Amanda Fernandes Pereira da Silva
(Organizadora)

ENGENHARIAS: Pesquisa, desenvolvimento e inovação 3

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Sabendo que a Atena Editora faz parte do grupo de instituições que incentivam a difusão de inovação científica, a mais nova coleção “Engenharias: Pesquisa, desenvolvimento e inovação 3” engloba pesquisa científica, aplicada, desenvolvimento experimental e inovação tecnológica. Um dos grandes desafios enfrentados atualmente nos mais diversos ramos do conhecimento, é o do saber multidisciplinar, aliando conceitos de diversas áreas.

Atualmente, é necessário que os profissionais saibam discernir e transitar conceitos e práticas levando em consideração o viés humano e técnico. Diante desse contexto, este livro traz capítulos ligados a teoria e prática em um caráter multidisciplinar, apresentando de maneira clara e lógica conceitos pertinentes aos profissionais das mais diversas áreas do saber. Os mais diversos temas estão relacionados às áreas de engenharia, como civil, materiais, mecânica, química, dentre outras, dando um viés onde se faz necessária a melhoria continua em processos, projetos e na gestão geral no setor fabril.

Esta obra se mostra como fundamental, de abordagem objetiva, para todos os âmbitos acadêmicos e pesquisadores que busquem alavancar em conhecimento. Aos autores, agradeço pela confiança e espírito de parceria.

Boa leitura.

Amanda Fernandes Pereira da Silva

SUMÁRIO

ARTIFICIAL INTELLIGENCE APPLIED IN DIFFERENT AREAS OF ROBOTICS

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ABSTRACT: Artificial intelligence is a multidisciplinary area, knowledgeable systems, one of its divisions. Which use programming techniques that emulate human behaviour. The expansion of technology, and consequently, processing capacity, significantly increased applications in different research areas, such as electrical engineering, computer science, and economics. Techniques such as deep learning from approximately 2010 onwards have grown exponentially. This work aims to present some fundamental concepts and objectively some of the main applications of artificial intelligence, or intelligent computational techniques in robotics, such as humanoid robots, swarm robotics, robotics in agriculture, among others, due to the already large and expansive universe of robotics, few areas of application were addressed. This article presents a forecast of the growth of robotics in the industry, considering autonomous robotics to be one of the pillars of industry 4.0. Despite the difficulty of forecasting in technological areas, it is intended to contribute to this direction. This work ends with a conclusion and address future investigations.
KEYWORDS: Artificial Intelligence; Autonomous Vehicle; Precision agriculture; Unmanned aerial vehicle.

1 I INTRODUCTION

For many researchers, robotics is divided into two areas: programmed robotics and intelligent robotics; in programmed robotics, if there is any change in the robot's activity, it will have to be reprogrammed. On the other hand, in autonomous robotics, the robot must learn and adapt (two premises of artificial intelligence, specifically intelligent computational systems) (Corke P. 2011).

The imitation of human behavior has always been the inspiration for intelligent robotics. In addition to currently processing decision-making capability (Hexmoor, H. 2013), (Russel S.; Norvig P. 2020) these two areas must work together in autonomous robotics, and it is currently almost impossible to separate one from the other (Siciliano, B. 2012). Furthermore, as mentioned above, autonomous robotics tends to grow in industrial applications as it is one of the pillars of industry 4.0 (Faz-Mendoza, A. *et al*, 2020).

Artificial intelligence (AI) is a division of computing bioinspired by human intelligence, one of its motivations and objectives is to design and study intelligent agents capable of dealing with the inputs of the system in which it operates, obtaining an output that meets the objectives of its designer.

According to researchers like Brooks (Brooks, R. 1986), for example. The areas of study are based on human beings, involving thought and reasoning processes, and on rationalism with a combination of mathematics and engineering measuring their behavior with the ideal concept of intelligence. Currently, the author's different AI techniques and human cognition into distinct areas allow both to develop, as in computer vision, and natural language processing, which incorporates neurophysiological evidence into computer models (Coppin B. 2004).

