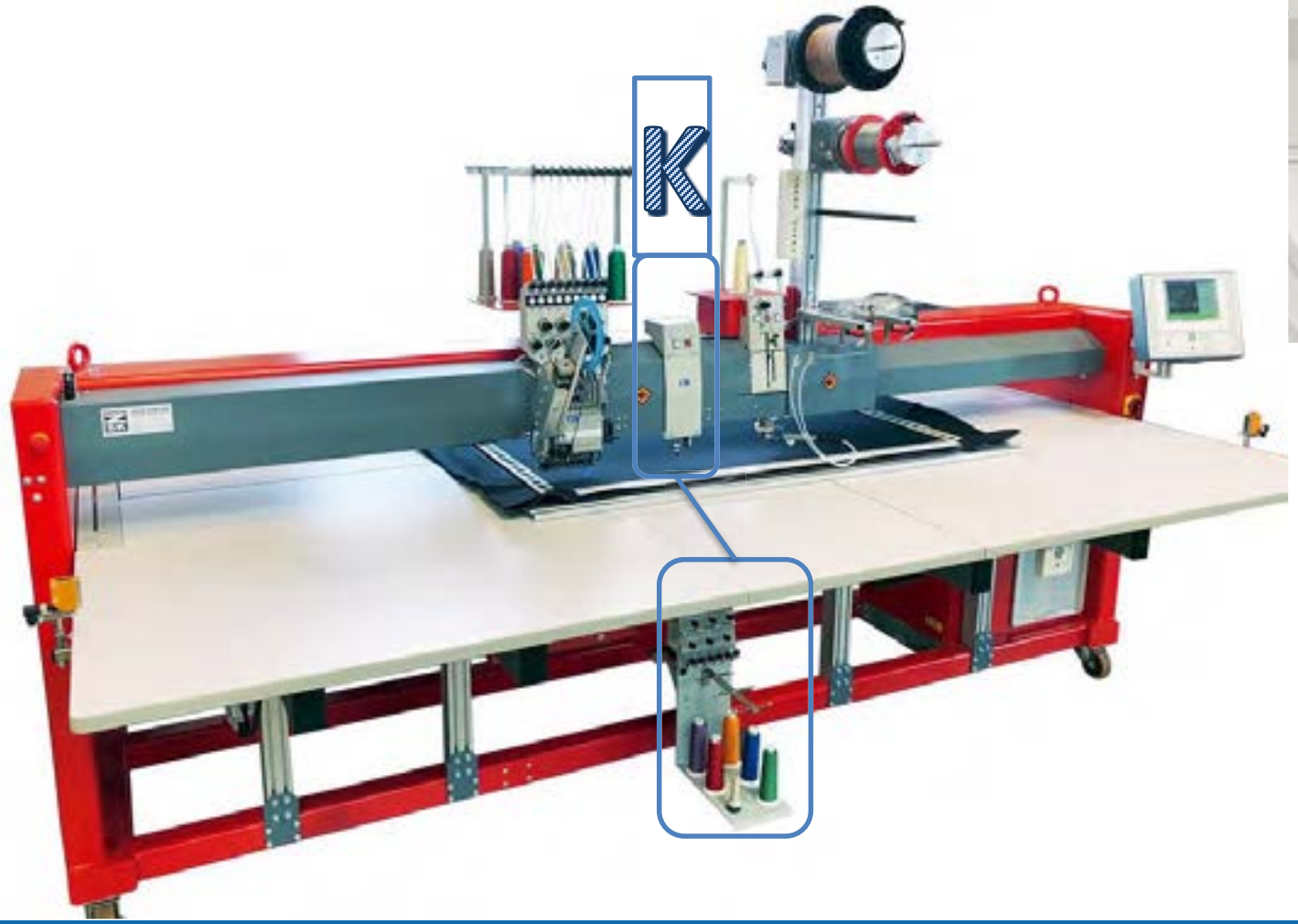
- Decoration
- Electrical insulation to
  - avoid accidental activation
  - allow two conductive paths crossing each other

Washing tests of ZSK-E-Tex-Board



- ZSK E-Tex Board with and without encapsulation with WEVOPUR PD 52/10 (colored in grey and black) by WEVO-CHEMIE GmbH
- With and without encapsulation the board was still functioning after 100 washing circles
- Encapsulation can still improve the reliability, especially due to specific customized solutions for electronic protection by WEVO-CHEMIE GmbH

ZSK K-head for chenille embroidery (moss and chain stitch)



