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The Future of Robotics Technology

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Abstract: In the last decade the robotics industry has created millions of additional jobs led by consumer electronics and the electric vehicle industry, and by 2020, robotics will be a $100 billion worth industry, as big as the tourism industry.. For example, the rehabilitation robot market has grown 10 times between 2010 and 2016, thanks to advancements in rehab/therapy robots, active prostheses, exoskeletons, and wearable robotics. In short, the very next decade robotics will become vital components in a number of applications and robots paired with AI will be able to perform complex actions that are capable of learning from humans, driving the intelligent automation phenomenon. Therefore, in this paper we try to depict the direction and the fields of application of such important sector of future markets, and scientific research.

I. INTRODUCTION

Most certainly, in near future, and as for biological systems, Robotics will be submitted to a selective pressure under which most of its branches and authors will change All of that will happen because of several factors: the enormous costs of production and maintenance of such machines; because of the ecosystemic and energetic costs of the robots, which are similar if not higher than any other machine; likely due to the saturation of an already seemingly fragile market. Because of that, it is quite important to try to predict the future of intelligent machines in order to focus one's efforts on the appropriate field

Robotics is the engineering branch that deals with the conception, design, construction, operation, application, and usage of robots. Digging a little deeper, we see that robots are defined as an automatically operated machine that carries out a series of actions independently and does the work usually accomplished by a human. In the beginning of the millennium indeed, scientists and enterprises started to apply the binomial Robot/AI to almost all of the possible domains with the "naïve" conception that the emerging technologies could have dealt with any task. Given that, it happens that the number of artefacts - that we call Robots - has been exploited to such a number that both the scientific and the business markets cannot actually absorb and, as a consequence, we are about to face a phase in which selection will become necessary. Therefore, let's now see which are the largest and maybe more promising fields, trying to distinguish their domain of competences with their domains of application, since the two things that are not necessarily the same.

II. ROBOTICS FIELDS

At the moment being, the number of robotics fields is nearly uncatchable, since robot technology is being applied in so many domains that nobody is able to know how many and which they are. Such an exponential growth cannot be fully tracked and we will try to identify and discuss upon the most evident fields of application, which, as far as we, comprehend are:

1) *Healthcare Robotics:* Robotics used in the context of patient monitoring/evaluation, medical supplies delivery, and assisting healthcare professionals in unique capacities as well as, Collaborative robots and robotics used for Prevention.
2) *Medical and Surgery Robotics:* Devices used in hospitals mostly for assisting surgery since they allow great precision and minimal invasive procedures.
3) *Body-machine Interfaces:* help amputees to feed-forward controls that detect their will to move and also receive sensorial feedback that converts digital readings to feelings .
4) *Industrial:* Arms, grippers and all of the warehouse robotics used for automation of industrial processes. They are used both for saving manoey and speed up the productions
5) *Housekeeping:* Floors, Gardens Pools and all the Robot Cleaners .
6) *Military Robotics:* Drones, Navigators, Researchers, Warriors and all of the possible robotics extensions which are to be applied in spying operations and battle field.
7) *Underwater, Flying and Self -Driving Machines:* All the Robotics that deals with self-piloting in all circumstances, on earth, air and water .
8) *Space Robots:* All of the Robotics used in Space missions, therefore highly resistant, expert in exploration and material data collection.
9) *Entertainment:* Toys, Games and Interactive Robotics for children
10) *Art:* Most creative robotics, which don't aim at a specific functionality but follows criteria of beauty and conceptual inspiration

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III. ANALYSIS

Let us now look at all of these branches distinguishing them on two different scales. Robotics that mainly belongs to the research domain from those that aim at application, therefore, market oriented. Fields that are proficient and uprising from those that seem declining or apparently stuck in a bottle neck.

