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A Survey on Types of Robots Based AI Driven Technologies Used in Various Industries

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Abstract
This review article is committed for recent robotic technologies applications in the different industrial fields. Robotic solutions based on AI driven techniques are presented with non-intensive applications and their executions, impacts are discussed briefly. The review also offers an overview of different articles and publications, classified by their industrial applications criteria and development of existing solutions structure and identify the challenges also. The discussion revealed the background to the challenges and obstacles faced by robotic applications, and its types used in different industries like factories, manufacturing industries, agriculture, medicine and others. These kind of existing challenges are related with areas of human nature, specific AI execution, psychology, and robot oriented object design and errors. These types of robots analysis review shows that the conventional emerging applications in robotics deal with different psychological and technical faults. Hence this review suggested that there is a requirement in robotics advancement based on enhanced AI based solutions, psychological solutions to human-robot interaction, development of intelligent companions and enhanced robot oriented object design in future for different industries.
Keywords: Types of Robots, Industrial Robots, AI driven techniques, Human-Robot interaction.

1. Introduction

In globalisation era, the industries are dealing with increasing innovations dynamics, diversification of product range and shortened product lifecycles. Similarly, they are in pressure due to the high skilled workers cost and shortage. Hence industrial robots based on different types, automation and effectiveness are considered as better solution for both flexibility and productivity. Yet the industrial robotic system programming for specific application is highly complex, expensive and time-consuming. AI driven methodologies are recently becomes highly upgrading the industrial robotic system and its easier for factories and industries to implement the robotic system easily and inexpensive. Nowadays several nations focusing on Industry 4.0 development to promote the upgrade and transition of their respective sector, for e.g. manufacturing sector. It is considered as 4th industrial revolution and its major aim is to realize the flexible, personalized and intelligent process of manufacturing based on AI driven methodologies (Gihleb, Giuntella, Stella, & Wang, 2022; Grover & Ashraf, 2023; Koch, Manuylov, & Smolka, 2021).

The establishment and utilization of them are highly enhanced and it is increase the productivity of industries with more advancement in sensors and devices, automation and information technologies in recent years. Several functions like multi-objective criteria have been developed in several fields like welding, material transportation, mechanical processing and assembly in manufacturing industries. Sensors get the details and used to make decisions of industrial robots, external environment and assisting in regulate the robots for executed functions (Bonci, Cen Cheng, Indri, Nabissi, & Sibona, 2021; Lai, Lin, & Wu, 2018; Mikolajczyk et al., 2022). Hence this study focuses on reviewing the classification of robots, types in different fields, robots across industries, their challenges have been discussed. Finally the conclusion has been drawn based on the discussion.

2. Classification of robots

Robots has been divided based on their function and with respect to their environment shown in fig.1. The most general differentiation is among the mobile and fixed robots. These robots have presented in various working environments and thus needs various capabilities. Industrial robotic manipulators are said to be fixed robots which performs in well-defined environments which are suitable for the robots. However industrial robots work certain repetitive works like painting or soldering parts in car manufacturing environment. For human-robot interaction, due to the enhancement of devices and sensors, the robotic manipulators are used more in the lesser controlled surrounding like greater precision surgery. In alternative, mobile robots are predictable to travel and work tasks more, but uncertain and ill-defined surroundings are not suitable for robots.

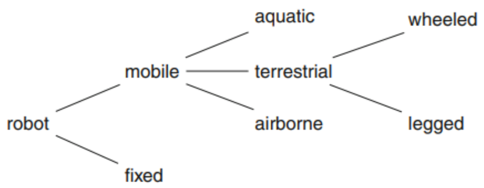

Fig.1. Robots classification by interaction mechanism and environment(Ben-Ari, Mondada, Ben-Ari, & Mondada, 2018).

Yet the researchers and scientists are need to address the situations which are not accurately known before and that modified over time. These kinds of environments can comprise with impulsive entities like animals and humans. Mobile robots examples are self-driving cars and robotic vacuum cleaners. There exists no clear classification line among the tasks performed by mobile and fixed robots, humans can be relate with mobile and industrial robots can be restricted to transform on tracks and yet it is convenient to focus two classes as basically different. Specifically, fixed robots are involved to stable mount on ground and they can measure their position with respect to internal state whereas mobile robots are based on environment perception with respect to location identification. There are three major environments for mobile robots which needs importantly various design principles due to motion mechanism like aerial (drones), aquatic(exploration of underwater) and terrestrial (cars).