Moss embroidery for decoration

Moss embroidery for technical application by using conductive threads

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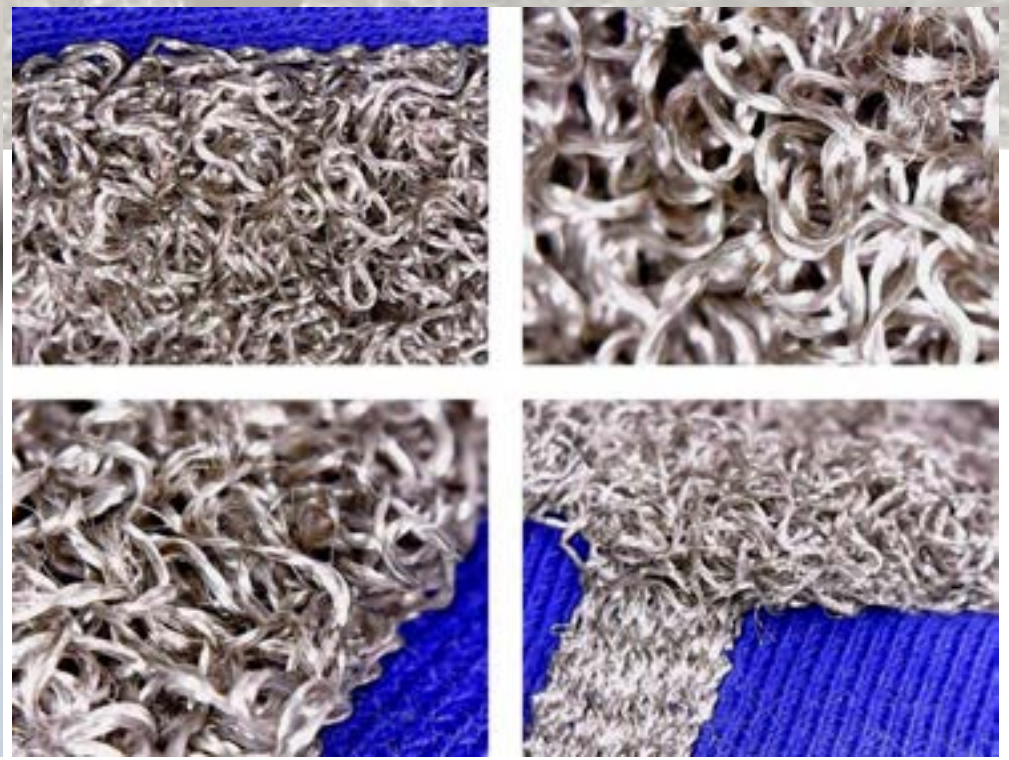
Application-Sample: Moss embroidered electrodes

Electrodes can be used for:

- **Electrical muscle stimulation (e.g. EMS)**
- **Electrical nerve stimulation (e.g. TENS)**
- **Bioelectrical signal measurement (e.g. ECG)**



