Chapter 6
Needs, Feelings, and Emotions of Embodied Mind

ABSTRACT

Model of artificial mind discussed in this and the following two chapters considers critical elements of the mind operation. The question is whether we can propose artificial brain structures in machines that will be able to create the basis of intelligence and consciousness. Wanting to build an artificial brain, we propose what properties it should have, and how it should be organized. The chapter begins with presenting embodiment of the mind as the part of the environment that is under control of the mind. Perceiving and identifying with one's own body depends on observing the body's actions in the environment. The embodiment must communicate with the brain through channels that ensure the perception of the environment. The use of body dynamics facilitates control, planning, and decision making. Conditions that exist in the real world create a framework for proper action and reflect the compatibility of agent's competencies with the environment. In a conscious embodied mind, representations are created and used for actions. Higher level consciousness can be treated as an abstract version of the coordination of perception and action. Conscious states are triggered by externally supplied signals from the environment and by internally generated mental states. Self-consciousness requires distinguishing oneself from the environment. The definition of embodied intelligence adopted in this book is aimed at building an intelligent and conscious machine. The authors have recognized the ability to learn as the most important feature of intelligence, which is why they consider beings that do not learn anything as not intelligent. Machines will not have the same needs as people but must have needs whose fulfillment is a measure of success. Meeting these needs will require physical and mental effort, and the development of useful skills will be associated with the development of intelligence. The agent treats unmet needs as a signal to act. Using the analogy to pain, these signals representing unmet needs will be called the pain signals. Strength of these signals can be measured and compared with each other. Various pain signals not only provide motivation for action but also control the learning process. Finally, they discuss the role of feelings and emotions and their importance in the agent's learning process. In particular, they discuss their role in creation of conscious sensations. They explain the source of feelings as associated with but different than reward or punishment signals. The signals provided by the senses to anticipate reward or punishment are related to the physical properties of the observed objects, which are directly related to feelings. Pleasure is the promise of meeting a real need. Feelings will fuel emotions. They

relate emotions to subconscious reactions to what happened. They also discuss why we may need to build emotional machines and how artificial emotions can be created in machines.

We began by imagining the structures of memory cells capable of processing information in such a way that a system with such structures will show many behaviors of the conscious mind. In this chapter, we will show that natural minds contain such structures, and it is through them that they can be conscious. By analyzing the qualities of the human and animal psyche, we suggest that many of the properties of the brain structures could be used to organize artificial structures of the memory of the intelligent system so that they demonstrate consciousness similar to humans'. The organization of brain structures and their functions constitute a functional model of the conscious mind. The model is a description of the physical structures and the set of heuristics to which these structures are subject. The best way to verify this kind of model would be to build a physical model and see if it works or not. Will the system with the physical artificial brain built according to our model show the mental qualities inherent to the conscious mind? Can it have the motivated emotional mind, we have found in living creatures?

Unfortunately, no one can do this yet. Although it is quite easy to imagine brain structures with the desired properties, their physical realization proves quite complex. So did we approach this problem too lightly in our book? It's a question of discussion, which we hope to initiate with the help of our book. So far, it seems that the construction of self-conscious machines acting independently, according to their own plans and pursuing their own goals, would not be possible at all. In this section, we will try to demonstrate that the basic structures that determine the state of consciousness can be built with the existing technology. We cite many examples of experiments confirming that machines can effectively perform the designed intelligent tasks. We will also indicate the paths of further development needed to make robots and smart machines consciously cooperate with people and other conscious beings.

Among the many conditions mentioned in the previous chapters, we pointed to the necessity of embodiment of the mind so that it can gain consciousness. Now we will deal with this issue in more detail. Must our artificial mind also have a body? Why can't it be locked in a regular box like all the decent computers?

THE EMBODIED MIND

The notion of embodied mind was introduced in part I, proving that the embodiment of the mind is essential for the intelligent system to interpret simple sensory impressions and turn them into qualia. Discussing the natural mind, we drew attention to the importance of the notion of an embodied mind in the shaping of speech, and we even quoted the concept of embodied mathematics to explain how mathematical abilities have evolved in human minds. Now we will examine this concept as fundamental to the design of artificial minds and to understanding what qualities can be achieved by an autonomous agent—a robot operating in a natural environment. Moreover, we claim that no intelligence can arise without this embodiment.

The embodied mind is the mind of an autonomous agent who possesses the body. The principles of designing robots using the idea of embodied intelligence were first described by Brooks (1991) and were characterized by several postulates for the development of embodied agents. The first assumption is that agents develop by acquiring experiences in a changing environment in which they act and observe the effects of their actions through their senses. Another important assumption adopted by Brooks is the

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