Similarly the classification is not stern, for example there exists amphibious robots which travel in both ground and on water. Robots for three environments can classified into subclasses like aerial robots can be heavier than aircraft or lighter than air balloons or terrestrial robots can have wheels or tracks or legs, have been classified into rotary wing and fixed wing. Robots can be divided by intended application field and the operations they works shown in fig.2. Industrial robots has performs in well-defined environment on production works. The initial robots have been industrial robots due to well-defined environment and the design to be simplified. Also the service robots can supports humans in their works. These involve chores at home like self-driving cars for transportation, defence applications like investigation drones and vacuum cleaners. Medicines also assist with robots for surgery, training and rehabilitation. Recent applications used the robots which needs enhanced sensors and nearer interaction with user.

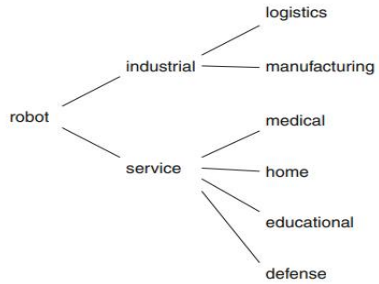

Fig.2. Robots classification by applications(Ben-Ari et al., 2018)

3. Human–robot interaction

HRI- Human Robot Interaction evolution has been nearly entangled with the Artificial Intelligence- AI and Robotics advancements. This historical mechanism offers certain understandings into the period of travel from initial attempts at incorporating AI into human-robot interactions to the present state of AI driven human-robot interaction emphasizing on challenges, opportunities and milestones on the path(Galin & Meshcheryakov, 2020; J. Huang, Wu, Zhang, & Chen, 2020). Robotics evolution can be outlined back to the ancient civilizations in which mechanical devices and rudimentary automata have been designed for different causes. But the major advancements in robotics started in 20th century, the pioneers like *Joseph Engelberger and George Devol* designed the initial industrial robots which is skilled for doing repetitive tasks in the manufacturing sites. Simple commands are used for early robots which performed in controlled surroundings which lays the basics for robotics field. In 1950s AI field emerged with the milestone of establishing machines which is suitable for possessing human like intelligence (Natale & Ballatore, 2020). Due to the restrictions of data availability and computational power, the progress has been restricted, but earlier AI has been concentrated on logic based, expert and symbolic reasoning systems(Chuah & Yu, 2021; Henschel, Hortensius, & Cross, 2020; Li et al., 2020; Spezialetti, Placidi, & Rossi, 2020).

As AI continues in progress the HRI field is composed for major innovation and growth. (Babarinde et al., 2023) reviewed future outlooks and trends in AI driven HRI emphasizing on shared interdisciplinary efforts, emerging trends for dealing with challenges and the significance of regulatory contexts for the AI in HRI responsibility. AI driven HRI is the future which is established by many emerging trends which have the potential in shaping the way robots and humans interact in varied domains. It can be influence the recent machine learning techniques for adapting robot behaviour and personalize the interactions with respect to contexts, user preferences and behaviour by individuals. This may allow robots in offers highly tailored and better companionship, assistance and support to the individuals across different applications like entertainment, industries, education and healthcare. (Obaigbena et al., 2024) argued that the future HRI systems may integrate multi-modal interaction contexts which permit individuals to interact with the robots with the help of combination of facial expressions, gestures, touch and speech. This kind of technique may enable high intuitive and natural interactions among the robots and humans, improving the engagement, collaboration and communication in diverse mechanism.

According to (Johnson, Berman, Azen, Otieno, & Campbell-Kyureghyan, 2024), for future HRI, cobots or collaborative robotics plays major role and it enabling robots and humans to perform together effortlessly for attaining general goals. Cobots may designed to balance human capabilities which supports the works which needs precision, endurance or physical strength and it adapt the behaviour with respect to human preferences and compliments. The HRI systems in future may characterize socially intelligent robots modelled with advanced AI techniques which enable to focus and understand and react tp the human intentions, social cues and emotions. These kinds of robots ensures empathy, social skills and emotional intelligence which enable them to relate with humans in emotionally sensitive ways and socially suitable ways(Kopp, Baumgartner, & Kinkel, 2021; Onnasch & Roesler, 2021).