Application-Sample: Heart rate monitoring by reading ECG signal through hands

Moss embroidered used for sensors

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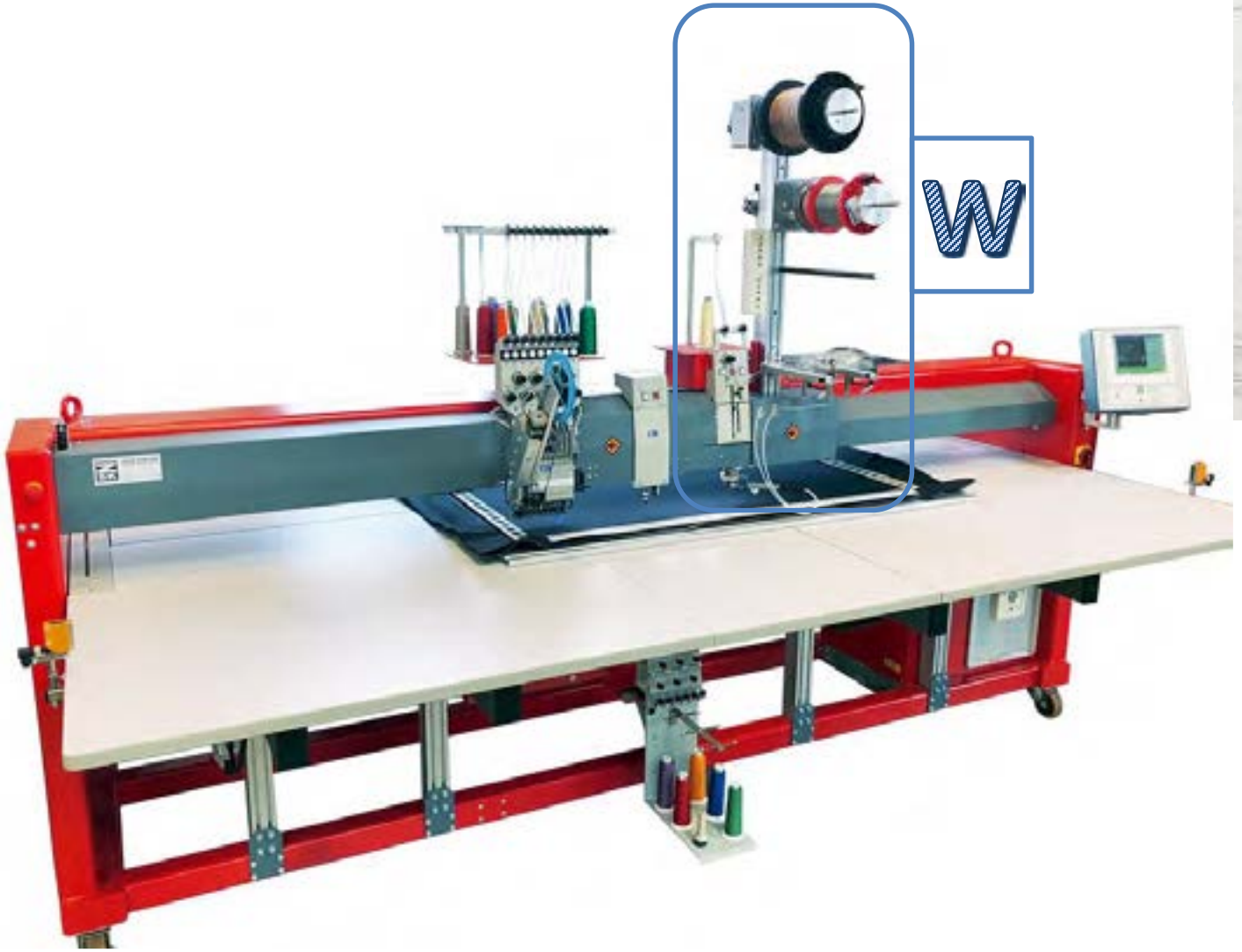
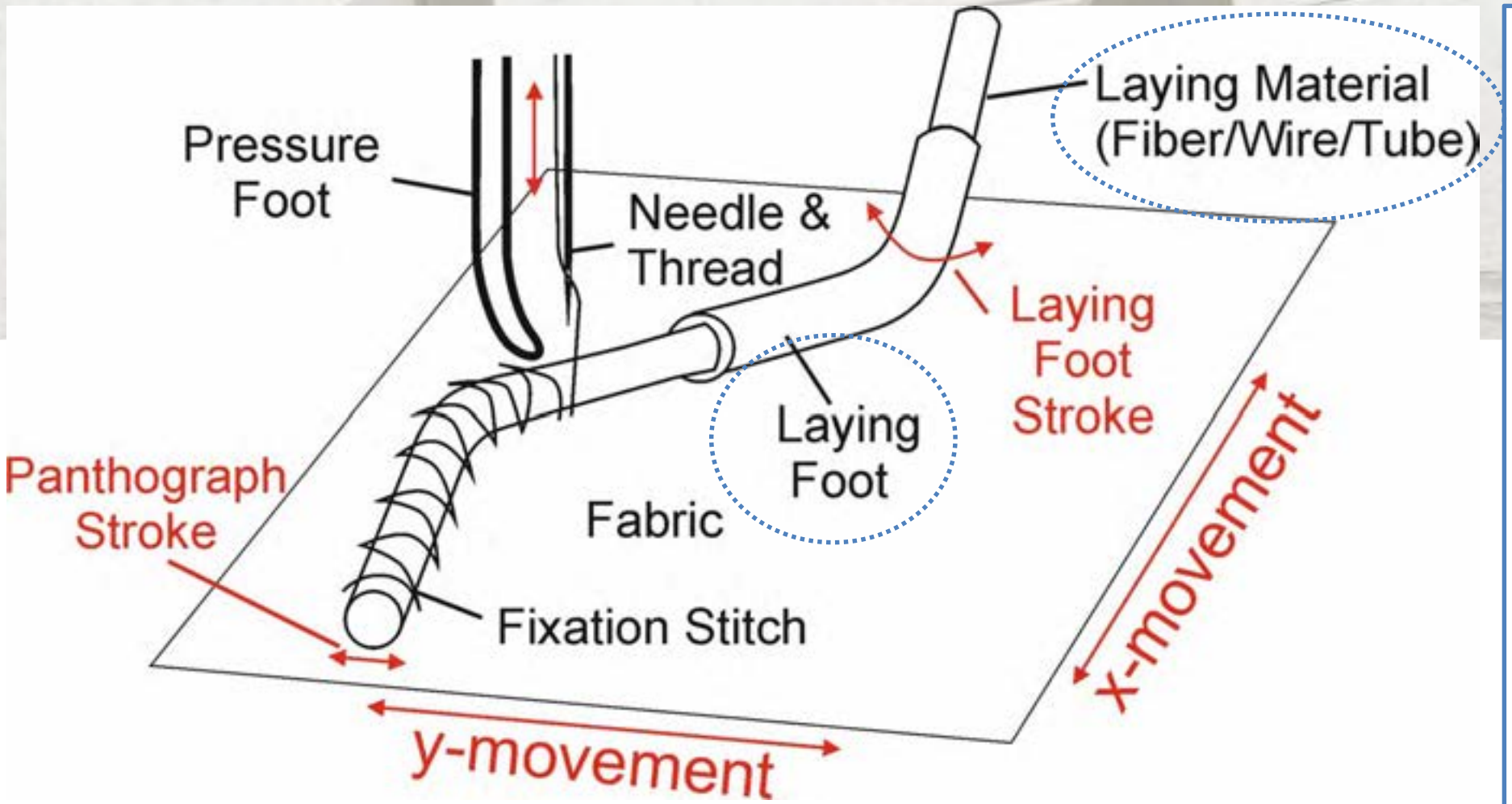
- Moss embroidered areas can be used as sensor electrodes for
  - Touch sensors
  - Proximity sensors
- 3D-shape of moss embroidery allows the user to feel the sensor area without seeing it
- Different shapes can be recognized by touch without

