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Textile and Artificial Intelligence-A Review

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Abstract

The term artificial intelligence (AI) is associated to any machine that exhibits traits related to a human mind such as learning and problem solving. For the manufacturing, artificial intelligence is reshaping their production process and the way they conduct business. Textile is such an industry where a wide variety of technologies can be applied to advance processes and provide fresh new varieties of clothing fabrics and fibres.

Textile manufacturing businesses with access to historical and real-time operational data can leverage artificial intelligence to improve efficiency and augment the capabilities of their human employees. Automated inspection can be performed by the use of artificial intelligence and image processing for inspection of the quality of the product. Based on the improvement of the machine vision theory, industry can use industrial robot technology to realize the automation of cut pieces cutting and replace manual labour. Artificial intelligence is the field of study that deals with the synthesis and analysis of computational agents that act intelligently. One area of apparel manufacturing where artificial intelligence improves quality control is grading of yarn and other base materials. Automation in garment product is becoming a reality due to technical development and the use of modelling and simulation. Artificial intelligence is one of the technologies that can help in extensive data management as it uses the gained information from big data machine to do things that once were the human domain.

Keywords: *Artificial intelligence, smart textiles, new technologies, fabric inspection, sewing technology, digital components, quality control.*

INTRODUCTION

The demand of quality increased leading to the application of automated artificial intelligence in textile industries recent years. The automation with applications of artificial intelligence in textile production is becoming much popular due to the technical developments and the use of modelling and simulation. Artificial intelligence (AI) is gaining impetus over the last two decades in the textile industry.

The automation of various instruments by the application of artificial intelligence in spreading, cutting, sewing and material handling can reduce the production cost and minimize faults in overall textile production. In many instances of textiles production, there are huge chances of error. The application of AI can deal with the production process without error. As a result, over the last few years the use of AI is rapidly growing in textile industries for various applications. Textile industries are becoming more automated to cater them increasing demand of consumers. Adoption of AI reduces the number of faults and keeps the production cost low. It is applied in all stages of textiles manufacturing. It is increasingly used to different stages of a sewn seam, design development, in PPC, fabric spreading, cutting, bundling, in various sewing operations, pressing, ironing, quality control, SCM, etc. Some of the important applications of AI in textile industry may be discussed with reference to various processing activities [1].

The rise of new technologies such as AI and Internet of Things (IoT) has transformed the once labour-intensive textile industry. Computerized machinery is now found in most textile factories, and these machines are far more efficient at creating specific designs on a massive volume than human workers. New smart apparel products are being created every day. Along with technologies such as Blue Tooth Low Energy (BLE), edge computing and cloud data, smart textiles can monitor and communicate the wearer's formation, including biometric data such as blood pressure, pressure, heart rate, perspiration and more. For textile manufacturers AI is reshaping their entire process and the way conduct business. AI communicates and collects historical and real-time operational data, providing insights that can improve operational efficiency. It is easier to tweak process to magnify workers' capabilities. Whether it is product cost, textile production, quality control, just-in-time manufacturing, data collection or colour matching in the production, AI leaves an imprint on every part of the process. Some commonly AI applications are defect detection, pattern inspection, colour

matching, the AI has enabled smart apparel or smart clothes that leverage. IOT and electronic sensor to create a regular uphold information in is experienced. By leveraging these technologies smart clothes can offer a more comfortable experience and a right focused experience [2].

The future of textile technologies is one that is subject to heavy change, with the constant inflow of new technologies and innovations and rapid changes. Textile is one such industry where a wide variety of techniques can be applied to advance processes and provide fresh new varieties of clothing and fibres. Automation and AI can be used by the textile industry to reduce labour and manufacturing costs and to deliver items according to customers' demands. The rise of new technologies like AI and IOT can modify and upgrade the textile business which once was labour-intensive. In most textile industries, computerized machines are now available and the production of specific designs on a large scale is significantly more efficient than in real-time to provide access records of operational information in real-time to provide insights that can increase operational efficiency. Some of the applications that are quality of life improvements for the industry and manufacturing process are fault detection, pattern checking and colour matching for textile production. Inn textile industry the smart clothes which uses IoT and electronic sensors and provide a more pleasant health-oriented experience by utilizing these techniques [3].