(Stasevych & Zvarych, 2023) discussed about autonomous robots which are capable of autonomous behaviour and proactive decision making which may become highly prevalent in future HRIs. These kinds of robots may offers preferences, taking initiatives, user needs for supports with tasks and adapt to their behaviour which is enthusiastically to changing contexts and environments. For focusing on the challenges in AI driven HRI needs collaborative interdisciplinary efforts which include designers, ethicists, stakeholders, engineers, psychologists, researchers, and policymakers. Resourcefulness of collaborative research includes industry, government sectors and academia which move to innovation in AI driven HRI, capable of more robust and advanced robotic development. Usercentered techniques and design thinking can be important for developing AI driven HRI systems which are said to be socially acceptable, intuitive and user friendly (Lindblom, Alenljung, & Billing, 2020). The guidelines and regulatory contexts for AI driven HRI plays major role in assuring the ethical and responsible use which can safeguarding the well-being and user rights(Mantelero & Esposito, 2021). These kind of guidelines can deal with problems like transparency, fairness, bias, privacy, and accountability offers guidance to developers, policy makers, researchers and developers for traverse to ethical challenges in HRI(De Pagter, 2023; Grau, Indri, Bello, & Sauter, 2020). Standardized organisations and regulatory agencies will develop the security and safety standards for AI driven HRI systems which assuring the robots to operate securely and safely in different applications and environments (Hoggenmueller, Lupetti, Van Der Maden, & Grace, 2023). These kind of standards focusing on the factors like robot reliability, risk management, design, cyber-security, and performance ensuring the responsible and safe use of AI in HRI(Chang, Ballotta, & Carlone, 2023). But, in dealing with ethical considerations and challenges related with AI driven HRI may needs rigorous efforts from stakeholders across industry, civil society, academia, and government to assure that AI technologies may deployed and developed in a manner that is advantageous to society while reduce the harms and potential risks(Obaigbena et al., 2024; Zacharaki, Kostavelis, Gasteratos, & Dokas, 2020).

4. Recent Robot applications

From crops harvesting to automobiles assembling and medications deliveries the robotics solutions are improving the growth, productivity, safety and assures higher flexibility in different industries. Creative organisations are identifying forward thinking robotics which supports them in assuring noticeable outcomes. Intel tasks nearly with system integrators, end customers and manufacturers to assists robots in delivering human centric and powerful results. As manufacturers of robots continue to deliver creativities and knowledge across the capabilities, form factor, solutions and price which are executed in ever increasing count of applications and industries. Latest improvements in AI capabilities and processing power explain that the robots can use to satisfy the critical purposes in many ways. While robotic applications differs highly in providing directions, welding metals in critical environments, stocking shelves and many more, recent robots can usually categorised into different categories as described below.

4.1 Autonomous Mobile Robots (AMRs)

AMRs can traverse globally and make decisions in real time nearly. The technologies like cameras and sensors assists them consume the information about their environment. On-board processing tools supports them evaluate it and makes an informed decision, whether its travelling to avoid an oncoming employee, choosing precisely the correct package or choosing suitable surface to disinfect. They are the mobile solutions which need to limit human input to perform their work. Several AMRs are developed to assists the professionals performing in arranged settings like warehouses. A motivating example is a weeding field robots shown fig.3. This setting or environment is structured partially; however recent technology based sensing needs to do the tasks of recognizing and eliminating the weeds. Robot's sensing is extremely reliable even in the environment which is shared with humans like highly designed factories. May be the AMR is attaining the high publicity these days is said to be self-driving cars. Due to the strict safety requirements and greater complex with uncertain settings of motorized traffic, the self-driving cars are highly difficult to design (Kriegel, Rissbacher, Reckwitz, & Tuttle-Weidinger, 2022).

Fig.3. E.g. of AMR weeding a field (Ben-Ari et al., 2018)

(Fragapane, De Koster, Sgarbossa, & Strandhagen, 2021) discussed about the AMRs increasing ability to carried out the activities and tasks and the point about AMRs operation, interact and navigation with machines and humans which is varied than AGV which needs newer setting of decision. During decision making, managers require guidance for attaining the optimal performance. For e.g. in car manufacturing at strategic decision level, it is important for supportive material handling activities degree of control decentralization defining for AMR. In warehouses with planned level, for collaborative AMRs the workzones has identified. In hospitals at operational level lower and safer contagion risk AMRs travel way should be arranged.

(J. Zhang et al., 2023) surveyed about AMRs and AGVs which comprises the outcomes from current research and different past areas on both robots. Moreover different AGV navigation principles have been related. Visual tracking technologies are there which enhances the robustness, real time performance and accuracy of AMR/AGV visual navigation models. At last the AMR/AGVs technologies application for civil department has reviewed based on road construction, pavements and bridges. These technologies plays major role in condition inspection, manpower free up, construction, degree of automation improvement and detection of defects in civil engineering(Bekishev, Pisarenko, & Arkadiev, 2023).