ZSK W-Head for fibre, wire or tube placement

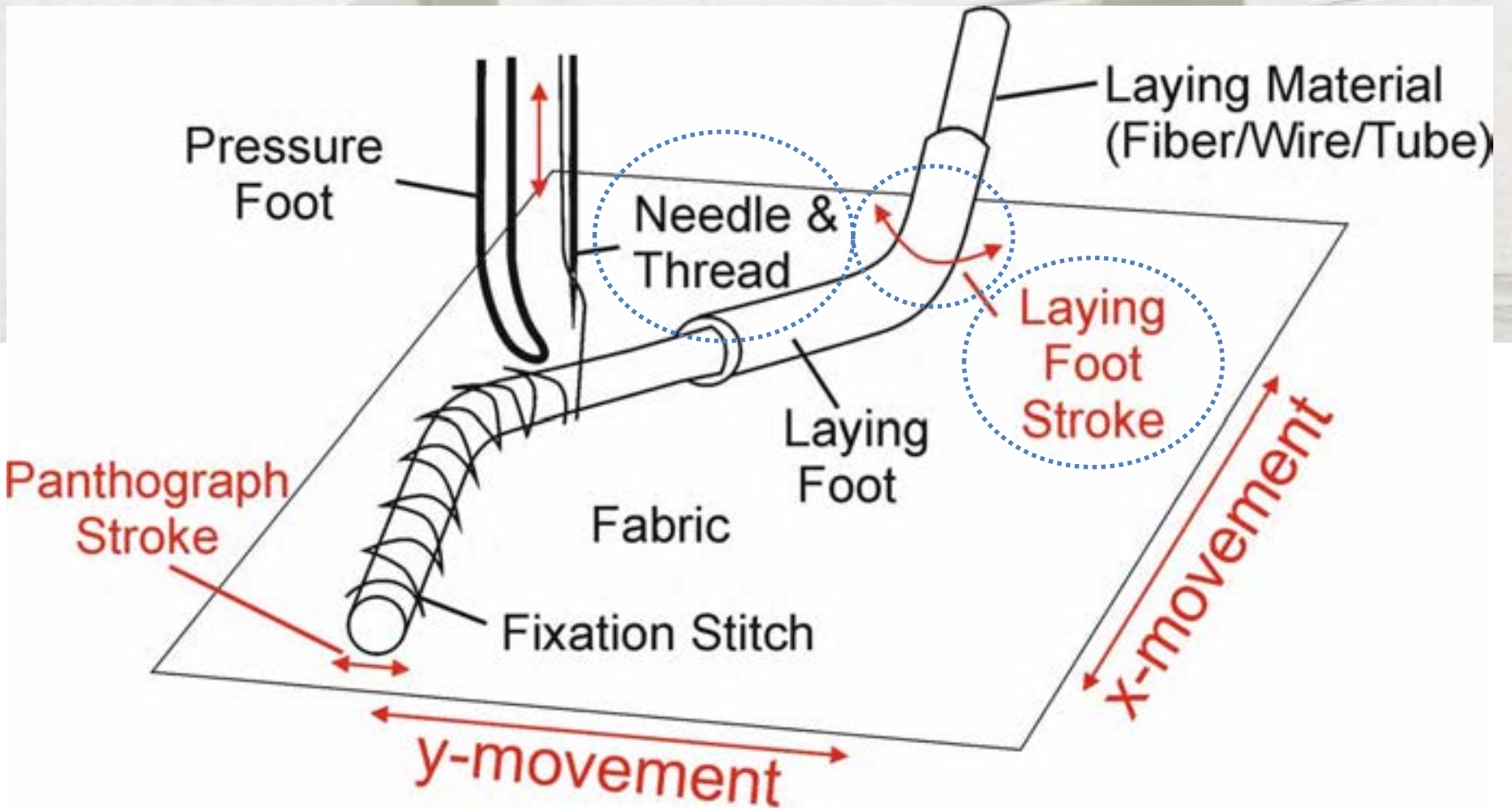


Principle of W-Head



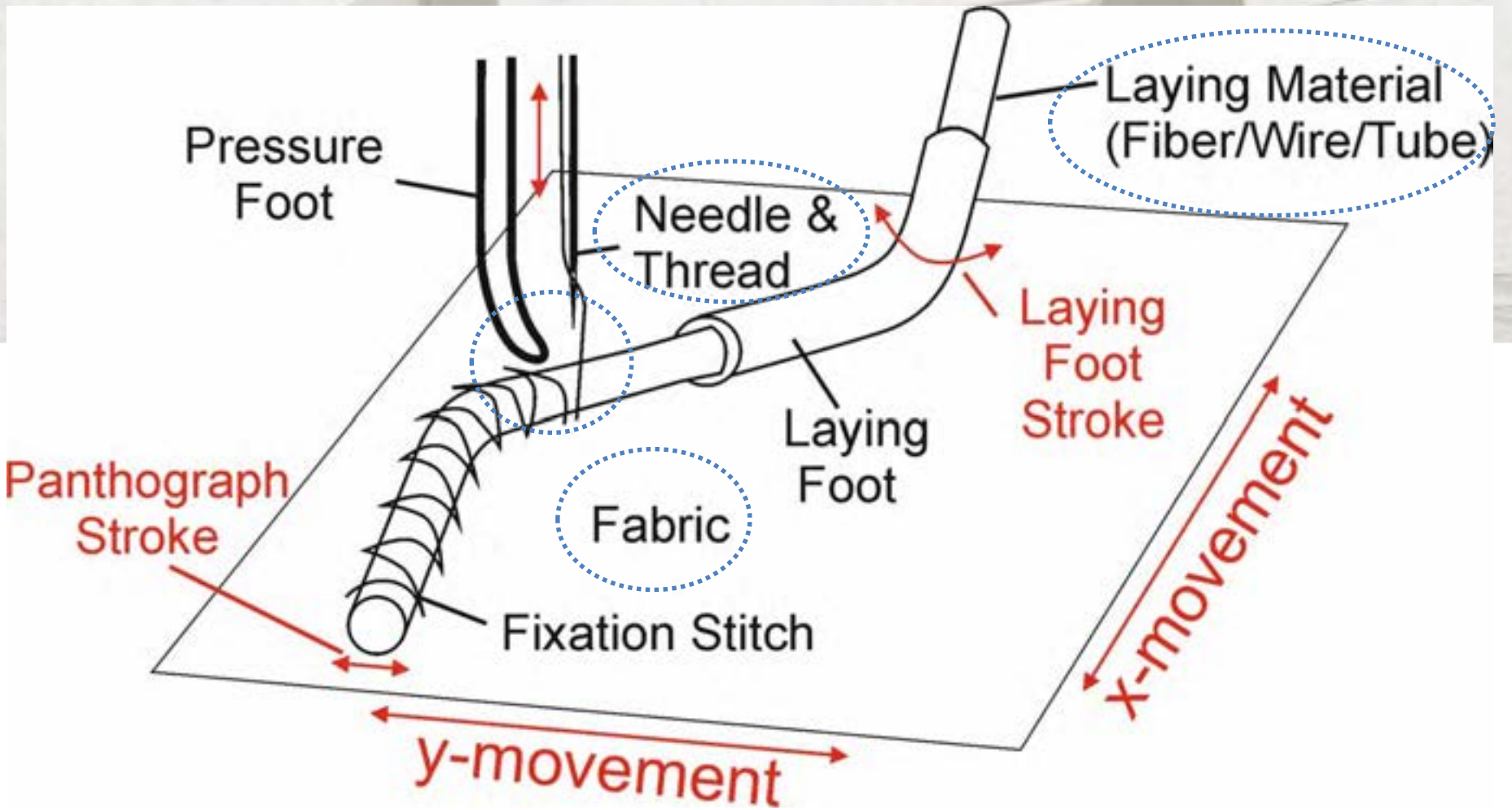
Laying material (e.g. wire) is fed by a laying food in front of the needle

