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CONCEPT OF ARTIFICIAL INTELLIGENCE IN VARIOUS APPLICATION OF ROBOTICS

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***Abstract* - Artificial intelligence is a theory. The base object is the agent who is the "actor". It is realized in software. Robots are manufactured as hardware. The connection between those two is that the control of the robot is a software agent that reads data from the sensors decides what to do next and then directs the effectors to act in the physical world.**

The aim of this paper is to provide basic, background information of global scope on two emerging technologies: artificial intelligence (AI) and robotics. According to the Department of Trade and Industry (DTI), it is important to consider these emerging technologies now because their emergence on the market is anticipated to 'affect almost every aspect of our lives' during the coming decades (DTI, 2002). Thus, a first major feature of these two disciplines is product diversity. In addition, it is possible to characterize them as disruptive, enabling and interdisciplinary.

Keywords- AI concept, robotics, software

I. INTRODUCTION

Many researchers now feel that the goal of mimicking the human ability to solve problems and achieve goals in the real world the so-called 'strong AI' is neither likely nor desirable because a long series of conceptual breakthroughs is required AI systems are generally embedded within larger systems-applications can be found in video games speech recognition, and in the 'data mining' business sector. The field of robotics is closely linked to that of AI, although definitional issues abound. 'Giving AI motor capability' seems a reasonable definition, but most people would not regard a cruise missile as a robot even though the navigation and control techniques draw heavily on robotics research. AI and robotics are likely to continue to creep into our lives without us really noticing. Unfortunately, many of the applications appear to be taking place amongst agencies, particularly the military that do not readily respond to public concern, however well articulated or thought through.

II. BASICS

AI has been one of the most controversial domains of inquiry in computer science since it was first proposed in the 1950s The ultimate aim is to make computer programs that are capable of solving problems and achieving goals in the world as well as humans Today, successful AI applications range from custom-built expert systems to mass produced software and consumer electronics. Robotics, on the other hand, may be thought of as *'the science of extending human motor capabilities with machines'* (Trevelyan, 1999). However, a closer look at this definition creates a more complicated picture. For example, a cruise missile, although not intuitively referred to as a robot, nevertheless incorporates many of the navigation and control techniques explored in the context of mobile-robotics research. This report, however, considers robotics research as the attempt to instill intelligent software with some degree of motor capability. Since many of the major areas of AI research play an essential role in work on robots, robotics will be considered here as a sub-section of AI. Many of those in industry do not use the term 'artificial intelligence' even when their company's products rely on some AI techniques.

III. RESEARCH AREAS

AI, based upon the capabilities of digital computers to manipulate symbols, is probably not sufficient to achieve anything resembling true intelligence. This is because symbolic AI systems, as they are known, are designed and programmed rather than trained or evolved. AI software designers are beginning to team up with cognitive psychologists and use cognitive science concepts. Another example centers upon the work of the 'connectionists' who draw attention to computer architecture, arguing that the arrangement of most symbolic AI programmers is fundamentally incapable of exhibiting the essential characteristics of intelligence to any useful degree. As an alternative, connectionists aim to develop AI through artificial neural networks (ANNs). The emergence of ANNs reflects an underlying paradigm change within the AI research community and, as a result, such systems have undeniably received much attention of late. However, regardless of their success in creating interest, the fact remains that ANNs have not nearly been able to replace symbolic AI. AI researchers have a variety of learning methods at their disposal. However, as alluded to above, ANNs represent one of the most promising of these. There are many advantages of ANNs and advances in this field will increase their popularity. Their main value over symbolic AI systems lies in the fact that they are trained rather than programmed: they learn to evolve to their environment, beyond the care and attention of their creator (Hsuing, 2002). Other major advantages of ANNs lie in their ability to classify and recognize patterns and to handle abnormal input data, a characteristic very important for systems that handle a wide range of data. As a result, they are best used when the results of a model are more important than understanding how the model works. To this end, these systems are often used in stock market analysis, fingerprint identification, character recognition, speech recognition, and scientific analysis of data (Stottler Henke, 2002).

The following chains of reasoning, considered in isolation without supporting argument, all exhibit the Fallacy of the Giant Cheesecake:

• A sufficiently powerful Artificial Intelligence could overwhelm any human resistance and wipe out humanity. [And the AI would decide to do so.] Therefore we should not build AI.

• A sufficiently powerful AI could develop new medical technologies capable of saving millions of human lives. [And the AI would decide to do so.] Therefore we should build AI.