AI today is already present in several areas, and the trend is for it to be more used and applied in areas still unexplored with this tool. In general, robotics already works together with AI enabling applications in several areas with promising perspectives, such as agriculture (Siciliano, B. 2012), military (Brooks, R. 1986), social (e.g., the rescue of victims) (Soares, P. *et al*, 2018), games (virtual agents) (Wooldridge, M. 2009), among others.

Numerous other classes of robots benefit from AI, some are only conceivable with AI, and this pair is gaining more and more ground. With these technologies evolving more and more, the discussion and implementation of these contents in the course curricula have become advantageous and differential in research, such as the Boston Dynamics Funky Feet and the Atlas, which benefit from greater agility (Russel S.; Norvig P. 2020).

This article presents, in Section 2, the historical context of artificial intelligence and its evolution. Then, section 3 presents applications of artificial intelligence in robotics, particularly the use of robots in agriculture, due to the expansion of this area of the agricultural industry in Brazil, which is still lacking in state-of-the-art technology. Section 4, on the other hand, emphasizes robots, a priori with more difficulty and need for voice recognition systems, robotic vision, advanced control, and autonomous decision-making, with fall and stand functions, such as the Asimo, for example. In Section 5, a forecast of robotics growth in industries is presented. Moreover, finally, section 6 closes and suggests further investigations.

2 | BACKGROUND

In this section, the main concepts circumscribed to the theme will be approached to help understand this work, from the origin of artificial intelligence to its advances with machine learning and deep learning.

The first work recognized as AI was done by Warren McCulloch and Walter Pitts in 1943 (Haykin, S. S. 2009). They drew on three sources: knowledge of the basic physiology and function of neurons in the brain; formal analysis of propositional logic created by Russell and Whitehead; and Turing's theory of computation (Russel S.; Norvig P. 2020).

In its early years, it generated enthusiasm in the scientific community, but it still had the limitations of computers and programming tools. This fact led to frustration, as the first developed systems failed when they were tried on larger problem sets or more complex problems.

In the mid-1980s, at least four different groups reinvented the backward programming learning algorithm, first discovered in 1969 by Bryson and Ho. As a result, the algorithm was applied to many problems, causing great excitement, and marking its research and development return. Currently, AI is applied in the most varied areas, from learning and perception to specific tasks, such as games, demonstrating mathematical theorems, creating poetry, driving an autonomous vehicle on busy roads, and diagnosing diseases such as covid-19, for example (Roy S. *et al*. 2020).

Machine Learning (ML), one of the divisions of intelligent computational systems that is a division of AI, gives the system the ability to learn and improve its performance based on experience and knowledge about the task it performs, without the need to be explicitly programmed, in this example used to make complex decisions in negotiations (Aydoğan, R. et al, 2018).

This tool, combined with robotics, allows the robot to become an expert in its performance. With this, the ML is an excellent ally of robotics.

With the computational expansion in the early 2000s, due to Big Data and parallel programming in GPUs (Graphics Processing Unit or Graphics Processing Unit), the market saw a growth in computational techniques. This enabled deep learning (Deep Learning) as the essential and promissory mechanism for building Artificial Intelligence systems.

Inserted in ML, Deep Learning (DL), in a simplistic view, consists of an Artificial Neural Network (ANN) with several hidden layers, which makes possible other training algorithms different from the conventional ones for simpler ANNs. Some authors say that there is already a DL structure with more than ten layers hidden in an ANN (Haykin, S. S. 2009). DL has successfully increased image recognition, speech, pattern, and structure recognition applications, enabling numerous applications and applications in conjunction with robotics (Brooks, R. 1986).