Much of the migration in textile industry to East happened over the past couple of decade, when labour costs began to rising in Asian counties, notable in China. With increasing penetration of industrial automation in the industry, textile manufacturing businesses with access to historical and real-time operational data can leverage AI to improve efficiency and augment the capabilities of their human employees. The adoption of AI application in the textiles manufacturing industries is still very early, and although there are a few use cases, there doesn't appear to be wide spread adoption of AI even in developed countries. As per the report it could not find any list of successful use areas of Cognex's VIDI technology at the time of presenting the article. It is possible that the technology is in research and development or pilot phase or the current customers have not given permission to be identified by name. Textile manufacturers might save on costs and time taken for inspecting the quality of the final fabric end-product by replacing visual inspection with use Cognex VIDI platform. Typically the manufacturers might install the camera based inspection system in these

factories and input a few hundred images of ‘good’ final samples and ‘bad’ samples. The platform learns the weaving patterns, yarn properties, colours and tolerable imperfections from these images and after a training period a couple of weeks and might potentially be able to detect defects [4].

AI is increasingly used to different stages of a sewn seam, design development, in PPC, fabric spreading, cutting, bundling in various sewing operations, pressing, ironing, packaging, quality control, SCM, etc are the top eight applications of artificial intelligence in textile industry. Defects in fabrics reduce the value of the textile products. Any defect in the fabric is passed into the final product, which can result in the rejection. Fabric inspection is manually checked by skilled workers using tables with equipment and is a time consuming process. In this process, AI can perform this task at a faster rate with much higher accuracy. Colour matching is an important aspect textile product. The colour of a product is judged to be acceptable or unsatisfactory and to solve this this problem, AI can be developed that has pass/fail feature to help improve the accuracy and efficiency. SCM in fashion includes the flow of fibres, yarns, fabrics, garments and accessories in different production points or to retail. SCM integrates various business processes, activities, information and resources for creating value for the buyers. Standards SCM activities information and resources for creating value for the buyers can manage the cost and business competitiveness [5].

After the 21st Century, the main problem the clothing industry faces is still how to further enhance production efficiency and reduce production costs. Based on its quality of high efficiency and low cost, artificial intelligence can solve both problems at the same time. In the clothing production industry, the human cost has always dominated the total production cost. Introduction artificial intelligence, can replace intelligent robots with manual labour to complete some repeated and relatively cumbersome work. Furthermore after a long period of working, the possibility of mistake increases and the efficiency decrease. AI helps skip these problems. Not only is the execution of efficiency much higher than that of human labour but it can even run 24 hours a day if condition permits. However, due to immature technology of artificial intelligence, most clothing enterprises still need to use a lot of manpower to complete some links in the production chain, such as cutting and sorting and transportation between various links. A few links can be executed by some automatic machines, such as employing sewing machines for cut pieces, sewing, etc. Therefore, to reach the assembly

production of clothes, still depends on the combination of a large number of labour-force and a portion of automatic machinery [6].

Apparel manufacturing is labour intensive, which is characterized by low fixed capital investment with a wide range of product designs and hence, input materials, variable production volumes, high competitiveness and often high demand on product quality. To cater these demands, the labour intensive processes should be converted into automated process accomplished by the use of computers, models, digital components, and AI. Artificial Intelligence is the field of study that deals with the synthesis and analysis of computational agents that act intelligently. In this study, various applications of AI in apparel manufacturing have been discussed. It also includes different types of AI such as expert systems, neural network, fuzzy logic, generic algorithm and other approaches used in garments [7].

The human eye is a remarkable instrument but it is variable. One area or apparel manufacturing where AI improves quality control in grading yarn and other basic materials for materials used in apparel manufacturing. In other word, Ai can uphold a higher and more consistent standards for materials than human being can alone there by raising the average quality of finished garments. Distribution centres (DCs) are primary sources and beneficiaries of operational data. DC managers have many information sources that can help them optimize their current task load, from historical data on consumer and vendor trends to real-time insights into market fluctuations. Artificial Intelligence can turn distribution into a nexus data concerning [8].

Garment manufacturing is labour intensive, which is characterized by low-fixed capital investment, a wide range of product designs and hence input materials, variable production volumes, high competitiveness and often high demand on product quality. However, due to high demand for garment quality and increased consumer awareness is leading to the use of automated tools and equipment in recent years during garment manufacturing. Automation in garment production is becoming a reality due to the technical developments and the use of modelling and simulation. Due to its labour-intensive nature, the apparel industry can seek great benefits of the AI intervention in their businesses. In this era of information technology, artificial intelligence (AI) has revolutionized the field of engineering physics, medicine and management.

Traditional mathematical models are used to solve problems or in the decision making process, which is the key principle of AI. AI can provide superior solutions to various problems due to its heuristic and intelligence characteristics. Significant results such as improving quality, increasing productivity and lowering production cost can be achieved with the help of AI. Tech Know Gram Limited can access our need and propose solutions as needed. AI systems can provide superior solutions over classical systems due to their heuristic and intelligent nature [9].