1) *The Market:* Looking at the market, the richest applications are those that belong to industrial robotics, where automation of processes is requiring more and more clever and fast robots for assembling any kind of product. No comparison, this is and apparently will be the most important robotics field for quite a while, at least. Following that, there are at least few very promising fields, Entertainment, Medical, Surgery and Housekeeping Robotics. With a completely different philosophy – few expensive vs. lots of cheap sells - they established themselves into the market in a quite persistent way. Nevertheless, even if those market slices are not saturated yet, we would say they are getting close to it, leaving little space for future improvement. We cannot say the same for Industrial Robotic
2) *The Research:* At the moment, researchers are keen on a set of fields that are very interesting under the scientific point of view but, oppositely, pretty poor as market chances. They are Humanoids, Telepresence, Swarm, Microbots, Robotic Networks, Modular Robotics, and BodyMachine Interfaces. Such fields are crucial for basicresearch and, probably, something exceptional will come out of all these investigations, but for the moment being, we can't foresee a single reasonably profitable application from all of them. On the contrary, Underwater, Self -Driving Machines and, in particular, Flying Robots (e.g. Amazon's Drones, etc.) are moving towards a promising number of vends and who's impact can be more than consistent in the next decade
3) *The Exceptions:* An odd man out seems to be both Space and Military Robotics. For these two quite rich fields - where the concept of research and application tend to melt – there is still a large margin of exploration and exploitation. Of course, besides any further consideration, both Space and Military application can be considered, under the economical point of view, self-sustaining since they both produce and consume for their own market.
4) *The Upcoming:* There are few promising fields of robotics for the early future. They are Exoskeletons, Wearable Robotics, Healthcare and Collaborative Robotics. There is, indeed, a flow of investments both from Medical and Fashion Houses that are trying to sustain the research in these fields. Investments are motivated by marketing reasons and, sometime, by a real intent of generating a new trend in their consumers market.
5) *Out of Trend:* In its short history, Robotics is already producing leftovers. Indeed, few branches of past pretty popular Robotics are getting out of trend. They are Humanoids, Geminoids, Cyborgs, etc. Their appeal and impact on the public (and on a big slice of researchers) seems to be fading away, as if both the experimentation and the public imaginary had been saturated.
6) *Innovations:* At the moment, the most innovative branch is Environmental and Alternately Powered Robotics that is attracting interests from different Institutes and Industries. Anyway, few are the existing application (i.e.: toys, navigation, etc.) and they do not represent a valuable set by which we could evaluate their effective potentialities. Nevertheless, they theoretically represent a quite important goal since a big obstacle in this machine-driven society is around the energy costs, and renewable energies in Robotics, as in all other applications seems to be the unique answer.

IV. A WORD ABOUT ROBOT SOFTWARE

Software robots are computer programs that perform tasks without human intervention, such as web crawlers or chatbolts. These robots are entirely virtual and not considered actual robots since they have no physical characteristics. This technology shouldn't be confused with robotic software loaded into a robot and determines its programming. However, it's normal to experience overlap between the two entities since, in both cases, the software is helping the entity (robot or computer program) perform its functions independent of human interaction.

V. THE FUTURE OF ROBOTICS AND ROBOTS

Thanks to improved sensor technology and more remarkable advances in Machine Learning and Artificial Intelligence, robots will keep moving from mere rote machines to collaborators with cognitive functions. These advances, and other associated fields, are enjoying an upwards trajectory, and robotics will significantly benefit from these strides.

We can expect to see more significant numbers of increasingly sophisticated robots incorporated into more areas of life, working with humans. Contrary to dystopian-minded prophets of doom, these improved robots will not replace workers. Industries rise and fall, and some become obsolete in the face of new technologies, bringing new opportunities for employment and education.

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That's the case with robots. Perhaps there will be fewer human workers welding automobile frames, but there will be a greater need for skilled technicians to program, maintain, and repair the machines. In many cases, this means that employees could receive valuable in-house training and upskilling, giving them a set of skills that could apply to robot programming and maintenance and other fields and industries.

VI. THE FUTURE OF ROBOTICS: HOW ROBOTS WILL CHANGE THE WORLD

Robots will increase economic growth and productivity and create new career opportunities for many people worldwide. However, there are still warnings out there about massive job losses, But thanks to the consistent levels of precision that robots offer, we can look forward to robots handling more of the burdensome, redundant manual labor tasks, making transportation work more efficiently, improving healthcare, and freeing people to improve themselves. But, of course, time will tell how this all works out.