It is essential to emphasize predictions of a computational superintelligence by Rodney Brooks that will be equivalent to or surpass human intelligence in a few decades. This context, among other technological advances, can be seen in the work of Zhang and collaborators (Roy S. *et al*. 2020), which, in addition to superintelligence, addresses the advancement of the internet of things IoT to the super internet of things, the need for a sixth generation of communication speed and the promising area of machine learning, such as deep learning for example.

3 I APPLICATIONS

There are numerous areas in which Artificial Intelligence can be applied, and with technological development, its applications in robotics are increasingly present. Some examples of virtual robots are used in military applications to create prototypes that help in fields such as cartography, communications, and battlefield advising, assisting people, and space exploration, such as the Rover, swarm robotics. Some of these application examples will be presented, emphasizing humanoid robots, among others, such as agricultural applications due to the strong development of the agricultural industry in Brazil.

3.1 Robotics competitions

There are different types of robotic competitions, even challenges between robots. The Defense Advanced Research Projects Agency DARPA is a US Department of Defense research and development agency that promotes emerging technologies, particularly for military use (Faz-Mendoza, A. *et al*, 2020).

Figure 1: The Robot Thor, from DARPA challenge.

Source: Boston Dynamics.

Recently, a steelmaker, “Vale do Rio Doce, in portuguese”, in Brazil, made available a real, inhospitable problem (causes fire) to inspect its conveyor belts. The competition was through simulated experiments.

For example, virtual robots will autonomously inspect a kilometer of treadmills. It is noteworthy that it was the first competition promoted in Brazil and the results are not yet A it is believed that in the not-too-distant future they were promising. In Figure 1, an example of a DARPA challenge, the robot Thor.

3.2 Rescue operations robots

The main challenge of disasters is response time: survival rates drop significantly after 48 hours. Therefore, first responders need to move as quickly as possible, avoiding static and dynamic obstacles, and cover the most expansive area to reach all potential victims to save their lives. An emerging alternative to human first responders is emerging in disaster rescue robots or search and rescue (Aydoğan, R. et al, 2018).

B&S tasks need to deal with scenario exploration and require the determination of all victims’ locations without jeopardizing the rescuers’ lives. These restrictions make B&S challenging tasks for human beings, and a possible solution to the disadvantage is the use of robot systems, in particular SMR (O’Grady R. *et al*, 2011). However, RD robots have not been widely adopted due to their relative newness, but that landscape is changing as technology evolves. As of 2012, they have been used in approximately 30 disasters in six countries, mainly in mining and structural construction collapses (Hexmoor, H. 2013).

Several papers addressed exploration and B&S objectives using swarm based SMR. The article (O'Grady R. *et al*, 2011) presents a behavior-based swarm of robots to perform B&S operations in unfamiliar environments. Unlike this work, the stopping criterion for simulations is a fixed number of steps, and a selected leader dynamically guides the swarm. Robots are controlled with fuzzy logic.

3.3 Spatial exploration robots

Robots employed in space exploration are examples of the importance of autonomous robotics. Explorations over very long distances, such as Mars, are clear instances of this need. Although robots at this distance in current technology cannot be manned and cannot be steered, a signal from a sensor would take, and a control action would take approximately 8 minutes to reach land. Therefore, it makes the controllability principle unfeasible, in other words, possible with a delay of more than 15 minutes. In other words, a robot that performs maneuvers without human intervention is unfeasible (Mendonça, M. *et al*, 2019). An example is shown in Figure 2.

Figure 2: Perseverance, NASA.

Source: NASA.

3.4 Swarm robotics

Swarm robotics uses swarm intelligence concepts inspired by natural phenomena such as collective behaviors seen in social insects, fish, birds, and bats (Rizk, Y.; Awad, M.; Tunstel, E. W. 2018). A common characteristic of intelligent behaviors is producing something orderly, unlikely to occur, and presenting unpredictable results (Beni G. 2005). The primary motivation for employing swarm intelligence techniques, such as swarm robotics, is their ability to solve problems typically challenging for conventional computational techniques (Li, X.; Clerc, M. 2019).

