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Research Paper

ARTIFICIAL INTELLIGENCE (Biologically Inspired Intelligent Robots using Artificial Intelligence)

Engineering

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MAMIDI SAI AKASH 12TH STANDARD, FIITJEE Jr.COLLEGE, HYDERABAD, TELANGANA STATE, INDIA

ABSTRACT

Artificial Intelligence is a branch of Science which deals with helping machines finds solutions to complex problems in a more human-like fashion. This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way. A more or less flexible or efficient approach can be taken depending on the requirements established, which influences how artificial the intelligent behavior appears .Humans throughout history have always sought to mimic the appearance, mobility, functionality, intelligent operation, and thinking process of biological creatures. This field of biologically inspired technology, having the moniker biometrics, has evolved from making static copies of human and animals in the form of statues to the emergence of robots that operate with realistic appearance and behavior. This paper covers the current state-of-the-art and challenges to making biomimetic robots using artificial muscles.

Introduction:

AI is generally associated with *Computer Science*, but it has many important links with other fields such as *Math's*, *Psychology*, *Cognition*, *Biology* and *Philosophy*, among many others. Our ability to combine knowledge from all these fields will ultimately benefit our progress in the quest of creating an intelligent artificial being.

Why Artificial Intelligence?

Motivation...

Computers are fundamentally well suited to performing mechanical computations, using fixed programmed rules. This allows artificial machines to perform simple monotonous tasks efficiently and reliably, which humans are ill-suited to. For more complex problems, things get more difficult... Unlike humans, computers have trouble understanding specific situations, and adapting to new situations. Artificial Intelligence aims to improve machine behavior in tackling such complex tasks.

When will Computers become truly intelligent?

Limitations...

To date, all the traits of human intelligence have not been captured and applied together to spawn an intelligent artificial creature. Currently, Artificial Intelligence rather seems to focus on lucrative domain specific applications, which do not necessarily require the full extent of AI capabilities. Researchers know this limit of machine intelligence as narrow intelligence. There is little doubt among the community that artificial machines will be capable of intelligent thought in the near future. It's just a question of what and when. The machines may be pure silicon, quantum computers or hybrid combinations of manufactured components and neural tissue. As for the date, expect great things to happen within this century!

How does AI work?

Technology...

There are many different approaches to Artificial Intelligence, none of which are either completely right or wrong. Some are obviously more suited than others in some cases, but any working alternative can be defended. Over the years, trends have emerged based on the state of mind of influential researchers, funding opportunities as well as available computer hardware.

Over the past five decades, AI research has mostly been focusing on solving specific problems. Numerous solutions have been devised and improved to do so efficiently and reliably. This explains why the field of Artificial Intelligence is split into many branches, ranging from *Pattern Recognition* to *Artificial Life*, including *Evolutionary Computation* and *Planning*.

Artificial life through robotics:

Laws of Robotics:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first or second law.

Robotics has been an evolution of the field of automation where there was a desire to emulate biologically inspired characteristics of manipulation and mobility. In recent years, significant advances have been made in robotics, artificial intelligence and others fields allowing to make sophisticate biologically inspired robots [Bar-Cohen and Brea zeal]. Using these advances, scientists and engineers are increasingly reverse engineering many animals' performance characteristics. Biologically inspired robotics is a subset of the interdisciplinary field of biomimetics. Technology progress resulted in machines that can recognize facial expressions, understand speech, and perform mobility very similar to living creatures including walking, hopping, and swimming. Further, advances in polymer sciences led to the emergence of artificial muscles using Electro active Polymer (EAP) materials that show functional characteristics remarkably similar to biological muscles. Making creatures that behave like the biological model is a standard procedure for the animatronics industry that is quite well graphically animates the appearance and behavior of such creatures. However, engineering such biomimetic intelligent creatures as realistic robots is still challenge due to the need to physical and technological constraints.

Artificial Muscles:

Muscles are the key to the mobility and manipulation capability of biological creatures and when creating biomimetic it is essential to create actuators that emulate muscles. The potential to make such actuators is increasingly becoming feasible with the emergence of the electro active polymers (EAP), which are also known as artificial muscles [Bar-Cohen, 2001]. These materials have functional similarities to biological muscles, including resilience, damage tolerance, and large actuation strains. Moreover, these materials can be used to make mechanical devices with no traditional components like gears, and bearings, which are responsible to their high costs, weight and premature failures. The large displacement that can be obtained with EAP using low mass, low power and, in some of these materials also low voltage, makes them attractive actuators. The capability of EAPs to emulate muscles offers robotic capabilities that have been in the realm of science fiction when relying on existing actuators.

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FIGURE 1: A graphic illustration of the grand challenge for the development of EAP actuated robotics – an arm wrestling match against human.