With the emergence of globalization and digitization the concept of extensive data management and AI to connect business globally has gained attention. In its simplest form, Big Data is a massive amount of data available in various formats. It is often stored in distributed systems or the cloud. While extensive data management entails the organization handling, and use of this big data, it usually requires specific technologies and analytical method. AI is one of the technologies that can help in extensive data management as it uses the gained information from big data machines to do things that once were the human domain.

The importance of AI technique has become even more significant. Activity collected data methods and passively acquired data can provide a massive amount of data, providing companies with opportunities to track customer behaviour and gain trend production insights. By collecting large amounts of data from different sources at each step of the apparel supply chain and turning it into useful information companies can quickly make critical decisions based on the most popular styles, colours, fabrics and sizes [10].

Application of Artificial Intelligence in Textile Industry

Defects in fabric reduce the value of the products. In this case, the application of AI can perform the task of inspection at a faster rate, with much higher accuracy and without fatigue. AI can be used to predict the fabric properties before manufacturing with the help of the neuro-fuzzy or other systems by using the yarn and the fabrics a constructional data. Fabric pattern may have multiple aspects such like weaving, knitting, braiding, finishing and printing, etc. AI technique like ANN is applied for defect identification in inspection of the textile industries.

The fabric picture to be analyzed is obtained from the image acquisition system and saved in relevant image format. Colour is an important aspect of textile products. The colour of a product is judged by acceptable or unsatisfactory, or it can be judged in more details to be: to light or too dark or too green. To solve this problem, AI can be developed that has pass/fail feature to help improve the accuracy and efficiency. In sewn seams and stitches are useful to join two or more pieces of fabrics together. The case of seam formation and the performance of the seam are the important parameters are known as 'sew-ability': AI can be applied to find out the sew-ability of different fabrics during production. Supply Chain Management in fashion includes the flow of fibres, yarns, fabrics, garments, trims and accessories in between different production points or retail. SCM integrates various business processes, activities, information and resources for creating value for the buyers, Standard SCM can manage the cost and business competitiveness [1].

Much like how fibres trackers can help their users live healthier and more alternative life style, smart apparel combined with electronic sensing technology can do the same. Since our clothes have a larger area of contact with our body than something like a smart watch, smart apparel can potentially provide more types of physiological signal measurements. Smart clothing can enable continuous monitoring of important biometric, such as our heart rate, with long-term monitoring more feasible, physician can better identify or diagnose potential cardiac diseases. Smart clothing helps patients collect complete and comprehensive heart-related data, tracking long-term heart disease and enhance the detection and diagnoses of heart issues through regular monitoring over an extended period. Clothes embedded with BLE technology can feel, sense and regulate data and the development of the fabric-based sensors should only improve the overall weaving experience. Artificial intelligence is not only technology driving forward the textile industry but colour data, edge compute, accurate sensors and ultra-lower-power technologies are also necessary components. Especially for smart clothes that rely BLE and IoT technologies, a long-lasting energy source from their embedded battery must provide a satisfactory and useful consumer experience [2].

Automation and AI can be used by the textile industry to reduce labour and manufacturing costs and deliver items according to customers. The rise of new technologies like AI and the IoT can modify and upgrade the textile business, which once was labour intensive. In most textile industries, computerized machine are now available and the production of specific

designs on a large scale is significantly more efficient than that of people. AI can access records of operational informational in real-time to provide insights that can increase operational efficiency. Some other applications that are quality of life improvements for the industry and manufacturing process are fault detection, pattern checking and colour matching for textile production. One other new possibility that has opened up due to the use of artificial intelligence in textile industry is smart clothing of smart clothes, which use IoT and electronic sensors and there by provide a more pleasant health-oriented experience by utilizing these technologies. The artificial neural network technology makes it easier to spot defects in models like weaving and knitting [3].