In this sense, swarm robotics can be defined as the study of how a large group of relatively simple agents (robots) in hardware can be built to perform tasks that are beyond the capabilities of a single agent (Şahin, E. 2005). Thus, there is a need to use a swarm of robots only if the desired tasks can be performed at the team level or if completion time is a determining factor for achieving the objectives. In other words, increasing the number of robots in a group can significantly reduce the time to complete these tasks (Khamis, A.; Hussein, A.; Elmogy, A. 2014).

Using swarm robotics has three main benefits. The first is robustness; that is, the loss of some robots will not cause system failures and will not interrupt the execution of the proposed tasks (Şahin, E. 2005).

The second benefit is flexibility, as the hardware for these robots is not necessarily customized for a particular task. By cooperating and grouping differently, the swarm of robots can also perform other tasks, whereas a complex robot would need a reconfiguration or reformulation of its structure. Finally, there is scalability. A robotic swarm algorithm can be applied unchanged to a group of any reasonable size due to its dependence on local information alone. Any global communication would prohibit scalability and is avoided in this type of system (Hamman, H. 2010).

Although a swarm of robots (exemplified in Figure 3 (McLurkin, J. 2019) does not have centralized control, the swarm (or population) level system reveals remarkable complex and self-organizing behaviors, often because of local interactions between individuals in the swarm. and individuals with the environment, based on simplistic interaction rules (Li, X.; Clerc, M. 2019). In general, one of the relevant characteristics for multirobot systems employing SWARM ROBOTICS is the use of a massive number of robots, in some cases tens of hundreds or thousands of robots, as can be seen in the Figure 3.

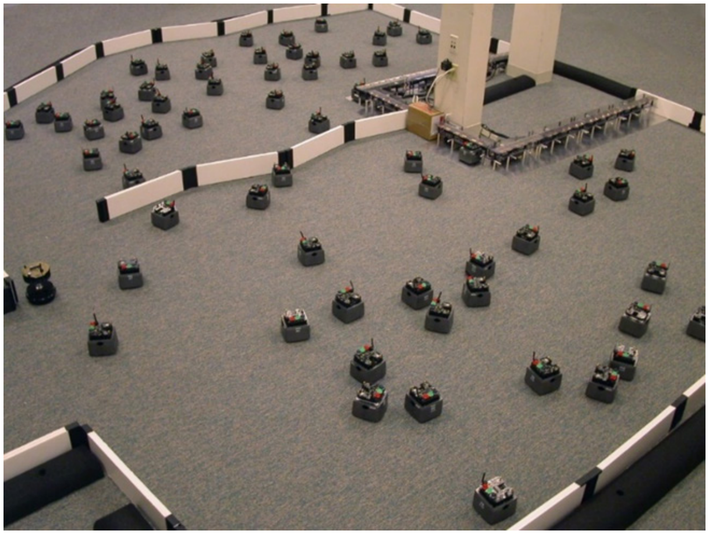

Figure 3: Swarm Robotics example.

Source: Peter Corke, 2011.

The robots in a swarm can exhibit different behaviors, such as grouping, chaining, searching, aggregating, and foraging. These behaviors are classified as collective, cooperative, collaborative, and coordinating. Perhaps the simplest type of interaction is collective, in which entities do not know other entities on the team, but share objectives, and their actions are beneficial to other team agents. In cooperative interaction, agents also share goals, and their actions are beneficial to other agents. However, they are aware of the other entities present in the group. An example of this type of interaction is several robots working together to perform a joint task such as pushing a box (Parker, L. E. 2008).

Collaborative interaction is characterized by agents that help each other to achieve their individual but compatible goals. It occurs when robots have individual goals, are aware of others on the team, and their actions help to complete the goals of others. Finally, there is the coordinating interaction. In it, entities are aware of each other but do not share a common goal, and their actions are not helpful to other team members. In multi-robot systems, these situations often occur when robots share a shared workspace. Therefore, robots must work to coordinate their actions to minimize the amount of interference between them and other robots (Parker, L. E. 2008).