Unfortunately, the EAP materials that have been developed so far are still exhibiting low conversion efficiency, are not robust, and there are no standard commercial materials available for consideration in practical applications. In order to be able to take these materials from the development phase to application as effective actuators, there is a need for an established infrastructure. For this purpose, it is necessary to develop comprehensive understanding of EAP materials' behavior, as well as effective processing, shaping and characterization techniques. The technology of artificial muscles is still in its emerging stages but the increased resources, the growing number of investigators conducting research related to EAP, and the improved collaboration among developers, users, and sponsors are leading to a rapid progress. The Responsibility of AI Research and Development

The question that concerns many in regards to the development of machines capable of intelligence comparable to that of a human being, is that of consequences of creating servants capable of becoming masters. This is a question in itself containing many more: How much power will these machines - (robots, as many like to think of them) have? Who is going to control them? What are they going to be used for? What responsibilities will they carry? These are just a few of the questions, which are on the minds of many who ever stopped to think what AI is about.

Robots, which could build other robots, tried to protect humans from everything until people could not do anything by themselves. They became totally dependent on the machines. The creator of these robots could not destroy them because they would keep him away from doing so. After all how could they protect people after they would be destroyed? How much responsibility and authority should these machines have? This question becomes even more important when one considers a fact that one of the biggest supporters of AI research is military. One of the reasons is that in "...a nuclear age, a new generation of very intelligent computers incorporating AI could actually defend the country better, faster, and more rationally than humans."4 Even if this is true we do not think that a machine should handle the responsibility for the fate of human civilization, no matter how intelligent it is.

Biometric Robots using EAP :

Mimicking nature would significantly expand the functionality of robots allowing performance of tasks that are currently impossible. As technology evolves, great number of biologically inspired robots actuated by EAP materials emulating biological creatures is expected to emerge. The challenges to making such robots can be seen graphically in Figure 2 where humanlike and dog-like robots are shown to hop and express joy. Both tasks are easy for humans and dogs to do but are extremely complex to perform by existing robots.

FIGURE 2: Making a joyfully hopping human-like and dog-like robots actuated by EAP materials are great challenges for biomimetic robots

FIGURE 3: An android head and a robotic hand that are serving as biomimetic platforms for the development of artificial muscles.

Remote Presence via Haptic Interfaces:

Remotely operated robots and simulators that involve virtual reality and the ability to "feel" remote or virtual environment are highly attractive and offer unmatched capabilities [Chapter 4 in Bar-Cohen and Brea zeal, 2003]. To address this need, the engineering community are developing haptic (tactile and force) feedback systems that are allowing users to immerse themselves in the display medium while being connected thru haptic and tactile interfaces to allow them to perform telepresence and "feel" at the level of their fingers and toes. Recently, the potential of making such a capability with high resolution and small workspace was enabled with the novel MEMICA system (Me-

chanical Mirroring using Controlled stiffness and Actuators) For this purpose, scientist at JPL and Rutgers University used an EAP liquid, called Electro-Rheological Fluid (ERF), which becomes viscous under electro-activation. Taking advantage of this property, they designed miniature Electrically Controlled Stiffness (ECS) elements and actuators. Using this system, the feeling of the stiffness and forces applied at remote or virtual environments will be reflected to the users via proportional changes in ERF viscosity.

Biologically Inspired Robots:

The evolution in capabilities that are inspired by biology has increased to a level where more sophisticated and demanding fields, such as space science, are considering the use of such robots. At JPL, a six-legged robot is currently being developed for consideration in future missions to such planets as Mars. Such robots include the LEMUR (Limbed Excursion Mobile Utility Robot). This type of robot would potentially perform mobility in complex terrains, sample acquisition and analysis, and many other functions that are attributed to legged animals including grasping and object manipulation. This evolution may potentially lead to the use of life-like robots in future NASA missions that involve landing on various planets including Mars.

The details of such future missions will be designed as a plot, commonly used in entertainment shows rather than conventional mission plans of a rover moving in a terrain and performing simple autonomous tasks. Equipped with multifunctional tools and multiple cameras, the LEMUR robots are intended to inspect and maintain installations beyond humanity's easy reach in space with the ability to operate in harsh planetary environments that are hazardous to human. This spider looking robot has 6 legs, each of which has interchangeable end-effectors to perform the required mission (see Figure 4). The axis symmetric layout is a lot like a starfish or octopus, and it has a panning camera system that allows omni-directional movement and manipulation operations.

FIGURE 4: A new class of multi-limbed robots called LEMUR (Limbed Excursion Mobile Utility Robot) is under development at JPL

Robots As Part of the Human Society:

As robots are getting the appearance and functionalities of humans and animals there is a growing need to make them interact and communicate as a sociable partner rather than a tool. This trend is requiring that robots would be able to communicate, cooperate, and learn from people in familiar human-oriented terms. Such a capability poses new challenges and motivates new domestic, entertainment, educational, and health related applications for robots that play a part in our daily lives. It requires obeying a wide range of social rules and learned behaviors that guide the interactions with, and attitudes toward, interactive technologies. Such robots are increasingly emerging and one example of such a robot is the Kismet that was developed by Breazeal [2002]. Kismet perceives a variety of natural social cues from visual and auditory channels, and delivers social signals to people through gaze direction, facial expression, body posture, and vocalizations.

