APPLICATIONS OF MACHINE FEEDING AND COLLABORATIVE ROBOT TECHNOLOGIES IN THE FIELD OF MANUFACTURING PROCESSES

MAKİNE BESLEME VE KOLABORATİF ROBOT TEKNOLOJİLERİNİN İMALAT YÖNTEMLERİ ALANINDAKİ UYGULAMALARI

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Özet

Makine besleme robot hücreleri; otomatik çalışan fakat parça besleme ve boşaltma işlemleri manuel olarak yapılan makinelere entegre edilen ve parça besleme boşaltma işlemlerinin tam otomatik bir şekilde yapılmasını sağlayan sistemlerdir. Transfer tezgahlar, presler ve CNC tezgahlar endüstriyel makine besleme robotlarının en sık entegre edildiği makinelerdir. Fakat bu makinelerin dışında; döner tablalar, plastik enjeksiyonlar, test kontrol aparatları vb. makinelere de endüstriyel tip makine besleme robotları entegre edilebilir. Makine besleme robot hücreleri sayesinde yüksek hız ve hassasiyete sahip endüstriyel tip makine besleme robotları ile üretim verimliliği arttırılabilir ve üretim maliyetleri minimize edilebilir. Makine besleme robot hücresi; otomatik çalışan fakat parça besleme boşaltma işlemi manuel yapılan makinelere entegre edilebilen sistemlerdir. Makine besleme işlemleri tamamlandıktan sonra kalite kontrol, etiketleme, markalama vb. operasyonlar da makine besleme robot hücresi içerisinde gerçekleştirilebilir. Cobot veya kolaboratif (işbirlikçi) robot, paylaşılan bir alanda veya insanlarla robotların birbirine yakın olduğu yerlerde doğrudan insan-robot etkileşimi için tasarlanmış bir robotlardır. Cobot uygulamaları, robotların insan temasından izole edildiği geleneksel endüstriyel robot uygulamalarından farklıdır. Cobotun güvenliği, hafif yapı malzemelerine, yuvarlatılmış kenarlara ve doğal hız ve kuvvet sınırlamasına ya da güvenli davranışı sağlayan sensörlere ve yazılımlara dayanmaktadır. Sensörler ve hafif malzemeler ve yuvarlatılmış kenarlar gibi diğer tasarım özellikleri sayesinde işbirlikçi robotlar (cobot'lar) insanlarla doğrudan ve güvenli bir şekilde etkileşime girebilmektedir. Cobot'ların, kamusal alanlardaki hizmet robotlarının bir örneği, bir bina içinde malzemeleri taşıyan lojistik robotlarından, insanların ağır parçaları taşımasına yardımcı olmak gibi görevleri otomatikleştirmeye yardımcı olan CNC besleme ve montaj işlemleri için kullanılan endüstriyel robotlara kadar pek çok geniş alanda kullanımı bulunmaktadır.

Anahtar kelimeler: Makine Besleme Uygulamaları, CNC, Kolaboratif Robot Teknolojileri, İmalat Yöntemleri, Makine Mühendisliği

Abstract

Machine feeding robot cells are automated systems that are installed into machines where part feeding and unloading activities are performed manually, allowing part feeding and unloading operations to be performed totally automatically. Industrial machine feeding robots are most commonly integrated into transfer benches, presses, and CNC machines. Aside from these equipment, there are rotating tables, plastic injections, test control devices, and so on. Machine feeding robots of the industrial kind can also be integrated into the machines. With industrial

type machine feeding robots with high speed and precision, production efficiency may be raised while production costs can be reduced thanks to machine feeding robot cells. Machine feeding robot cell; These are automated systems that may be incorporated into machines that handle manual part feeding and unloading. Following the completion of the machine feeding operations, quality checking, labeling, marking, and so on. The machine feeding robot cell can also be used for operations. A cobot, or collaborative robot, is a robot built for direct human-robot interaction in a shared area or in close proximity to people and robots. Cobot applications differ from standard industrial robot applications in which robots are kept separate from humans. The cobot's safety is based on lightweight materials, rounded edges, and natural speed and force limits, as well as sensors and software that assure safe behavior. Collaborative robots (cobots) can interact with humans directly and securely because to sensors and other design elements such as lightweight materials and rounded edges. Cobots have a broad range of applications, ranging from logistics robots that transport products within a building, which is an example of a public space service robot, to industrial robots used for CNC feeding and assembly operations, which aid automate jobs such as assisting workers in moving heavy components.