Another inherent aspect of swarm robotics is movement coordination. It can only be related to other robots, the environment, external agents, and combinations (Din, A. et al, 2018), (Siciliano B.; Khatib, O. Eds, 2016). Furthermore, swarm robotics systems can be homogeneous or heterogeneous. Heterogeneous systems consist of robots with different designs or functionalities that generally complement each other to efficiently complete tasks (Barca J. C.; Sekercioglu, Y. A., 2013). An example is given by aerial robots looking for ground targets to be rescued by ground robots. However, heterogeneous swarms are avoided by the academic community. Instead, most research presents robots with the same design and functionality to fulfill the desired tasks (Barca J. C.; Sekercioglu, Y. A., 2013).

Among the main areas of application of swarm robotics is the operation in environments harmful to human beings, such as search and rescue of victims and environment mapping (Soares, P. *et al*, 2018), (Bakhshipour, M.; Ghadi, M. J.; Namdari, F. 2017), (O'Grady R. 2011), but it can also encompass games [29] (Daylamani-Zad, D.; Graham, L. B.; Paraskevopoulos, I. T. 2017) and other areas of knowledge (Bayindir, L. 2016).

3.5 Precision agriculture

Due to this, new technologies and methods have been used to contribute to the increase in production, mainly on a large scale. Thus, to increase cost-effectiveness and to combine production and quality with good management of natural resources and, in this way, reduce environmental impacts (McLurkin, J. 2019).

From the inclusion of technologies such as advanced detection and robotics, using new machines, drones, and equipment for precision agriculture, artificial intelligence in agriculture is a strong ally for sustainable, faster, and more profitable production.

Among the benefits of precision farming is better to crop management through surveys. Through robotic devices, sensor data and captured images have been widely studied to obtain information remotely.

Figure 4: Unmanned Aerial Vehicles (UAVs).

Fonte: Zhang, 2019

In this context, Unmanned Aerial Vehicles (UAVs), shown in Figure 4, develop a new paradigm for image acquisition of culture. Through its use, it is possible to provide spatial resolutions in the order of centimeters, in addition to a temporal resolution, programmed as a function of the time, day, and time conditions of identification and quantification of weed species that are difficult to control. In general, agricultural UAV flight path planning based on the traditional method it easy to reach a local minimum point in a semi unknown or unknown environment (Zhang, L.; Liang, Y. C.; Niyato, D. 2019).

3.6 Autonomous vehicles applied in agriculture

Food security concerns have increased dramatically in recent years. The growth of the human population, together with the reduction of agricultural resources, has caused many governments and international conglomerates worldwide to look for new ways to improve the efficiency of agriculture.

The development of autonomous vehicles with artificial intelligence is a strong trend in the sector due to its ability to identify failures and threats from analyzed patterns. For example, an unmanned ground vehicle can also accurately dosing pesticide in a crop without any direct human interference.

Guided by GPS and other sensors, this equipment reduced the workload in the stages of cultivation, from planting to harvest, and increasing the accuracy and regularity of the results obtained.

VineRobot, an autonomous mobile farming robot designed to aid production and wine agriculture by the Seventh Framework Programme, which is sponsored by the European Union (EU). Figure 5 shows an example of these autonomous robots used in agriculture.

Figure 5: VineRobot.

Fonte: European Union

3.7 Humanoid robots

Humanoid robots are characterized by having abilities that emulate human behaviour, such as vision with image recognition, ability to move around different degrees of freedom (DOF - Degree of Freedom), among other skills. Some reach 35 DOF and the ability to compensate for inertia from the movements of the robot's functional members. In turn, humanoids are robots with complex characteristics, such as movement guided by artificial vision, interaction with the environment, identification of the movement itself, self-protective reflexes, strategies for picking up objects that do not have geometric modelling, planning trajectories in time real among others. An example of the related complexity in developing humanoid robots. Specifically, we can cite works that address such features.