(Grover & Ashraf, 2023) suggested that future studies can be performed for analyse the factors which adequate assimilation of AMR in the warehouses like third party logistics distribution hubs, retails, public and others. In addition, the government role can be examined in using AMR assimilation on the basis of contexts like tax rebates and subsidies. Beyond the warehouse industries can also researches can be performed. Since, AMRs can also be used in hospitals, grocery stores, airports, restaurants and others. Hence it is beneficial to discuss the challenges the other industries dealt with respect to AMR implementation.

For robotic systems, AMRs are said to be special class which transform a payload from one location to other or achieve particular task. They permits precise, streamlined and efficient workflow that establishes human tasks lesser difficult. The research and market task associated to these robots has increasing in Industry 5.0 anticipation in which machines and humans are expected to co-work and co-exist. The future mobile robots looked for cost-effective and clean energy sources to be with compliance and more operational time with settings needs to permit applications in diverse fields. For mobile robots, the studies on mechanical perception, control, design and navigation has engraved out several commercially viable solutions. But their broad applications are still restricted because of effective power systems for use in highly and diverse uncontrolled or unknown settings. The present power solutions suffers from greater early expenses and needs refuelling or recharging, which in turn inappropriate for cost-effective applications and unattended long-haul performance times. The limitations are said to be significant obstacles in broader terrain based mobile robots applicability to daily life and new domains, and it can possible with conventional perception, control and mechanical technologies. The advancement needs in the environment offers solutions and serves as guidelines for choosing energy source of robot with respect to expected needs(Farooq, Eizad, & Bae, 2023).

4.2 Automated Guided Vehicles (AGVs)

AGVs are based on predefined paths or tracks and needs operator oversight and freely traverse settings. These are generally used to move items and deliver materials in controlled environments like factory floors and warehouses(Søraa & Fostervold, 2021). AGVs growing popularity used in the manufacturing which has not only be the outcomes of the technical features but also from their capability to perform. Increased flexibility in production allowed by the co-operative based internal logistics. Due to AGV which are internal logistics executive part, their co-operation with manufacturing equipment and information systems is specifically significant. Greater degree of flexibility demanded by advanced production models which enables with often modifications that resulted from orders which are modified by agile production technologies, customers and lower material buffers which are attained by robotised production stations and production technology's several variants can be used(Aizat, Azmin, & Rahiman, 2023).

Conventional industrial robot system is doing assigned works on particular assembly stations and frequently separated from human operators and other stations using the fences like physical barriers. Collaborative and safe robots into the production systems which perform together with humans discloses the robots usages for several different tasks and allows the physical pressure to rest of production process to elevated. Robot automation enables from this option and are used by different industries and however these robots are still used by particular assembly stations. Extensive usage has attained when these collaborative robots combines with AGVs in different assembly stations. The production staff efficiency has increased further. Data fusion methods allows incorporation of collaborative robot, different sensors and AGVs which attains docking functionality, robot and AGV recalibrated to specific assembly station. For e.g. (Moshayedi, Reza, Khan, & Nawaz, 2023) analyses in 3D unity environment in which RAZBOT and TurtleBot2i robot platforms were incorporated and controlled using ROS. Many advantages attained due to unity as simulator for robot performance, and they are greater quality of graphics and robot behaviour.

4.3 Articulated Robots

Robotic arms are otherwise referring as articulated robots which are refer as imitating the human arm functions. Generally, these can characterize anywhere from 2 to 10 rotary joints. Every additional axis or joints permits for higher degree of motion making these perfect for material handling, packaging, arc welding, and machine tending(Sato, Ito, Mizuura, & Shirase, 2021). For e.g. (Gonzalez et al., 2023) presented the analysis and measurement of impact of velocity on industrial manipulators' quasi-static deflections of 3 various manufacturers. The variations to analyse the robotic compliance calibration applicability are focused at lower velocities. For this analysis, the three industrial articulated robots deflections have been measured at various loads and speeds. In focusing on similarity in between the robot models used in analysis and this research briefs the impact on measurement and its implications for articulated robots compliance calibration. The quasi deflections were greater compared with static ones for all industrial articulated robots. Further the quasi static deflections magnitude shows proportional relationship to Cartesian velocity. Further planar articulated robotic arms with a series of gear-slider mechanisms with springs have been presented in (Ashagrie, Salau, & Weldcherkos, 2021; Nguyen, Lin, & Kuo, 2020).