Keywords: Machine Feeding Applications, CNC, Collaborative Robot Technologies, Manufacturing Processes, Mechanical Engineering

1. INTRODUCTION

A collaborative robot, often known as a cobot, is a robot designed to directly engage with humans in a shared environment or in close proximity to humans. Cobot applications are distinct from standard industrial robot applications, which include robots operating in isolation from people.Cobot safety may be dependent on software and sensors that guarantee safe behavior, or it may be dependent on lightweight building materials, rounded edges, and intrinsic speed and force limitations. The key to a sustainable future and an increasingly productive manufacturing facility is automation. Industrial robots are a valuable asset for small and medium-sized manufacturers (SMM) as they can secure certain production tasks. An industrial robot is the ideal "employee" for jobs that are straightforward and repetitive since it can operate around the clock more effectively, faster, and with less labor expense. There has been a significant increase in the use of industrial robots as many businesses have come to understand the potential of these machines and, more crucially, collaborative robots, or "cobots." Cobots are inexpensive industrial robots that can safely work in close quarters with people.

2. METHOD

The robots sector has grown at a pace never seen in previous decades. In actuality, the increasing automation of work that some see as a threat to human labor is the most sensible development in technological advancements. The goal has always been to improve the safety and effectiveness of the production process.

From the perspective of manufacturing technology, factors such as product material and its impact on the degree of fluency and rhythm of the technical process, as well as seriality and stability of goods during production, are significant. The questions of the product's appropriateness and worthiness for automated manufacturing, as well as the qualitative traits that determine the products' competitiveness, must be resolved. It is crucial to make sure that the essential activities that form the technical manufacturing process are continued in the design of the manufacture of a specific product (P. Demeč et al., 2016).

Collaborative robots		Conventional industry robots
Simply programming		Programming is time- consuming
Lower weigh of robot < 29kg		High weigh of robot > 50kg
Embedded security features		Missing of safety sensors
Operation in the limited space		Large operation space
Lower weigh of machined workpiece		Greater load capacity
Mobile		Immobile
External force sensors		Sensors of external forces are missing
Faster and simpler setting		High operation speed in operation
Flexibility of deployment		Universal usage in the limited space

Figure 1. Differences industrial robot and cobot (Miriam Matúšová et al., 2019).

Automation must be included into the manufacturing or assembly process in order to continuously increase job productivity. Automated robots are a great alternative to humans in situations when labor is boring, loud, dangerous, or otherwise unfavorable. In addition, it's wise to replace a worker when automation may improve output's precision and quality. Man's performance fluctuations brought on by his physical or mental health, his relative strength, or his light fragility are attributes that have no place in the production process. Product manufacturing expenses may be significantly decreased by automation, which will lower the final product price. Automation reduces manufacturing times and improves production flexibility. Automation requires a sophisticated understanding and cannot be limited to the chosen machine (O. Moravčík et al., 2008).

3. FINDINGS

Before the 2000s, the design of what is now known as a cobot advanced slowly. The Occupational Safety and Health Administration (OSHA) first expressed concerns about the manner employees at automotive factories had to go about their everyday business more than 20 years ago. The repetitive nature of those tasks, their heavy load, and their lack of ergonomy were seriously taxing the bodies of human workers. Technology thus advanced the robotic arm's development toward a more improved and reliable model. Intelligent Assist Devices (A brief history of collaborative robots 2019) was the name of the product. The SMMs were the first to applaud the coming of cobots since they could integrate the robotic and human labor (Daniela Balog, 2020)(CollaborativeRobots,2019).

The fact that such a robot required less money to purchase than an industrial robot was another justification for doing so. Collaborative robots quickly became necessary in a variety of industries, including the food and industrial sectors. (Robotic Industries Association, 2019).

The yearly income for cobots will reach a total value of US$11 billion in 2030, according to a 2019 ABI Research research titled "The Collaborative Robot Market Will Exceed US$11 Billion by 2030." This will account for 29% of the industrial robot market as a whole. The revenue for the year 2019 was $711 million USD. This research, which was conducted in 2015 by the same ABI Research Organization, provided an estimate for the years 2016 through 2020 as well as the state of affairs in 2015. It is simple to observe the ABI Research estimation (Chiao, M., 2019).