• Once computers become cheap enough, the vast majority of jobs will be performable by Artificial Intelligence more easily than by humans. A sufficiently powerful AI would even be better than us at math, engineering, music, art, and all the other jobs we consider meaningful. [And the AI will decide to perform those jobs.] Thus after the invention of AI, humans will have nothing to do, and we'll starve or watch television.

IV. Algorithms And Genetic Programming

An algorithm is defined as a 'detailed sequence of actions to perform to accomplish some task' (FOLDOC, 2003). One branch of algorithm theory, genetic programming, is currently receiving much attention. This is a technique for getting software to solve a task by 'mating' random programs and selecting the fittest in millions of generations. Khan (2002) elaborates: 'Genetic algorithms use natural selection, mutating and crossbreeding within a pool of sub-optimal scenarios. Better solutions live and worse ones die – allowing the program to discover the best option without trying every possible combination along the way.'

V. Logical Ai

This type of reasoning concerns what a program knows about the world in general, the facts of the specific situation in which it must act, and the goals that it must accomplish (Grosz and Davis, 1994). Such concepts are held within the program in the form of sentences of some mathematical logical language. The most successful example of this is an expert system, created when a 'knowledge engineer' interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task, such as diagnosis. However, the usefulness of current expert systems also depends on their users demonstrating a certain level of common-sense too.

VI. Applications

AI technology may be greater than this due to classification-related difficulties and the fact that such products are more likely to be embedded in some larger system than a stand-alone machine. In general, such applications are used to increase the productivity of knowledge workers by intelligently automating their tasks, or to make technical products of all kinds easier to use for both workers and consumers through intelligent automation of their complex functions (Stottler Henke, 2002). It is possible now to identify four families of intelligent systems that have broad applicability across a wide range of sectors (Grosz and Davis, 1994). These are intelligent simulation systems; intelligent information resources; intelligent project coaches; and robotics.

A. *Intelligent simulation systems*

These applications are commonly used in a number of different scenarios. First, an Intelligent Simulation System (ISS) may be generated to learn more about the behavior of an original system, when the original system is not available for manipulation. The modeling of climate systems is a good example. Second, the original system may not be available because of cost or safety reasons, or it may not be built yet and the purpose of learning about it is to design it better (Stottler Henke, 2002). Third, an ISS might be employed for training purposes in anticipation of dangerous situations, when the cost of real-world training is prohibitive. Such technologies are particularly well advanced in military applications through the simulation of war 'games'. Another very big business in the realm of ISSs is the videogame market, comparable to the film business in size. AI systems have become fundamental to this industry because, unlike in film, it is often up to a computer or game console to create a sense of reality for the game-player. Such standards of realism are going up all the time (Broersma, 2001).

B. *Intelligent information resources*

Intelligent systems must be able to provide including visual and audio data, in addition to commonplace structured databases (Grosz and Davis, 1994). One development in this area that is receiving much attention is 'data mining', the extraction of general regularities from online data (Weld, 1995). This area is becoming increasingly important due to the fact that all types of commercial and government institutions are now logging huge volumes of data and require the means to optimize the use of these vast resources.

C. *Sensors*

Sensors are the perceptual interface between robots. On the one hand we have *passive sensors* like cameras, which capture signals that are generated by other sources in the environment. On the other hand we have *active sensors* (for example sonar, radar, laser) which emit energy into the environment. This energy is reflected by objects in the environment. These reflections can then be used to gather the information needed. Generally active sensors provide more information than passive sensors. But they also consume more power. This can lead to a problem on mobile robots which need to take their energy with them in batteries. We have three types of sensors (no matter whether sensors are active or passive). These are sensors that either record distances to objects or generate an entire image of the environment or measure a property of the robot itself. Many mobile robots make use of *range finders*, which measure distance to nearby objects. A common type is the sonar sensor. Alternatives to sonar include radar and laser. Some range sensors measure very short or very long distances. Close-range sensors are often *tactile sensors* such as whiskers, bump panels and touch-sensitive skin. The other extreme are long-range sensors like the Global Positioning System (GPS). The second important class of sensors is *imaging sensors*. These are cameras that provide images of the environment that can then be analyzed using computer vision and image recognition techniques. The third important class is *proprioceptive sensors*. These inform the robot of its own state. To measure the exact configuration of a robotic joint motors are often equipped with shaft decoders that count the revolution of motors in small increments. Another way of measuring the state of the robot is to use force and torque sensors. These are especially needed when the robot handles fragile objects or objects whose exact shape and location is unknown. Imagine a ton robot manipulator screwing in a light bulb.