Principle of W-Head



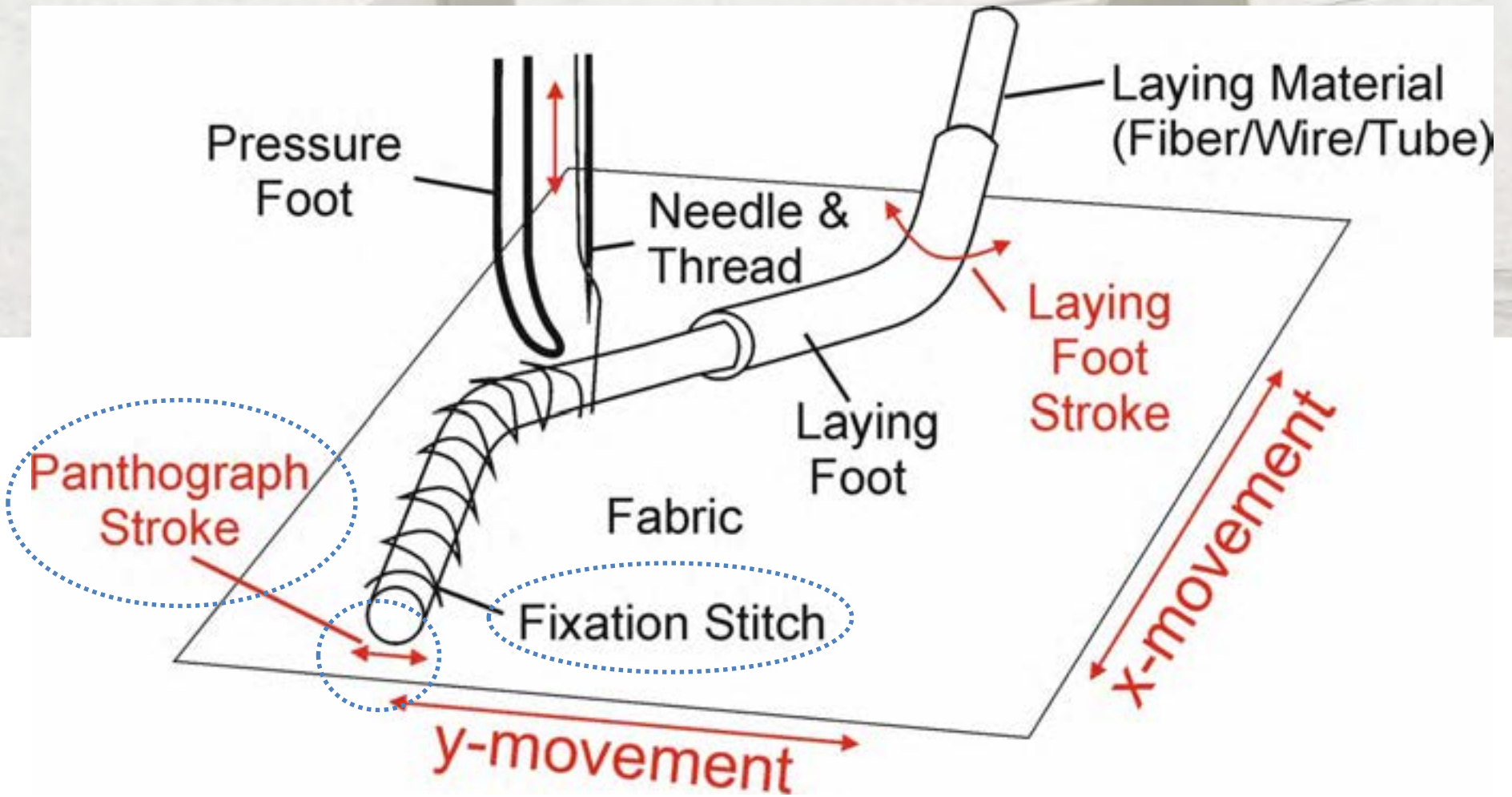
The laying foot moves the laying material to the side, each time the needle goes down preventing the punctuation of the laying material (laying foot stroke)