Artificial Intelligence in Apparel Production

Before sewing cut pieces into garments there is another step to be completed that is piece sorting. In this process, many pieces mixed together need to be classified and the pieces required for a ready-made garments need to be divided together. Otherwise, the cutting pieces will be superfluous or missing during sewing. In fact we can realize automatic sorting through Ai and IoT technology. When printing and dyeing cutting pieces we can add a QR code and cut it together with pieces into cutting step. During sorting the grabbing robots can scan the QR code on the piece to obtain the information as well as the position should be placed and leave it with other pieces of the garments before transporting it to other location for the next step. Programmable intelligent robot is introduced for sewing operations. It is only need to uphold the mobile cutting instruction to the robot in the form of programming and make it run successfully. But in fact, simply replacing manual work for mechanical arms will cause many problems. First of all, the console and manipulator plat form must be kept horizontal because the manipulator actually uses pressing to make the clothes follow it. Once the console and the manipulator cannot be kept horizontal, the cloth is likely to loosen as it moves. The Kawasaki Robots an example when writing codes, programmers can only adjust the relationship between the running speed of the robot and the maximum speed via the speed or acceleration instruction. However, it is difficult to adjust the speed of the sewing machine during automatic operation. If the speed difference is too large the sewing result will be much different from that of manual operation [6].

AII can turn distribution centres into a nexus of data concerning such as current inventory, historical and real-time demand, work force trends and fabric needs and raw materials

availability. There are considerable benefits from AI powers automated material handling assets in clothing factories and distribution centres. Even the ability to automate the transportation of raw materials from one area to a factory to another, from storage packing, for example could deliver considerable time and safely benefits. The ability of AI to work alongside humans and engage in safe path finding throughout modern facilities can enhance business productivity, efficiency and productivity in numerous ways, such as incident free, safe transportation throughout warehouse spaces, reduce time to completion for critical tasks, damage-free transportation of raw materials and finished goods, reduced likelihood of safety incidents and damage to facility structures and faster movement of goods and more efficient operations overall.

AI also has proven itself a boon in workflow and workforce management. When balancing current and future work with the available labour pool is more challenging than ever, AI helps managers create shifts and processes that meet present needs and anticipate future one. Every garment-making operation is different but experts see AI powered automated inspection software as a note worthy way apparel manufacturers can keep costs and errors down. Something as simple as identifying sub-standard yarn early in the manufacturing process can deliver value all the way down the economic chain [8].

Other Areas of AI Applications in Apparel Manufacturing

Textile fibres are the basic raw materials for the production of clothing and other textiles. The traditional practices of fibre identification are based on destructive tests using flame or chemicals. Recent advancements include the use of optical microscopes, Fourier Transformation Infrared, and Raman Spectroscopy. AI can also be used to identify and grade textile fibres according to their colour and other properties such as fineness, length, uniformity ratio and effect of spinning performance on yarn properties. There have been several applications of AI in yarn manufacturing that includes virtual modelling of yarn from fibre properties, prediction of yarn tensile properties, prediction of yarn evenness and yarn engineering. AI can be used to predict the fabric properties before manufacturing with the help of Fuzzy or other approaches by using fibre, yarn and fabric construction data. While applying Ai, it is essential to establish a proper linear and nonlinear relationship between the input fibre and yarn parameters and the property of the fabric needs to be predicted. However, the application of AI can be very expensive for fabric manufacturing, which

increases the cost of production. It can also be applied to investigate comfort properties. Garment manufacturing process is becoming more automated to cater the increasing demand of consumers, reduce the number of faults, and keep the production cost flow. AI is increasingly used to predict the performance of a sewn seam, designing of the cloth, in PPC, in various sewing operations and in quality control. AI can be applied for the intelligent manufacturing of clothing to predict the properties after a particular process [9].

AI is a broad field of computer science with developing intelligent machines capable of performing tasks that would typically require human intelligence. It applies a variety of approaches making it an interdisciplinary science, however, advance in machine learning and deep learning are causing a paradigm shift in nearly every sector of IT industry. Demands and trends on the market are highly volatile and business face intense competition in a market that is becoming more saturated. Accordingly, Big Data alone is insufficient to make a tangible difference to complete effectively and efficiently. In addition to growing businesses must rely on their experience and the data at their disposal. AI techniques can provide retailers with strong tools to construct data models and achieve maximum data utilization [10].

CONCLUSION

Artificial Intelligence is gaining impetus over the last two decades in the textile industry. The rise of new technologies like AI and the IOT has transformed the once tailor intensive textile industry. Most traditional systems that have been upgraded today, AI is the technology that is the key improvement. With the increasing penetration of industrial automation in the textile industry AI is to improve efficiency and augment the capabilities of their human employees. Automation inspection can be performed by the use of AI. Through machine vision technology the robots can accurately distinguish the size and shape of the cutting pieces and then cut it according to the scanning results. AI improves quality control grading yarn and other base materials. Due to its labour-intensive nature, the apparel industry can seek great benefits out of the AI intervention in their businesses. AI techniques can be used at different stages of the apparel supply chain management to improve business operations.

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