D. Effectors

Effectors are the means by which robots manipulate the environment, move and change the shape of their bodies. To understand the ability of a robot to interact with the physical world we will use the abstract concept of a *degree of freedom (DOF)*. We count one degree of freedom for each independent direction in which a robot, or one of its effectors can move. As an example lets contemplate a rigid robot like an autonomous underwater vehicle (AUV). It has six degrees of freedom, three for its (*x;y;z*) location in space and three for its angular orientation (also known as yaw, roll and pitch). These DOFs define the kinematic state of the robot. This can be extended with another dimension that gives the rate of change of each kinematic dimension. This is called dynamic state. Robots with non rigid bodies may have additional DOFs. For example a human wrist has three degrees of freedom – it can move up and down, side to side and can also rotate. Robot joints have 1, 2, or 3 degrees of freedom each. Six degrees of freedom are required to place an object, such as a hand, at a particular point in a particular orientation. The manipulator shown in Figure1 has exactly six degrees of freedom, created by five revolute joints (R) and one prismatic joint (P). Revolute joints generate rotational motion while the prismatic joints generate sliding motion. If you take your arm as an example you will notice, that it has more than six degrees of freedom. If you put your hand on the table you still have the freedom to rotate your elbow. Manipulators which have more degrees of freedom than required to place an end effector to a target location are easier to control than robots having only the minimum number of DOFs. Mobile robots are somewhat special. The number of degrees of freedom does not need to have corresponding actuated elements. Think of a car. It can move forward or backward, and it can turn, giving it two DOFs. But if you describe the car's kinematic configuration you will notice that it is three-dimensional. On a flat surface like a parking site you can maneuver your car to any (*x;y*) point, in any orientation. You see that the car has 3 *effective DOFs* but only 2 *controllable DOFs*. We say a robot is *nonholonomic* if it has more effective DOFs than controllable DOFs and *holonomic* if the two numbers are the same.

Holonomic robots are easier to control than nonholonomic (think of parking a car: it would be much easier to be able to move the car sideways). But holonomic robots are mechanically more complex. Most manipulators and robot arms are holonomic and most mobile robots are nonholonomic.

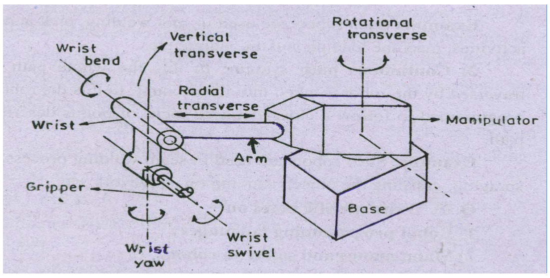

Figure 1. Manipulator having Six Degree of Freedom

VII. Robotics

A distinction has already been drawn above between robots working in informational environments and robots with physical abilities. One advantage of the former is that there is little need for investment in additional expensive or unreliable robotic hard ware as existing computer systems and networks provide adequate sensor and effector environments. On the other hand, the kinds of robotics systems elaborated on here, physical robots, require mechanization of various physical sensory and motor abilities (Doyle and Dean, 1996). The challenges involved in providing such a latter environment are considerable, especially when complete automation is sought, as in Honda's humanoid ASIMO project. Thus, rather than focus on the ambitious and distant goal of relative autonomy, this report picks up on Trevelyan (1999) who points out that complete automation is often unfeasible, impossible, or simply unwanted. Indeed, much of today's robotics research focuses instead on far humbler goals, such as simplicity, force control, calibration and accuracy. Thus, we can see that, to some extent, the field of robotics has followed similar lines as that of AI, attempting to rebound from the overly optimistic predictions of the 1950s and 1960s, and coming up against more contemporary problems not dissimilar to the AI effect .Indeed, while few of the innovations that emerge from the work of robotics researchers ever appear in the form of robots, or even parts of robots, their results are widely applied in industrial machines not defined as so (Trevelyan, 1999). In spite of these significant challenges, there are some good examples of AI-controlled robotic systems. For instance, Tri Path Imaging has built Focal Point, a diagnosis expert system that examines Pap smears for signs of cervical cancer. Focal Point screens five million slides each year, or about 10% of all slides taken in the US and, like human lab technicians in training, teaches itself by practicing on slides that pathologists have already diagnosed. Thus, one big advantage of such a system is that, if implemented properly, Focal Point allows you to replicate your very best people (Khan, 2002). A second example and, again, perhaps the most ambitious of all, concerns DARPA, who are in the process of developing an Unmanned Combat Air Vehicle (UCAV).