In another case, (Vishal & Mohan, 2021)examines the KUKA KR 16 industrial robot with the help of static structural analysis. 6 axis industrial robots considered and it's majorly used for material handling and arc welding in manufacturing and automobile industries. Using finite element analysis with ANSYS software, the parameters like strain energy, equivalent elastic strain, total deformation, equivalent stresses of industrial robots has been performed. The evaluation performed with various gripping loads and joints with 0.5N to 200N in order to identify robot's structural deformation. The general gripper loads are related to various conditions for observing the robots weaker parts(H.-C. Huang & Chuang, 2020).

4.4 Humanoids

Several mobile humanoid robots can be under the category of AMR and the word used for recognize the robots which were doing human centric operations and frequently consider the human like forms. Similar technologies have been used as AMRs to plan, act and sense as they perform tasks like given that caretaker's services and contributing directions (Ceccarelli, Russo, & Morales-Cruz, 2020).

Fig.4. a) LOLA b) Valkyrie c) TORO d) RH5- Humanoid robots with the hybrid design (Series to parallel) (Kumar, Wöhrle, de Gea Fernández, Müller, & Kirchner, 2020)

Humanoids are referring as bipedal robots which are armed with arms, head and upper body to imitate the human anatomy. These are said to be difficult mechatronic systems with technical factors which are greatly interdependent. Humanoid robotics recent researches show that they are established for greater dynamic act which needs better mass distribution and stiff structure. Both these features attained through design with parallel context. The bipedal robot Lola which is established by TU Munich in 2006 and it is the initial humanoid robot developed using the modular parallel joint idea, shown in fig.4.a. Among the output and actuator space the non-linear transmission presented in parallel context which can be used in benefit way through design parameters adjustment to typical robot movements with torque speed features. Higher uniform load distribution has attained on actuators with multi degrees of freedom (Andtfolk, Nyholm, Eide, Rauhala, & Fagerström, 2022; Rojas-Quintero & Rodríguez-Liñán, 2021).

In ankle joint, two DOF with rotational parallel context has used and in knee joint spatial slider crank context has used by Lola. Likewise the AILA robot established from DFKI-RIC in the year 2010 which is used the PKM modules for torso, wrist and neck joints. In fig.4.b. the NASA Valkyrie humanoid robot has presented which is established by JSC- Johnson Space Center by NASA which is to enter in DRC- Darpa Robotics Challenge in 2013 and the challenges followed same design in using the PKM modeules for torso, ankle and wrist joints. Humanoid TORO controlled by torque and revealed in 2013 and for generating pitch movement, from PAL robotics TALOS has released which are huge tree like systems and uses basic parallelogram association in its ankle shown in fig.4.c. Virginia Tech's SAFFiR and THOR humanoid robot uses 2 multi degree of freedom, PKM for ankle and hip roll yaw joints and Hoeken context has used for knee joints and hip pitch. For its torso design, in 2016 LARMbot announced as humanoid robot uses 2 linearly actuated tripod parallel contexts as cable and legs driven parallel mechanism. The parallel redundant actuation with complaint walking leg used by CARL which imitate the human muscles behaviour. The biologically inspired and lightweight humanoid robot of RH5 has established DFKI-RIC uses the PKM and association modules for all joints like for e.g. knee, wrist, hip flexion, ankle, and torso shown in fig.4.d. the bipedal robot may also has hybrid legs which is attaining fast walking behaviour, (Kumar et al., 2020). (Schwartz et al., 2022) presented TOCABI humanoid robot and it faced challenges and needed new paradigm of industrial design.

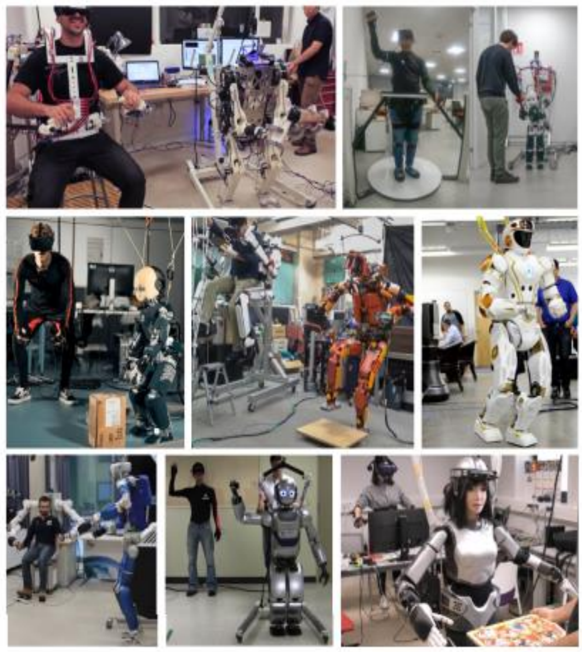

Fig.5. Humanoid robot teleoperation examples (top left - bottom right) (Darvish et al., 2023)

