

The Self-Aware Robot

— A Response to Reactions to Discovery News —

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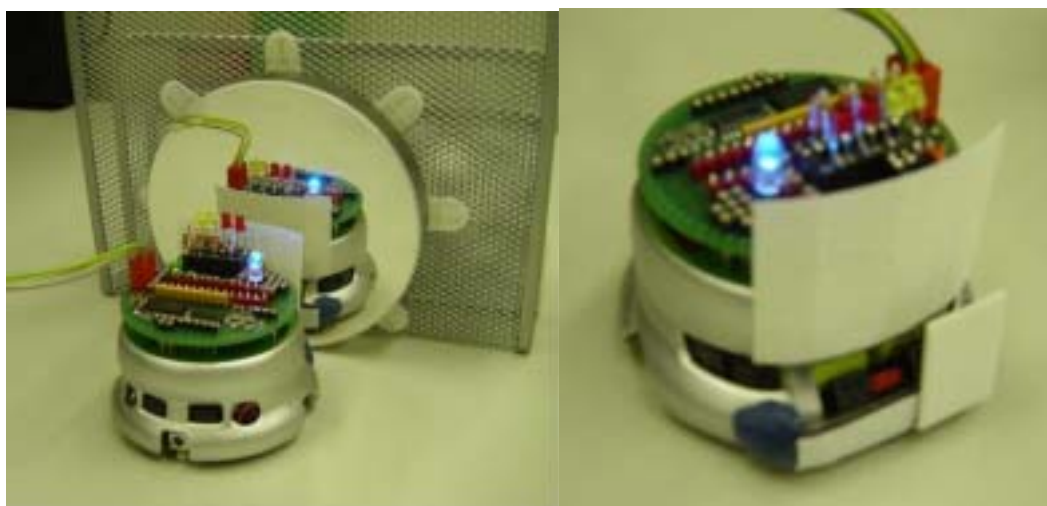


Fig. 1 The self-aware robot.

ABSTRACT: This book describes a conscious robot, which is the world's first successful result of mirror image cognition (Fig. 1).

The descriptions in this book are easy enough for beginners without expertise to understand.

What are the mechanisms of human consciousness?

This book is intended to unravel this mystery.

The web version of the Discovery Channel in the United States gave an account of this robot on December 21, 2005. In the couple of weeks that followed, more than 26,000 websites all over the world carried secondary items related to the robot.

In addition, a lot of web forums had vigorous discussions and carried related

information on their websites. Views in these discussions represented those both for and against the reported development.

As the writer of this book, I would like to take the opportunity to introduce the essence of those opinions and provide answers to the questions that were raised.

The article on the Discovery Channel had a tremendous and wide influence. Even more than six months after, the keyword “self-aware” ranked fourth in about 120 million Google searches. And, of course among researchers’ reports, it was in first place.

1. INTRODUCTION

This book describes the development of a conscious robot, which was the world’s first successful result of mirror image cognition. Mirror image cognition means being able to “recognize oneself in a mirror.”

How is the human reason mechanism made up in the nervous system? How are the emotion and feeling mechanisms related to reason? What is consciousness? What is self consciousness? What are sub-consciousness and explicit consciousness? What does it mean “to feel”? What is free will?

My research aims at unraveling such mysteries and, first of all, innovating the current state of AI (artificial intelligence), which is still at a deadlock. Then, it aims at constructing a rather new AI. In addition, if possible, it intends to create a model of the human brain in the future. For these purposes, my research tries to construct a kind of mechanism similar to human consciousness in a robot with somatic functions, rather than by such dangerous and difficult means as dissecting and analyzing the human brain itself. Universal knowledge obtained through such research will be valuable information for unraveling the mysteries of the brain.

First, the development of machinery based on new AI technologies will begin. Then, machinery all over the world will progress to a higher level. For example, cars equipped with new AI will operate as though specialized drivers were driving them, while cars currently in use are mainly designed to obey their human drivers’ instructions. Such new cars may operate safely all the time while obeying driver’s instructions. Even if the driver should suddenly lose consciousness while driving, the car will look after all the safety requirements, continue driving safely, go to a safe place nearby, and stop there. The car may even take all the time required to arrive at the destination safely if the arrival time is of no concern. The difference between such new AI cars and our conventional cars is their enhanced safety and convenience. Stress experienced by the drivers will be reduced remarkably.

Second, the new AI enables simultaneous interpreter robots to handle natural languages. These robots not only offer quick responses far faster than human simultaneous interpreters but also use homonyms properly according to the circumstances and translate the languages accurately. They understand jokes and ironies and even tell them. In hospitals, for example, they would sensitively judge the state of affairs and act appropriately, such as by avoiding disease-related topics and using their words properly.

Third, the new AI robots may physically and mentally care for the live-alone elderly and handicapped persons requiring nursing. In other words, those robots may provide nursing while being conscious of the mental and physical conditions of the elderly and handicapped. They may touch them with their hands and aid in walking. They may also support patients in wheelchairs and bed-ridden patients. In addition, they may talk to them with gentle words, encourage them, listen to them, give proper advice, and offer mental support.

Fourth, the new AI robots may create and suggest ways of surviving when humans encounter difficult and life-threatening situations and they would keep on supporting the humans as long as their energy sources held out.

In the future, the means of curing serious mental disorders such as dispraxia may be discovered. It may be possible to develop means of reviving lost consciousness, if the mechanism of consciousness is unraveled.

“Consistency of cognition and behavior” is my idea. Cognition means “to understand.” I think that the function of consciousness is maintaining consistent information about how “to behave” and how “to understand that behavior.”

Based on this idea, I developed a module for giving consciousness to a robot. It is called the Module of Nerves for Advanced Dynamics, or MoNAD for short. A hierarchical combination of MoNADs enables a consciousness system.

1.1 Research on Consciousness and Cognitism

Rene Descartes (1596 – 1650), the French philosopher, stands at the starting point of research on human consciousness. He was the first one to insist on the “existence of the self” that “feels itself”. “Cogito, ergo sum (I think, therefore I am)” is his basic philosophic principle. 1)

He advocated the notion of dualism, which asserted that the body and mind exist separately.

Then, Gottfried Wilhelm Leibnitz (1646-1716), the German mathematician, attempted to treat the body and mind in an integrated manner in his monadology. 2)

However, no one could reach a unified view based on a physical understanding about the body and mind.

By the way, when a person is “being aware of something,” that state of awareness can be sensed by that person only. This fact leads to the assertion that “being aware” is a “subjective” matter and cannot be treated scientifically. One of methods of treating human “consciousness” quite scientifically is to describe reactions to stimuli applied to the human subject. This method is called “behaviorism.”

In the 1960s, scientific evidences of complicated processing in the human brain were found, giving rise to the necessity of explaining the activities in the brain. Assume, for example, the question of judging whether a certain number is included in a given set of numbers. It has been proved that the examinees needed a longer time to answer the questions when the number of digits increased. 3) The viewpoint of admitting complicated processing in the brain is called “cognitism.”

Then, people discovered a lot of scientific evidences using equipment for measuring activities in the brain such as functional magnetic resonance imaging (fMRI) equipment.

The facts that have been proved by now are:

- (1) the brain executes some complicated processing, and
- (2) specific parts of the brain are activated.

Science developed behaviorism into cognitism. In other words, it proceeded with research on the internal processing in the brain by describing human reactions to external stimuli.

However, some people have criticized this in that such subjective matters as consciousness and a mind based on “self feeling” still lack scientific bases.

1.2 Husserl's Phenomenology

Now, let me introduce the “phenomenology (phaenomenologie)” proposed by Edmund Husserl (1859 – 1938), the German philosopher 4). I will explain phenomenology to the extent that I understand it, though it is a difficult philosophy.

Phenomenology is one of the “philosophic methods of establishing thoughts that haven't been established.” In short, people formulate hypotheses about unknown matters, check those hypotheses with phenomena, and use the check results to formulate new hypotheses which more people agree with. A certain hypothesis, though being the subjective thoughts of a researcher at the beginning, aims at consistency between subjectivity and objectivity through the above-mentioned process and finally achieves such consistency. At that time, the phenomenon comes to have an established

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Note:

Editor of the International Journal of RSJ (Robotic Society of Japan), 1991-
General Chair of ICAM94 (International Conference of Advanced Mechatronics)
Executive Committee of IEEE R & A 97 etc.
Program Committee of IAS4 etc.
Trustee of RSJ, 1998-2000
Chairperson of Advanced Robotics, RSJ, 1998-2000
President of the IFToMM sub-commission for Asia, 2000-
Program Committee of IROS 2006.
Visiting Professor of Karlsruhe University, Germany, 1989
Guest Professor of Karlsruhe University, Germany., 1994

Awards:

Centennially Awards of JSME (The Japan Society of Mechanical Engineers), 1997
Best paper of SCI 2003, -2004, CCCT04, IEA/AIE 2005

News:

Nikkei News, January 31st, 2005
Discovery Channel (Web version), Sept. 2, 2005 "Robot In Touch with Its Emotion"
Discovery Channel (Web version), Dec. 21, 2005 "Robot Demonstrates Self Awareness"

Exhibitions:

1997,1999,2001,2003,2005 International Robot Exhibition (invited)