The work (Mendonça M. *et al*, 2020), more recently, to accurately recognize the working targets in complex environments, an industrial robot vision model based on attention mechanism and deep learning is proposed in (1). The model uses an improved attention mechanism to quickly focus on the target and employs a 10-layer convolutional neural network that combines local connection with full connection to accomplish target recognition. The effects of different convolutional neural network structure parameters on the model are analyzed to satisfy the rapidity and reliability of robot vision. The test results show that the combination of improved attention mechanism and CNN model can achieve fast focusing and accurate recognition.

The work (Mendonça, M. *et al*, 2019) presents an approach using a vision system to predict the velocities of objects in the scene, allowing ASIMO to navigate autonomously through a dynamic environment safely. ASIMO abilities, neither obstacle positions nor velocities are known at the start of the trial but are estimated online as the robot walks. The planner constantly adjusts the footstep path with the latest estimates of ASIMO's position and the obstacle trajectories, allowing the robot to circumnavigate the moving obstacles successfully. Already work (Rizk, Y.; Awad,M.; Tunstel, E. W. 2018) Humanoid robots are characterized by having abilities that emulate human behavior such as vision with image recognition, ability to move around different degrees of freedom (DOF - Degree of Freedom), among other skills. Some reach 35 DOF and the ability to compensate for inertia from the movements of the robot's functional members. In turn, humanoids are robots with complex characteristics, such as movement guided by artificial vision, interaction with the environment, identification of the movement itself, self-protective reflexes, strategies for picking up objects that do not have geometric modeling, planning trajectories in time real among others.

An example of the related complexity in developing humanoid robots. Specifically, we can cite works that address such features. The work (Beni G. 2005) the authors review the state-of-the-art analysis in the field of object recognition in an image based on deep convolutional neural networks, with the purpose of solving the task of navigation of a mobile robot presenting a review to assess the possibility of applying some intelligent based approaches. neural network that combines local connection with full connection to accomplish target recognition. The effects of different convolutional neural network structure parameters on the model are analyzed to satisfy the rapidity and reliability of robot vision. The test results show that the combination of improved attention mechanism and CNN model can achieve fast focusing and accurate recognition. Other relevant work (Li, X.; Clerc, M. 2019) the authors consider a neural network approach to early motor learning. The primary purpose is to explore the need for bootstrapping the control of hand movements in a biologically plausible learning scenario. The model is applied to control hand postures of the humanoid robot ASIMO using complete upper body movements. It is demonstrated that the network can acquire accurate inverse models for the highly redundant ASIMO, applying bi-manual target motions and exploiting all upper body degrees of freedom. Authors also succeed in reproducing natural motion recorded from a human demonstrator, massively differing from the training data in range and dynamics.

The article (Şahin, E. 2005) author present an integrative approach to solve the coupled problem of reaching and grasping an object in a cluttered environment with a humanoid robot ASIMO. The authors also employed the concept of task maps representing the manifold of feasible grasps for an object. Rather than defining a single end-effector goal position, a task map defines a goal hypervolume in the task space using the Random Tree algorithm. Finally, the approach is demonstrated in two reach-grasp simulation scenarios with the humanoid robot. Moreover, finally, in the work (Şahin, E. 2005) the author review the state-of-the-art analysis in the field of object recognition in an image based on deep convolutional neural networks to solve the task of navigation of a mobile robot, presenting a review to assess the possibility of applying some intelligent based approaches.

Currently, robotics research and applications are growing on the world stage. Some applications, products, and research are carried out by large companies, universities, institutes, and Government Agencies, such as Boston Dynamics (BD), Honda, Massachusetts Institute of Technology (MIT), NASA, Sony, and Honda. Some of the sample features of these products follow from that research.

In continuation, some examples of some of the most known humanoid supplements use the functionalities mentioned above.