According to Boeing (2002), the UCAV system is designed to 'prove the technical feasibility of multiple UCAVs autonomously performing extremely dangerous and high priority combat missions.' In a typical mission scenario, 'multiple UCAVs will be equipped with preprogrammed objectives and preliminary targeting information from ground-based mission planners. Operations can then be carried out autonomously, but can also be revised en route by UCAV controllers should new objectives dictate.' If the program is a success, the US DoD expects to begin fielding UCAV weapon systems in the 2008 time-frame.

A. Types of Robots (used now a days)

1) Hard working Robots

Traditionally robots have been used to replace human workers in areas of difficult labor, which is structured enough for automation, like assembly line work in the automobile industry (the classical example) or harvesting machines in the agricultural sector. Some existing examples apart from the assembly robot are:

- Melon harvester robot
- Ore transport robot for mines
- A robot that removes paint from large ships
- A robot that generates high precision sewer maps

If employed in a suitable environment robot can work faster, cheaper and more precise than humans.

2) Transporters

Although most autonomous transport robots still need environmental modifications to find their way they are already widely in use. But building a robot which can navigate using natural landmarks is probably no more science fiction. Examples of currently available transporters are:

- Container transporters used to load and unload cargo ships
- Medication and food transport systems in hospitals
- Autonomous helicopters, to deliver goods to remote areas.

3) Insensible Steel Giants

As robots can be easily shielded against hazardous environments and are somewhat replaceable, they are used in dangerous, toxic or nuclear environments. Some places robots have helped cleaning up a mess:

- In Chernobyl robots have helped to clean up nuclear waste
- Robots have entered dangerous areas in the remains of the WTC
- Robots are used to clean ammunition and mines all around the world

For the same reasons robots are sent to Mars and into the depth of the oceans. They explore sunken ships or walk the craters of active volcanoes.

4) Servants and Toys

Robots may not yet be a common sight in our world, but we already encounter them in many places. Many modern toys like the Sony Aibo are conquering today's children's life. Robots are developed that will help older people to have a better and more secure life. Nowadays, they start to come to us as toys or household helpers. Their time has just begun.

VIII. Obstacles In AI

The standard test against which the possibility of strong AI is often judged concerns Alan Turing's 1950 article, Computing Machinery and Intelligence, in which the author discusses the conditions for considering a machine to be intelligent (Turing, 1950). He argues that if a machine could successfully pretend to be human to a knowledgeable observer then you certainly should consider it intelligent (McCarthy, 2003). This test would satisfy most people but not all philosophers, some of which have challenged the 'inevitable' achievement of strong AI based upon the assertion that the hypothesis of strong AI is itself false. One famous sceptic of AI is Hubert Dreyfus, who says that a computer will never be intelligent unless it can display a good command of common-sense (Dreyfus, 1992). Dreyfus then follows up by saying that computers will never be able to fully grasp common-sense, since much of our commonsense is on a 'know-how' basis. For example, the notion that one solid cannot easily penetrate another is commonsense, yet the knowledge required to ride a bicycle is not something you can gain from a book, or from someone telling you. You can only learn through experience. Thus, since current computers can only really 'represent' things, the possibility of taking a skill, emotion, or something else equally abstract, and changing it into a series of zeros and ones is according to Dreyfus, close to impossible (Matthews, 1999). A second famous doubter is John Searle, who, with his Chinese Room analogy, has responded directly to Turing (cited in Good wins, 2001).

IX. Future Of AI

In spite of the many fundamental barriers highlighted above, the fields of AI and robotics are replete with many wonderfully inventive predictions, a domain where reality and science fiction often meet. Indeed, it is likely that in the next two decades we'll see more and better capabilities that we tend to attribute as awareness (Hendler, 2000). However, it is unlikely that machines will ever have human awareness in the philosophical sense of the term, although they may come close in the long term. Rather, we can expect to see classical AI going on to produce more and more sophisticated applications in restricted domains, such as expert systems, chess programs and Internet agents. At the same time, the next 30 years will produce new types of animal-inspired machines that are more ‘messy’ and unpredictable than any we have seen before – less rationally intelligent but more rounded and whole (Humphrys, 1997).