Principle of W-Head



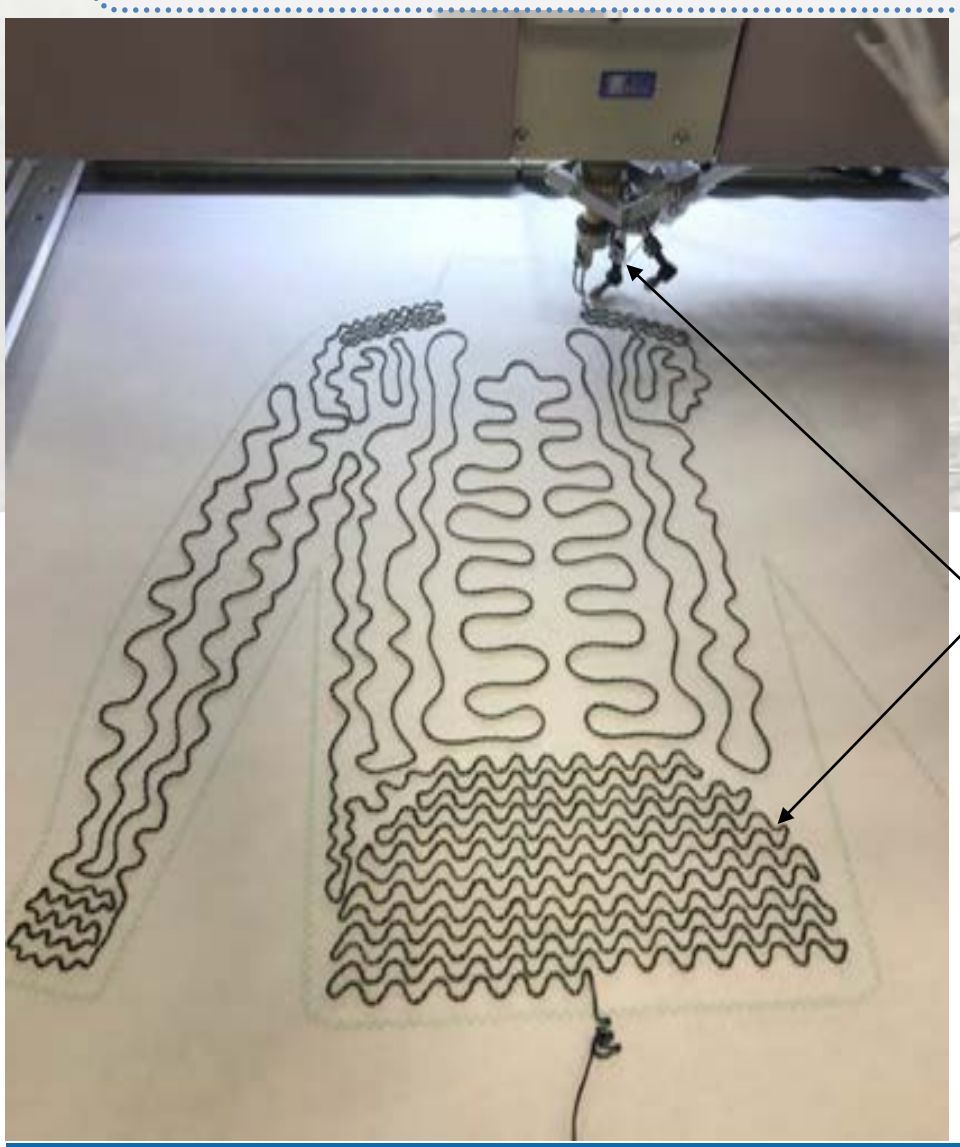
Embroidery thread fixes the laying material to the fabric

Principle of W-Head



In case, the laying foot stroke is not wide enough, a pantograph stroke can be added to create a zigzag fixation stitch around the laying material

How can Tailored Wire Placement (TWP) be used?