3.7.1 COG

The COG autonomous robot developed by Brooks more than 15 years ago has already shown two essential concepts of artificial intelligence, learning ability, and adaptation in this famous image of one of the demonstrations of this robot that uses robotic vision and intelligent computer systems. This robot can learn to handle a spring without prior knowledge. Thus, the COP demonstrated learning and adaptability with the difficulty that its actuator is not similar to a human hand (Suleiman W. *et al*, 2011). In one of the several videos that MIT makes available, the COG learns to reproduce a maneuver with a plastic spring just by watching Rodney Brooks.

Figure 6: COG, MIT.

Source: MIT.

3.7.2 Asimo

The Asimo robot (Figure 7) is developed by the Japanese company Honda Motors Co. Its name means: A for Advanced; S of Step in (Step); I for Innovative (Innovation); Mobility MO (Mobility) corresponds to "Advanced Step of Innovation and Mobility". Asimo has functions to work both in homes and companies, and it is autonomous, able to converse with one or more people, recognize faces, communicate in Japanese Sign Language (JSL), or Japanese Sign Language, walk with people carrying them to a specific location, interact with objects and guide transport carts (Sugiura, H. *et al*, 2006). Reacts in emergencies such as fighting fires and exposure to toxic substances can fall and get up. The only bias of this robot is its high acquisition cost, and because of that, it is more used by companies

Figure 7: ASIMO, Honda Motors Co.

Source: Honda Motors Co.

3.7.3 NAO

Developed by the French company Aldebaran Robotics, NAO is an autonomous robot (Figure 8), communicates with verbal and non-verbal language, reads newspapers, accesses the internet, interacts with objects, and provides help in case of emergency. In addition to the elderly public, it also works as a therapy for autistic children and hospitalized children. Several universities around the world widely use it for research development (Sugiura, H. *et al*, 2006).

Figure 8: NAO, Aldebaran Robotics.

Source: Aldebaran Robotics.

3.7.4 Valkyrie (Nasa)

The Valkyrie robot (Figure 9), or R5, is a humanoid robot developed by NASA. The robot was designed and built by Johnson Space Center to participate in the DARPA Robotics Challenge (DRC) in 2013.

The robot weighs about 140 kg, is 44 degrees of freedom, 1.88 m tall. Its power is done either by cable or by battery. The batteries have an energy of 1.8 kWh.

The robot was used in the simulation of the Space Robotics Challenge.

Compared to other robots, it has feminine curves and is covered with a “cloak” made of foam, which gives it a less metallic look and is also protected against shocks.

Figure 9: Valkyrie, NASA

Source: NASA.

4 I ROBOTICS’ AREA TRENDS PREDICITON

Prediction of time series is challenging, especially when working with long sequences, multi-step forecasts, and multiple input and output variables. What is intended in this section is through data from the IFR (International Robotics Federation) to estimate the growth of robotics or try to trace at least a trend in the coming years. For example, a philosophical question of AI is in the following question. Someday computers may be more intelligent than humans. Some experiments have already shown that AI can stand up to human capacity. For example, the famous confrontation between a deep blue from IBM and Gasparov (greatest chess player in the world). Nevertheless, we can argue it was only for a specific chess game.

However, Rodney Brooks, MIT researcher and robotics and creator of the subsumption architecture in a recent lecture on AI and Robotics, said that in the next 5 or 10 years, the concept of computational superintelligence would emerge, in which it should be as capable or more capable than humans. Deep learning theory already suggests that it is currently possible to deal with a massive amount of data and mitigate the designer's intervention in the analysis of results. That said, some variables will be difficult to control, such as what will be the computing capacity in the next five years.

As Artificial Neural Networks, Multilayer Perceptrons, or MLPs, can be used to model univariate time series prediction problems. Before a univariate series can be modeled, it must be prepared. The MLP model will learn a function that maps a sequence of sources passed as inputs to an output observation. As such, the desired sequence must be transformed into several examples from which the model can learn (Haykin, S. S. 2009).