(Darvish et al., 2023) mentioned that in domestic environments like supermarkets, hotels, houses and schools used the humanoid robot tele-operation with a broad range of aim like market shelves restocking, tele-tourism, providing care to housekeeping or elderly care, guiding visitors to hotels and teleeducation. These kinds of settings are built and intrinsically unstructured for use of human. Thus humanoid robot is used for deployment in these applications and it will be highly evident when humanoid robot operator cannot be exists in target environment. The employees perform tele-operation for humanoid robot can be anywhere. These kinds of operations are acceptable and for the humans they interact, modify and manipulate the remote locations. Moreover (Sugihara & Morisawa, 2020) highlighted that the humanoid robots goal is to realize the machines which perform as people and expressing highly, and its similar like machines with human wisdom. The researchers are aware of challenges which are otherwise the intelligence in engineering mechanism, ill-defined mathematically and are ensure as intelligence in which higher physical constraints potrays by entire behaviour of body. It is important to know the humanoids dynamics and mechanism which is similar to human like intelligence.

4.5 Cobots

Cobots are established to perform directly or alongside with humans. The tasks by other robots are doing independently on separated work environment whereas cobots can share their workspaces with employees to support them to attain more. From daily tasks flows they are frequently used to remove dangerous or energetic, manual tasks. Cobots can perform through learning from and responding to people in certain cases. The industries can think about the transforming cobots possibility in the factory environment since they can doing the tasks in many working stations. This the way in providing mobility to cobot manipulators in covering this way of usefulness and functionality. For instance, industries like KUKA established a collaborative combination of robot with AGV considered as better example uses LBR and KMR iiwa with robot manipulator based on autonomous and mobile platform (Chutima, 2023; Javaid, Haleem, Singh, Rab, & Suman, 2022; Liu, Guo, Zou, & Duffy, 2024; Weiss, Wortmeier, & Kubicek, 2021). (Storm et al., 2022) considered SHELLO model for emphasize the human factors associated for cobots design and offers systemic design to analyse human factors in other difficult sociotechnical models.

EVO cobot is another example which is combination of EVO and AGV and collaborative robot taken from universal robots shown in fig.6. 500kg payload can be considered and to 1000 mm/s travel can possible. 20 h autonomy reached by AGV and it is omnidirectional. In another case, UR10e cobot holds upto payload of 10kg and 1300 mm has reached with 33.5 kg. the system has developed for logistic applications in several stations assembling and logistics, machine tending and material handling. Through direct connection to master system it can communicate with other machines like PLC(D'Souza, Costa, & Pires, 2020).

Fig.6. From universal robots- EVO- Cobot 1 with UR10e Cobot(D'Souza et al., 2020).

4.6 Hybrids

Different robot types are frequently combined to develop hybrid solutions which are suitable for highly difficult tasks. For e.g. AMR may be joined with robotic arm for another robot creation to deal with the warehouse packages. Hence single solutions obtained from more functionality which measure the consolidated capabilities. (Hashemi-Petroodi, Thevenin, Kovalev, & Dolgui, 2020) mentioned that the human employees are creative, flexible and intelligent and may perform at various situations with various tools. These resources combination establishes human-machine or robot (hybrid) system in which robots and humans works different tasks like automated, hybrid and manual tasks in shared workspace. In alternative to conventional reviews, operational management issues are focused with features and applications for machine/robot and human collaborative systems in manufacturing. Hence HRC systems can optimized with respect to safety, ergonomics and throughput. Reconfigurability and flexibility in hybrid systems are considered as future studies suggestions.

Fig. 7. A) MANTIS b) CHARLIE c) SHERPATT d) HERITAGEBOT - Hybrid design- Multi-legged robots with series-parallel.(Kumar et al., 2020)

In multi legged robots, parallel mechanisms and closed loop associations are highly used and for greater payload applications are particularly designed. Specific joints can be reinforced with their usage and entire leg inertia are not compromised. Fig.7.b presented the hominid robot Charlie established in 2013 presenting the Stewart platform with $type\ 6 - RUS$ as 6 degree of freedom active joint module in neck and spine. In ankle joint, it also uses parallel context. Mantis of multi-legged robot established in 2016 comprises with PKMs of $type\ 2 - SPU + 1U$ in ankle joints and some revolute joints worked by slider crank context in its torso and legs shown in fig.7.a. $The\ SherpaTT\ rover\ (2016)$, considered as wheel leg hybrid robot with active suspension used closed loop association in outer and inner leg joints. 166 kg of system weighs carries 80 kg payload shows footprint size of $1\ m2\ (1m \times 1\ m) to\ 6.76\ m2$ $(2.4\ m \times 2.4\ m)$ and in range of $0.8\ m\ to\ 1.8\ m$ the body height can be adjusted. In 2005, $ATHLETE$ has initially built which is fully tree type art with active suspension rover along with legs and on hexagonal frame it has mounted $(2.75\ wide)$ and 2m max height. 850 kg is total weight with 300 kg payload capacity. Sherpa TT rover shows good payload related with ATHELETE in respect to weight ratio and it's a outcomes of hybrid leg architecture with series-parallel in a direct way. Another hybrid robot from Cassino University named HeritageBot shows capability of legged locomotion and flying on ground. Four tripod parallel contexts used as modular leg design. In the previous the manually controlled $Menzi\ Muck\ M545$ has been used. These kind of category has come under wheel leg series-parallel hybrid robot due to their automation in future. Higher speed running capability of MIT Cheetah has been used as four bar linkage and parallelogram linkage for entire leg inertia reduction in knee joint(Kumar et al., 2020).

5. Robots used across Industries

According to (Aizat et al., 2023; Murphy, Gandudi, & Adams, 2020), robots are used by individuals and businesses which enable humans to pursue education and job which minimizes the influence of productivity on ill employees, keeps social relationships and supports living facilities and safeguarding at-risk populations. Several exciting developments in past decades in robotic grippers fields are comprising with magnetic grippers, pneumatic grippers, suction grippers, electric grippers and vacuum and Bernoulli grippers. Different grippers are mounted on agricultural robots which offers robotic grasping of agricultural products and food in the past decades. In actuator technology, AT control techniques, materials science and sensing technology, new kind of developments are made which in turn enhances the performance and function of robotic grippers. (B. Zhang, Xie, Zhou, Wang, & Zhang, 2020).

Nowadays, Industrial robotic arms are general and there exists several factories and industries which are running to build a lightweight robotic arm which shows greater payload and similarly with broad motion range. Hence if arm's payload increase, there is an increase in mechanical weight and it ended up in expensive arm(Almurib, Al-Qrimli, & Kumar, 2012). On the other hand, there are many conventional solutions provides economically attractive lightweight robots which may be moved easily from one industrial process to another based basic reprogramming as requirement if it needed. User-friendly robotic solutions are not needs workers to exhibit technical innovation on robots. For industrial robotic technology, better prospects are foreseen. New materials and energy efficiency are invited by robots use. Customized elements' faster production at competitive prizes shows better encouragement to use this technology. Certain markets are predicting the demands increasing like plastic, beverage and foods, rubber, machinery and metal industries. The electronics and electrical industries are also showing greater demands for robots. Hence all these requirements encourages as major robotized manufacturing process increment in mid and short term, for SMEs and larger companies, shows the possibility in attaining the trend competitiveness for creative robotic solutions (Grau et al., 2020; Rodríguez-Guerra, Sorrosal, Cabanes, & Calleja, 2021).

Likewise in case of agriculture, the adopted technologies advance later in industries which follow the intelligent factories ideas and establish the concept of intelligent farm. (Gonzalez-de-Santos et al., 2020) evaluates the features the agricultural robots must attains from industrial robots in achieving concept of intelligent farm focusing on functionalities and robot structures with computing, data management and communication. Outdoor farm robotics evaluates various mobile robot structures and manipulators with advanced technologies used in innovative industries with goals of advancing the robotics characteristics for intelligent farms in future. Service robots are shown beneficial according to (Holland et al., 2021) and they minimizes human error, spread of infection prevention and permits front line workers to minimize the direct contact and concentrating on their attention on greater priority works and making the isolation to prevent direct exposure. Hence these robots are highly advantageous in healthcare especially during covid-19 pandemic and highly beneficial to healthcare workers, organisations, patients and customers (Vallès-Peris, Barat-Auleda, & Domènech, 2021). In addition it is useful for patients and supplies logistics and effective cleaning process, resource quality in hospitals, remote monitoring of patients, efficiency and increase system capacity and associated with healthcare environments like (Andtfolk, Nyholm, Eide, & Fagerström, 2022) discussed about humanoid robots helps for elderly persons care.