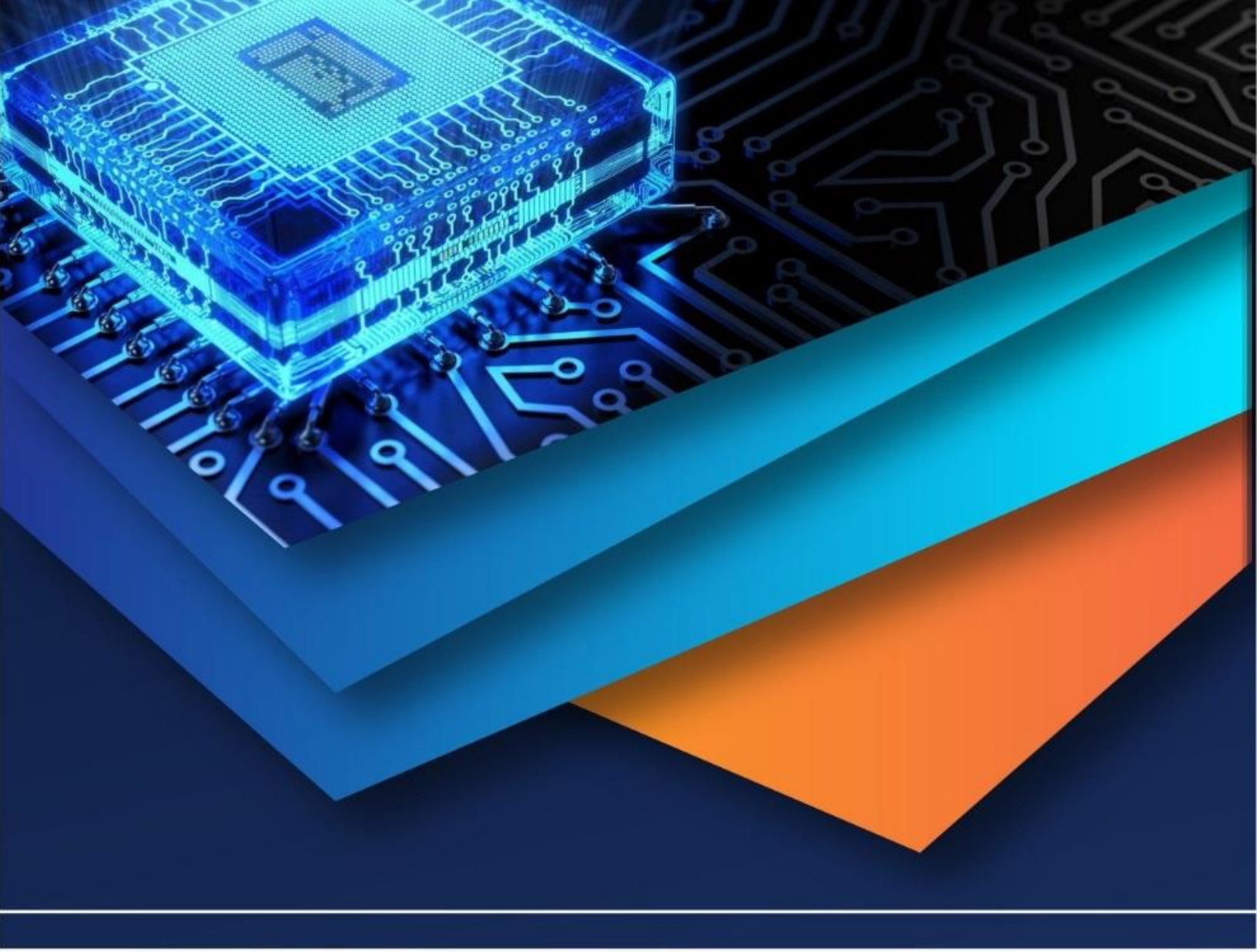
VII. CONCLUSIONS

In the last two decades Robotics has literally exploded, both in terms of research and applications. It has invaded the people's imaginary and almost all of the existing markets, up to the point that, on one side, we can spot at robotics news each single day and, on the other, Robotics is about to reach a market slice of 100 Billions dollars. In this paper we tried to summarize and analyse which are the most profitable and promising branches and where to look for new horizons. It appears that Industries' Automation is the leader of such a world while a number of applications are consolidating themselves or about to emerge and to play a consistent role in Robotics research and production. They are Healthcare, Surgery, Housekeeping, Autonomous Vehicles and, in part, Entertainment. We also underlined which are the branches that seem to lose affection of markets and researches, as for example Humanoids, and those who are gaining interests, as for example Alternately Powered Robotics. It is our belief that our analysis can provide a wider view on the world of Robotics and how to approach it in the early future.

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