The dataset used to make the predictions covers the annual number of sales for 22 years, between 2000 and 2021. The first sixteen years will be used for training the neural network, the rest of the data will be used for testing the network. Finally, the models will be developed using the training and training dataset in the test dataset.

The MLP model used has 100 (one hundred) hidden nodes layer and an output layer used to predict. The model was used using Adam's learning algorithm and optimized using a mean squared error, or "mse", loss function. The model expects the input shape to be two-dimensions. Therefore, we must remodel the single input sample before making the prediction, for example, with the form [1, 3] for 1 sample and 3-time steps as inputs resources. Data and initial data were taken from liveuniversity.com/ebusiness.

Figure 10, based on the cited information about time series using ANN, shows a growing trend in industrial robotics. Predictions in technological areas are always challenging due to the number of unmanipulated variables and some stochastic factors (Sánchez-Sánchez, P. A.; García-González, J. R.; Coronell, L. H. P. 2020).

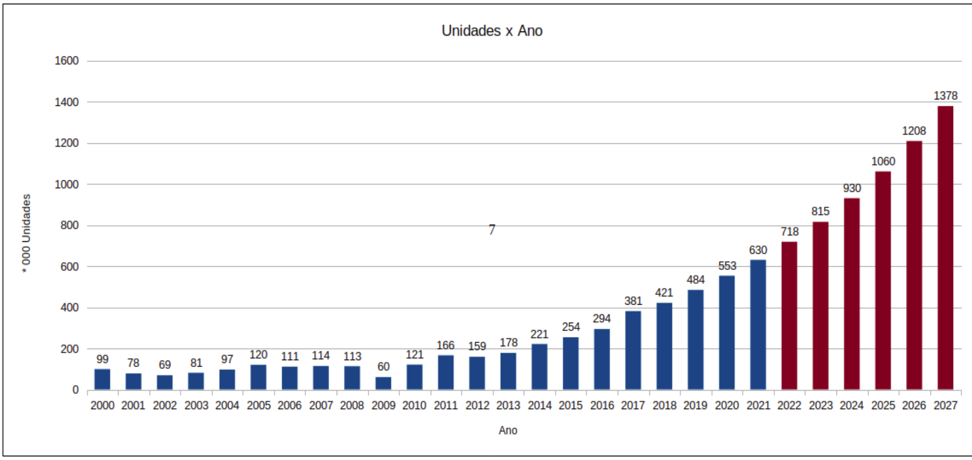

Figure 10: Growing trend in industrial robotic.

Source: Sánchez-Sánchez. P. A. *et al*, 2020.

5 I CONCLUSIONS AND FUTURE WORKS

This article had as its primary objective to show how artificial intelligence (AI) applied in robotics is increasingly expanding and being noticed, along with the technological evolution taking place all over the world. As a result, we are experiencing the fourth industrial revolution that brought a new paradigm where the evolution of technology, associated with the generation of information value, brought about a new economic concept.

Companies have bet on new technologies and digital transformation to insert artificial intelligence into their products and services. In this way, it is possible to achieve that it will be increasingly common to help these applications in our daily lives, not to take care of the functions performed by people, but rather to help and improve efficiency, regardless of the area, always looking for the union of human and machine.

It is up to engineers and scientists as data considerations, ethical about these advances, weighing their negative and positive impacts, fostering research and knowledge of these technologies to deconstruct the fear of a future with ultra-intelligent machines capable of surpassing the human being.

It is expected with the contributions of the research carried out, that the results indicate the convenience and number of potential applications to be developed, such as intelligent harvesters and autonomous vehicles that can transmit the plantation to identify the ripe fruits and weeds, ruling out any irregularity and performing the control without the use of pesticides.

Future works address AI research in robotics, The inclusion of analysis in new application areas due to the size and growing universe of robotics.

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