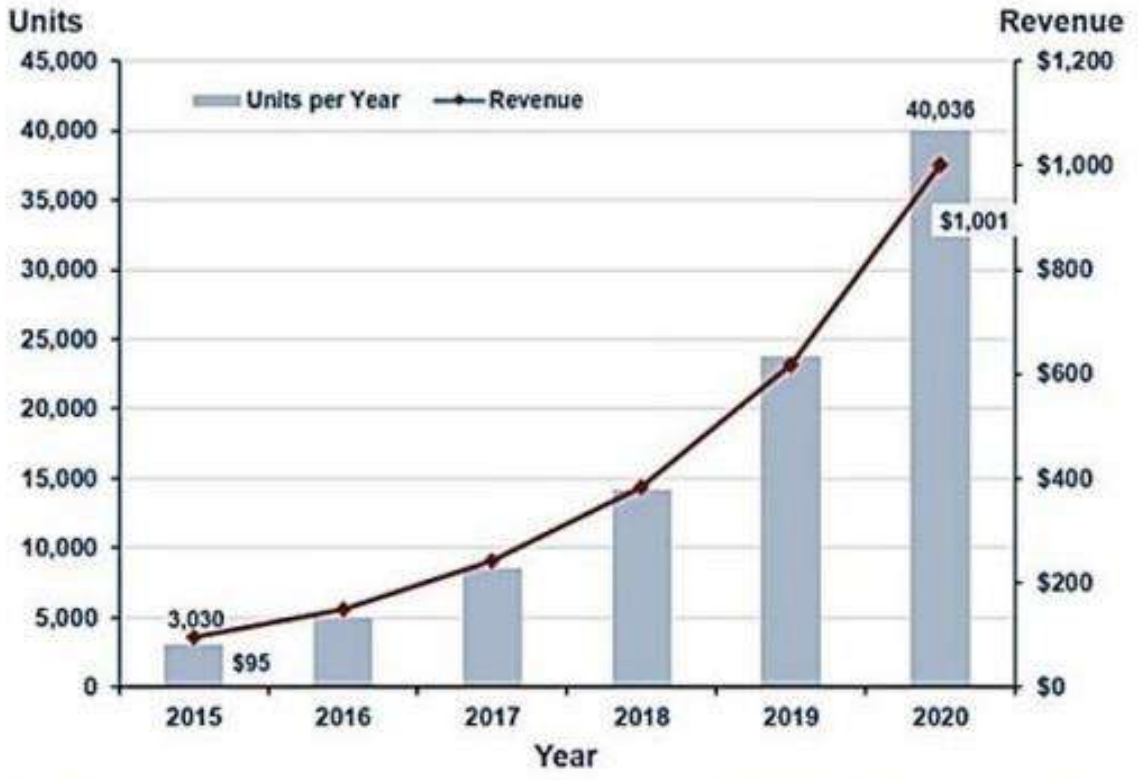
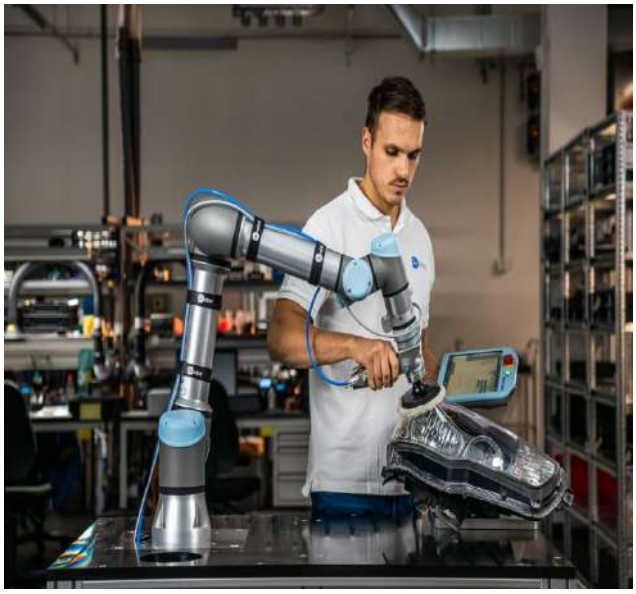


Figure 2. Collaborative robot market trends (ABI Research, 2020).