Heating Wire

Application-Sample:

Heating Jacket

How can Tailored Wire Placement (TWP) be used?

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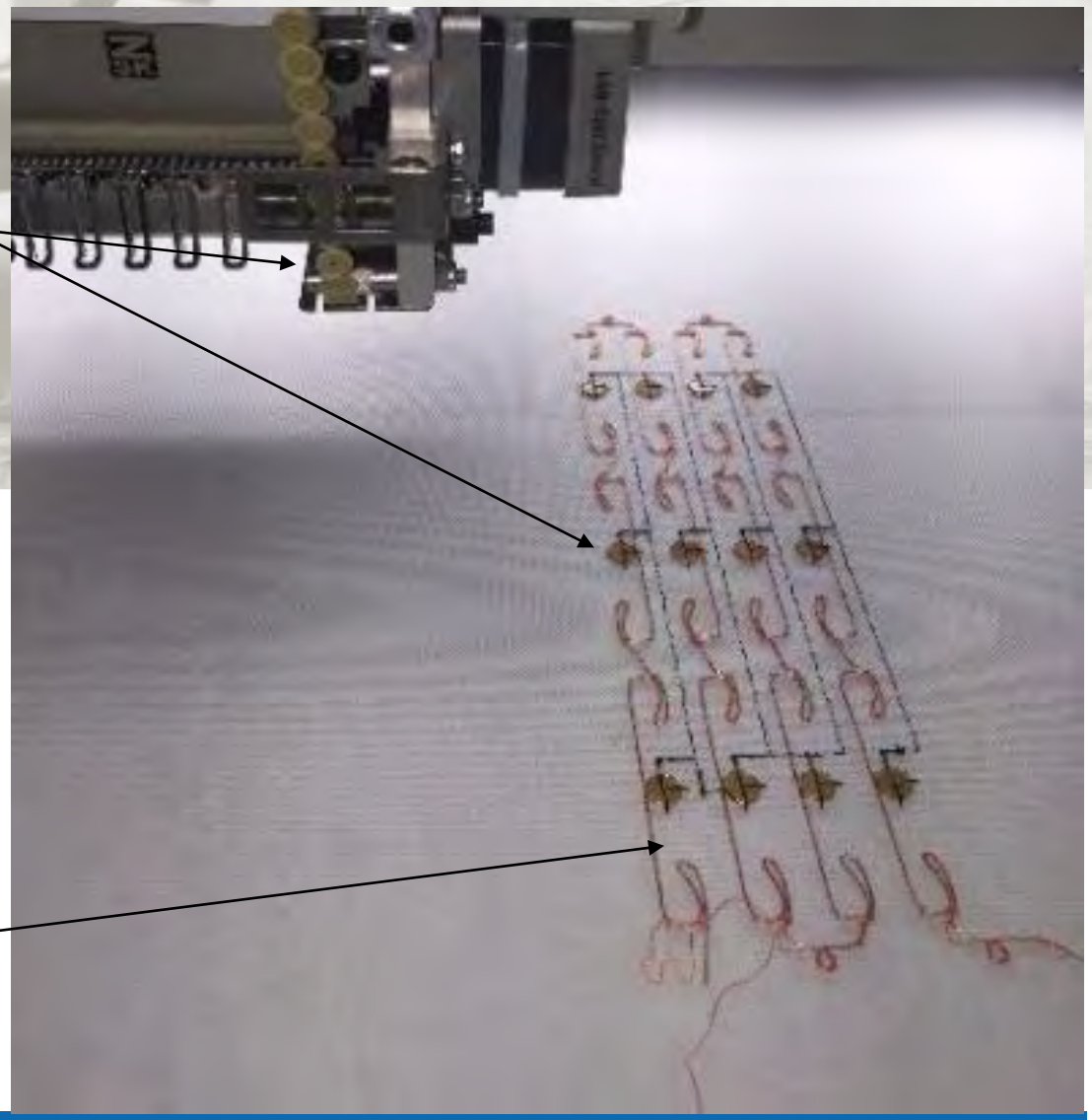
RFID-Chips
(s. F-Head)

Application-Sample:

Antenna (e.g. RFID)



Antenna Wire

How can Tailored Wire Placement (TWP) be used?