X. AI AND ROBOT COMBINATIONS

Many of the major ethical issues surrounding AI - related development hinge upon the being voiced based upon the workability of such a system. This is because, while testing may be possible for an autonomous tank and other weapons of the electronic battlefield, it is not feasible for National Missile Defense. Such a system can only be realistically evaluated in actual combat (Augarten, 1986). More fundamentally, significant moral difficulties arise out of human distaste for autonomous weapons. Gary Chapman (2000) summarizes this concern well.

XI. ROBOT SUPERIOR THAN MACHINE

Such issues of predatory machines are bound to raise concern over the scenario of AIs overtaking humankind and thus somehow competing with him. This idea has often been popularized by classic science fiction works and populist academics, such as Professor Kevin Warwick, Professor of Cybernetics at the University of Reading, UK, who has repeated this beliefs concerning robot ‘take-over’ on many occasions in the press, in his books, and on television and radio. Consider the following letter from Nicholas Albery (1999) of the Institute of Social Inventions. Published in New Scientist and entitled *Robot Terror*, Albery seeks support for the following petition: The strong public reaction to machine takeover appears, then, not to be well founded. However, if it is possible to agree, for argument's sake, that humankind will be able to create a truly intelligent machine, a much deeper issue arises: how will a sentient artificial being be received by humankind and by society? Barry (2001) asks pertinent questions: *‘Would it be forced to exist like its automaton predecessors who have effectively been our slaves, or would it enjoy the same rights as the humans who created it, simply because of its intellect?’* This is an enormous question that touches religion, politics and law, but to date little serious discussion has been given to the possibility of a new intelligent species and to the rights an autonomous sentient might claim.

XII. CONCLUSION

This paper began by stressing the need to provide background information on AI. In doing so, it was hoped that the prospects of these emerging technologies to affect quality of life in the coming decades could be realistically assessed. One consequence of providing such an overview is that there can be no decisive conclusions as such; the industries characterized here are too dynamic and uncertain to generate any real sense of resolution. However, it is possible to highlight a number of important differences and similarities between robotics and AI which go some way to shedding more light on their character. Perhaps the greatest contrast between the two industries concerns public interest. Indeed, as this paper has demonstrated, robotics is widely regarded as a ‘new’ and exciting branch of science and technology. AI, on the other hand, is viewed by many as a highly specialized and unproven discipline. One reason for this concerns the gross over-optimism that characterized the industry in the 1960s and 1980s. Another reason reflects the AI community’s seemingly insurmountable difficulty in publicizing its own achievements without whipping up general anxiety over machine superiority. The upshot of all this has been the field’s struggle to attract funding in the past and it is likely that this trend will continue for some time into the foreseeable future. Revealing similarities also exist between robotics and AI. There has been much talk recently regarding the convergence of traditionally separate scientific fields, in particular the blurring of the boundaries between the physical sciences and life sciences – perhaps even the first step towards the long sought after unification of physics, chemistry and biology (Howard, 2002). For example, the concourse of nanoscience, biotechnology, IT, and cognitive science (‘NBIC’) was discussed during a December 2001 NSF workshop. NBIC, it was agreed *‘could achieve a tremendous improvement in human abilities, societal outcomes, the nation’s productivity and the quality of life’* (Roco and Bainbridge, 2003). In some ways, the above conclusion is hardly surprising given the ambitious and broad scope of the technologies discussed in this paper. As pointed out above, ‘convergence’ largely arises from the wide availability of techniques and tools on offer today – the real innovation stems from the process of bringing individuals from traditionally separate disciplines together.

REFERENCES

[1] Tim Niemueller and Sumedha Widyadharma, July 8, 2003, “Artificial Intelligence – An Introduction to Robotics”.

[2] Daniel Wong, Ryan Zink and Sven Koenig, “Teaching Artificial Intelligence and Robotics via Games”, Los Angeles, CA 90089-0781.

[3] Eliezer Yudkowsky, August 31, 2006, “Artificial Intelligence as a Positive and Negative Factor in Global Risk”, Singularity Institute for Artificial Intelligence Palo Alto, CA.

[4] Alexander Huw Arnall, July 2003, Nanotechnology, Artificial Intelligence and Robotics; A technical, political and institutional map of emerging technologies”, Greenpeace Environmental Trust Canonbury Villas, London N1 2PN, ISBN 1-903907-05-5.

[5] F. Dellaert, D. Fox, W. Burgard, and S. Thrun, May 1999, “Monte carlo localization for mobile robots”, IEEE International Conference on Robotics and Automation (ICRA99).

[6] McCarthy, J., Minsky, M. L., Rochester, N. and Shannon, C. E. 1955, A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence.