



Study on the Environmental Cognition of a Self-evolving Conscious System

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Abstract

This study proposes a conscious model for a robot that achieves self-evolution by evaluating whether the internal state of the conscious system is represented as pleasant or unpleasant. For the definition of pleasant and unpleasant, we adopted the "smoothness of the flow of information" in the conscious system. Thus, our proposed conscious robot is capable of self-evolving tailored to the environment in which the robot itself is placed. In other words, it is possible to identify whether or not any external information has been input, and to identify the information with time series memory.

Keywords: MoNAD, Conscious System, Neural network, Self-evolving

1 Introduction

Robots of today are required to have human characteristics such as autonomous behavior and communication capability. Given that the progress of technology will accelerate the development of robots having a high level of intelligence and precision, robots will become closer to humans in time, and may serve as members of our families or as other partners. To attain this goal, more "humanness" is needed. Since human thought, emotion, and behavior arise from "human consciousness," it is likely that robots will gain the capacity for thought similar to humans if consciousness can be added to the capabilities of robots.

Human consciousness has been researched in many fields. Among these studies, we focused on mirror neurons (Gallese and et al., 1996) and mimesis theory (Donald, 1991), and have defined a new paradigm: "the consistency of cognition and behavior is the source of consciousness." Based on this definition, we have been developing a consciousness module called a Module of Nerves for Advanced Dynamics (MoNAD). (Takeno and et al., 2005) In our past study, we successfully conducted an

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experiment on self-awareness. (Takeno, 2011) And we developed the conscious system by introducing emotion and learning mechanisms into the system. (Kushiro and Takeno, 2011)

Our present study describes our efforts toward having this conscious system autonomously evolve through interaction with its environment. We believe that “pleasant” and “unpleasant” states are the key factors for the evolution of human consciousness. Based on this idea, we decided to develop a conscious system which evolves by itself.

2 MoNAD and Conscious System

The conscious system proposed in this paper is implemented with our MoNAD consciousness modules which we continue to develop. Our conscious system consists of several MoNADs in a layered structure.

3 MoNAD Characteristics

To determine whether the information input to the conscious system is known or unknown, the present study used the following characteristics of the MoNAD structure.

One characteristic of the MoNAD is that the value of cognitive representation and the value of behavior representation eventually become the same as the input information is repeatedly circulated. In addition, there is a large difference in the state of repetition between known information (learned information) and unknown information (not learned information). In the case of known information, the information flow is smooth and the difference between values quickly narrows. In the case of unknown information, however, the difference hardly narrows or the flow oscillates. The conscious system explained in the following sections employs this characteristic, and always determines whether the information is known or unknown when processing the input information. The duration of time before the output of a MoNAD is fixed and the cognitive representation is stabilized is called a cognition-behavior cycle.

4 Evolution of Conscious System based on “Pleasant” and “Unpleasant” States

In our past studies, we focused on the fact that humans have two basic states of consciousness, pleasant and unpleasant, and exercise their learning abilities so that an unpleasant state is changed into a pleasant state. Thus we thought that it would be possible to promote the evolution of knowledge by defining the state of consciousness as “unpleasant” when unknown information is input and “pleasant” when known information is input, and by applying this definition as a consistent rule (Ebisawa and et al., 2015).

Also we thought that our conscious system could evolve by learning the unknown information and changing it into known information. In other words, the principle of evolution that we proposed for our conscious system was to have the system changing in such a way that “the MoNAD speeds up the convergence of the values of the cognitive and behavior representations.” (Matsusita and Takeno, 2015)

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