6. Discussion and Challenges

Most of the studies and researches in robotics development recently are concentrated in making robots with more automation through higher intelligent control and enhancing sensors for the robot. Since good innovative sensors can obtain the information during difficult situation and however to handle these circumstances, robot control behaviour should be adaptable and flexible. In specific, it is considered as active field of research due to inexpensive cameras and also the details acquired are said to be highly demandable. Determinations are constantly made to build the system highly flexible and hence they can learn from people and adapting to newer situations. The human interaction and robots are also recently involves as active research areas which involve both intelligence and sensing also, but it should consider sociology and psychology of interactions. (Goel & Gupta, 2020) emphasized that human and robotics co-operation in industries may assists in taking difficult decisions in advance and it may have the capability of understanding the risks in future. Hence the researches are highly focused on the key feature of their ability in co-operatively control each other.

(Farouk, 2022) findings identified that the robots interactive behaviour related with combination of accessing information and mutual constraints solving related with it. The human-robot interaction cognitive model is said to be interactive system and can accurately mention the steps related in offering mental commands to robots. These kind of innovation and improvement must be studied in future since the process of HRI can contribute majorly in various areas like industries, medicine and agriculture. (Soljacic, Law, Chita-Tegmark, & Scheutz, 2024) emphasized that the robots may minimizes the human-human interactions and it is mentioned by several robot scientists also. The robot must be set by certain level emotional care threshold through participants and it is ambiguous and they believed that robots may not be replace human care and however they can be collaboratively perform with human service providers (Balakrishnan et al., 2023; Obrenovic, Gu, Wang, Godinic, & Jakhongirov, 2024; Prati, Peruzzini, Pellicciari, & Raffaeli, 2021).

In case of AVG implementation many challenges are seen in real world domains and applications. Pure data offers highly accurate performance with respect to AI driven methodologies. If the data is collected through mobile or sensor devices sometimes through AVG, it may be inconsistent or incomplete. Hence the pre-processing or labelling of data in AI driven methods can be manually performed. Hence intelligent model is required for refine the collected data for achieving better performance. Decision making support is essential and it is major challenge for automatic decision support system execution based on AI driven methodologies. In addition AVG results must consider the multi-objective aspects for attaining the global optimization for various domains and tasks. Hence it is said to be notable challenge for establishing the AVG based AI driven system for effective and intelligent decision making(Cupek et al., 2020).

More presence of industrial robots are seen recently in smart factories and also in large scale manufacturing specifically in versatile production processes for e.g. in SMEs since these production are categorised from customer requests as potential commitment and addressing the market demands. Both mobile agents and manipulators possibility are performing as co-ordinated way. Multi-robot co-ordination is necessary for dealing with certain well-known issues. Recently the open source project namely Robotic Operating System-ROS- Industrial has launched extends the advanced capabilities and focusing on robot behaviours which is considered as evolution of robotics based on innovative technologies across diverse fields(Grau et al., 2020).

7. Conclusion

The recent robot applications review exhibited different challenges and revealed that the recent robot implementations are not always restricted by technical obstacles. Certain application fields possess no tradition in these activities and they are food and agriculture industries and civil engineering. HRI in industrial robots and their specialised cobots are still in demand. But the non-technical factors like personal acceptance and human psychology of the robots in their working place are also reviewed. The subjective attitude of robots is discussed related with AI driven methodologies and process designs. The implementation are lacking in terms of experience and certain recent knowledge of cutting-edge attainments in robotic applications. Much automation are still restricted by AI which is associated with decision making for manipulating and grabbing, object identification and position identification. Human and robotics co-operation in industries may assists in taking difficult decisions in advance and it may have the capability of understanding the risks in future. Hence the researches are highly focused on the key feature of their ability in co-operatively control each other. On the other hand, there are many conventional solutions provides economically attractive lightweight robots which may be moved easily from one industrial process to another based basic reprogramming as requirement if it needed. User-friendly robotic solutions are not needs workers to exhibit technical innovation on robots.

As recently these robotic applications types based on AI has fewer publications and technical solutions. In addition specific industrial cases and general solutions are not yet obtained clearly. Hence the researches are needed for different robotic applications in industries based on AI driven methodologies with the accurate evidence.

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