Natural language processing will provide important services for people who speak different languages. If a computer is able to understand natural languages, it will also be able to translate from one language to another. The "universal translator" widely used Star Trek may actually become a reality! This, of course, also includes voice recognition, or speech recognition.

One of the big problems of humankind is that people start thinking only after they get into trouble. People like to invent new things but most of the time they never stop to think about consequences of their inventions. We think that now is the time to raise the question about Artificial Intelligence: "Should we do it?". As we have already mentioned, there are a lot of ethical and moral problems which could arise with the future development of Artificial Intelligence. Even though there are a lot of advantages of using Artificial Intelligence in the future, there are still big obstacles which should make us hesitant to develop or use robots in our lives.

Some may argue that this does not have to be true and all people will be happy and have a lot of free time to spend with their families and for leisure. But others will quote Marx and say: "Labor is what makes a man human." These people will argue that people will become dependent on AI, and they will loose the ability to provide for themselves, or even the ability to reason. Then humanity would be reduced to the primordial animal state.

Future of Artificial Intelligence: should we do it?

What kind of developments should we expect in the area of Artificial Intelligence? Judging from the research topics that we have today, we might predict that in the near future things such as object recognition, voice recognition, and natural language understanding will be a reality. Will there be systems so advanced that they have to be given rights similar to those of humans? Probably not in the foreseeable future. But maybe in a little more than half a century, if the humanity survives that long, such machines may very well develop.

What kind of advantages would future Artificial Intelligence systems offer?

They will probably be increasingly used in the field of medicine. A knowledge based expert system, which can cross-reference symptoms and diseases will greatly improve the accuracy of diagnostics. Object recognition will also be a great aid to doctors. Along with images from cats cans or X-ray machines, they will be able to get preliminary analysis of those images. This of course will be possible only if people solve legal questions that arise by giving power to a machine to control or influence the health of a human.

The most difficult question arises when we start to think about long term goals. Do we want to build a computer which will be like us? If we do, what do we need them for? What will these human-computers do for humanity? Nobody has an answer to these questions and we can only speculate about the conse-

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quences. What is even more important, scientist will not stop to try to achieve more and more every year. We will just have to live and see what the future of Artificial Intelligence and the future of Human existence, will be like.

- Idea of Artificial Intelligence is being replaced by Artificial life, or anything with a form or body.
- The consensus among scientists is that a requirement for life is that it has an embodiment in some physical form, but this will change. Programs may not fit this requirement for life yet.

Applications...

The potential applications of Artificial Intelligence are abundant. They stretch from the *military* for autonomous control and target identification, to the *entertainment industry* for computer games and robotic pets. Let's also not forget big establishments dealing with huge amounts of information such as *hospitals*, *banks* and *insurances*, who can use AI to predict customer behavior and detect trends.

Disadvantages:

1. Potential for malevolent programs, "cold war" between two countries, unforeseen impacts because it is complex technology, environmental consequences will most likely be minimal.
2. Self-modifying, when combined with self-replicating, can lead to dangerous, unexpected results, such as a new and frequently mutating computer virus.
3. As computers get faster and more numerous, the possibility of randomly creating an artificial intelligence becomes real.
4. Military robots may make it possible for a country to indiscriminately attack less-advanced countries with few, if any, human casualties.
5. Rapid advances in AI could mean massive structural unemployment
6. AI utilizing non-transparent learning (i.e. neural networks) is never completely predictable.

Conclusion : (what should happen)

- When programs that appear to demonstrate sentience appear (intelligence and awareness), a panel of scientists could be assembled to determine if a particular program is sentient or not.
- If sentient, it will be given rights, so, in general, companies will try to avoid developing sentient AI since they would not be able to indiscriminately exploit it.
- Software companies should be made legally responsible for failings of software that result in damage to third parties despite good-faith attempts at control by the user.

AI and robotics have the potentially to truly revolutionize the economy by replacing labor with capital, allowing greater production—it deserves a corresponding share of research fundin !

REFERENCE

Bar-Cohen Y. (Ed.), "Electroactive Polymer (EAP) Actuators as Artificial Muscles -Reality, Potential and Challenges," ISBN 0-8194-4054-X, SPIE Press, Vol. PM98,(March 2001), pp. 1 671 | http://ndeaa.jpl.nasa.gov/nasande/yosi/yosi-books.htm | | Bar-Cohen Y. and C. Breazeal (Eds.),"Biologically-Inspired Intelligent Robots," SPIE Press, Vol. PM122, ISBN0-8194-4872-9 (2003), pp. 1-410 | http://www.spie.org/web/abstracts/oepress/PM122.html |