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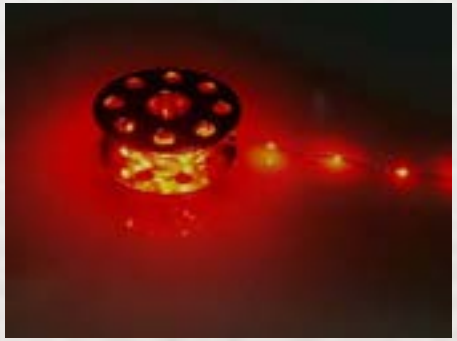
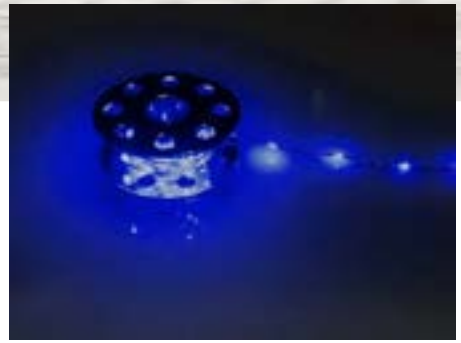
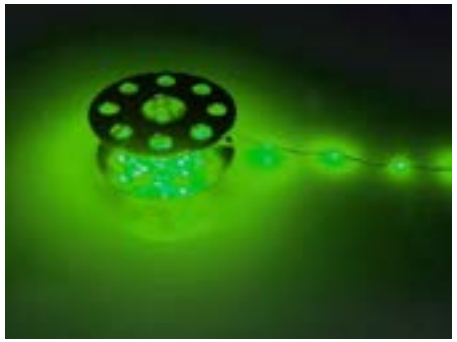
LED-Wire Integration for Lighting







How can Tailored Wire Placement (TWP) be used?

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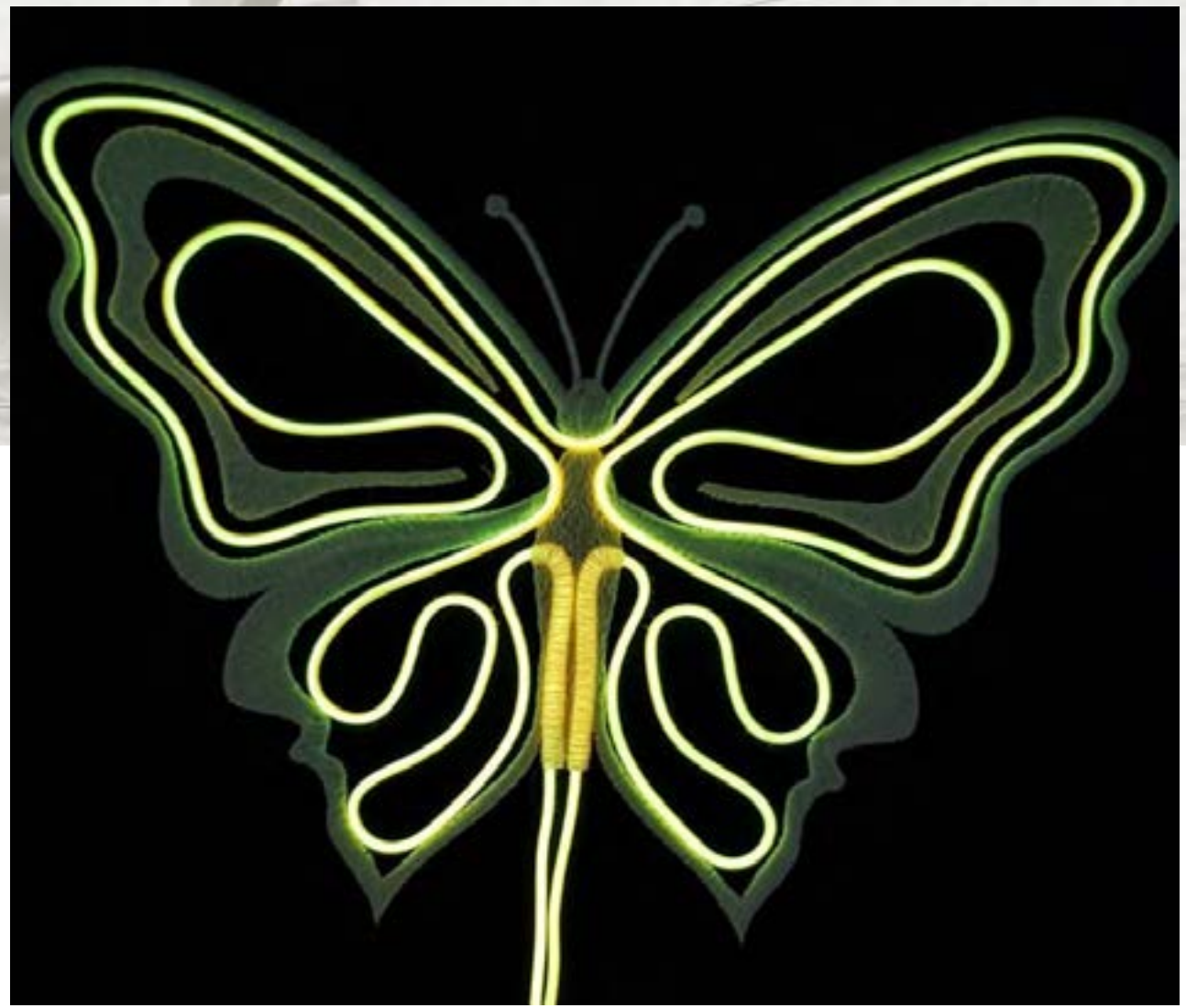

EL-Wire Integration for Lighting


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MADE IN GERMANY

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