Cobots with high work, efficiency and quality sensitivity can work in all areas of production with their flexible positioning, safe use, fast installation, affordable cost, easy programming and easy integration into new jobs and processes, and their light and compact structure. Cobots are



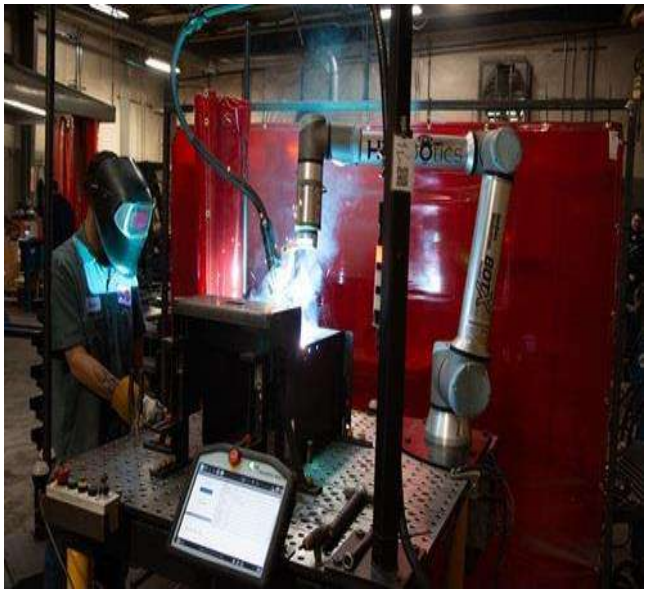


Figure 3. Cobots using in Manufacturing. Surface sanding (on the left), Welding (on the right).

the ideal solution for robotic automation from small and medium-sized companies to large-scale multinational companies, with the advantages of taking up little space in production areas, low energy consumption, 360° rotation ability, and fast return on investment. Cobots, which are used in more than 50 countries around the world today, have very easy programming thanks to their high-precision arms; In many processes such as deburring-polishing, machine feeding, quality control, transportation, assembly, gluing-distributing, bolting, sanding, pick-up-release, packaging-palletizing, labeling, injection molding, CNC, welding, laboratory analysis, testing and sampling. can also be used. The fact that production processes change and create a need for flexibility leads production technologies to change in this direction. With their modular structure, cobots can work in a narrow space, can be easily moved, and can be adapted to different processes. The use of cobots in various industrial applications is increasing day by day (O. Staš et al., 2013).

One of the riskiest occupations in manufacturing is material handling. Materials that can be extremely dangerous for human workers include plastic, metal, and other chemicals. Repetitive strain injuries can also result from the repetition of several material handling duties. Robotics-intensive industries report far lower rates of worker accidents. Mobile robot platforms make it simple to carry and move heavy goods around industrial floors. In the meanwhile, caring to machinery, especially heavy-duty CNC machine jobs. Cobots can also be employed in the production process to help with quality control. In contrast to humans, cobots never get weary or lose efficiency while carrying out the same activity in the same way. Cobots, for instance, are able to position and measure a camera in the same spot on as many work components as necessary without the requirement for optical recalibration. Cobots are capable of doing other duties that are as vital to manufacturing. For example, any process that includes filling molds requires the use of robots to remove material. These tiny robots are capable of evaluating the molded item and handling the cutting of any extra metal or plastic without endangering the component or putting human workers in danger.Cobots equipped with sanding kits from the UR+ platform may be used to polish parts for a bright, smooth finish, while cobots equipped with dispensing tools and hardware can be used to apply glue and other adhesives (S. Mraz, 2003).

4. RESULT, CONCLUSION AND SUGGESTIONS

Collaborative robots, which change classical production methods, can be used in hundreds of different areas in every corner of the world. Cobots can transform production operations into collaborative automation to automate tasks such as lifting heavy loads that are tedious or strain employees, to increase efficiency, or to complete or facilitate the production process in a shorter time. Cobots have many advantages, from more efficient production and faster packaging or welding applications to increased employee satisfaction and ensuring safe work safety.

In industrial production, work styles that require attention and are repeated frequently increase the likelihood of people making mistakes and occupational accidents. Depending on risk assessment analyses, cobots can be installed without safety barriers. Since cobots have higher safety standards than traditional robots, they offer the opportunity to work comfortably with people without a safety cage. Cobots also eliminate danger because they automatically stop depending on a force they encounter. Thus, while cobots prevent work accidents, they also increase the production efficiency of the enterprise as they eliminate the possibility of making mistakes. Cobots make production simpler because they take up little space, can be positioned as desired in production environments, and can be used without a safety cage depending on risk analysis. As a result, it can create safer work environments where cost and quality management

is carried out effectively. Cobots can be used side by side with humans or independently in many work environments that negatively affect employee health and safety. These applications are packaging, palletizing, assembly, press and machine feeding, painting, pick-up and drop-off, laboratory applications, which are continuous heavy lifting operations. By assigning difficult, boring and dangerous jobs to cobots, employees can take a more effective and active part in production processes.

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