

Research Article

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Masahiro Mori's Buddhist philosophy of robot

<https://doi.org/10.1515/pjbr-2018-0004>

Received September 6, 2017; accepted March 1, 2018

Abstract: Masahiro Mori is a well-known Japanese robotics scholar whose notion of Uncanny Valley is worldly famous. Mori is also an initiator of the Robot Contest and a student of Buddhism and a practitioner of Zen. He constructs his original Buddhist philosophy of robotics throughout his career. His robotics work and his learning of Buddhism develop together side by side in an interesting intertwined manner. This paper will take up the issues such as the ethical personality, quality of minds, and experiences of engineers as key components in and for an "ethical design" of robots by examining Mori's Buddhist philosophy of robotics. This paper is divided into four sections. After an introductory part, in the second section, we will explore Mori's view of Zen as aspiritual source for technological creativity. In Section 3, we will examine his view into a robot-contest as a location of a realized teaching of Buddhism, especially, in relationship to the Diamond Sūtra, in order to see Mori's educational contribution. In Section 4, we will examine how Mori became engaged to learn and practice Buddhism and came to the realization of Buddhahood in relation to robotics.

"We (humans) have become entangled with very strong co-habitants of machine and technology. We need to acquire a high spiritual status to control power originating from a combination of human power and mechanical power. To learn to do so, we need to learn religion." (M. Mori, *Mori Masahiro no bukkyō nyūmon* [Mori Masahiro's introduction to Buddhism], Kōsei Shuppan, Tokyo, 2003, 168-169)

Keywords: Masahiro Mori, Robot, Robot Contest, Buddhism, Zen, Diamond Sūtra

1 Introduction

Although leading scholars of roboethics, such as Veruggio, Solis, and Van der Loos [1], Sullins [2], Steiner [3], and Capurro and Nagenborg [4], do not mention religious aspects

of robotics directly, some other scholars have examined religious aspects as the next-generation robotics have become more entangled with artificial intelligence (AI) and enter the social sphere. From a culturally and theologically Christian perspective, scholars such as Geraci [5] and Forest [6] argue that a religious area of meaning exists in the relationship between a robot and human society. In Islamic societies, there are a few studies on the relationship between Islam and robotics/AI. Amuda and Tijani examine how Islamic legal and moral codes would be applied in evaluating using a sexbot [7]. By applying a humanoid robot to assist in educating autistic children to recite Quranic verses, Hashin, Yussof, Liyana, and Bahrin examine how parents regard the use of Nao – an autonomous, programmable humanoid robot developed by a French robotics company – in repeatedly reciting phrases from the Quran to help autistic children to learn and memorize them [8]. From a different angle, Halpern and Katz examine how different religious backgrounds affect young people's attitudes toward robots and argue that those following Judeo-Christian religions like robots less than those following Eastern religions [9].

In the Japanese context, several studies examine the animistic and Shintoistic dimension to Japanese robotics [10]. For example, Kitano argues that Japanese robotics are conditioned by animism, ethics, and modernization, and traditional rituals in ordinary life strengthen the advancement in robotics in Japanese society [11]. While these studies shed light upon aspects of relationships between religion and robotics in Japan, few studies describe how a robotics engineer examines the significance of robotics technology from a religious perspective, simply because robotics engineers are not typically well versed in religious teaching and traditions. The exception is Dr. Masahiro Mori (born 12 February 1927), who is well known for having invented the concept of "Uncanny Valley" [12], an English translation of the Japanese words of "Bukimino-tani" that Mori coined in 1970 [13]. Since Freud used the term uncanny, many Western scholars speculated about Freud's influence on Mori's discovery of "Bukimino-tani"; however, Mori's writings suggest that he grasped the notion of "Bukimi (Uncanny)" intuitively and originally without any influence from Freud's concept. Mori was officially acknowledged as the original inventor of the con-

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cept of “Uncanny Valley” at the special forum at International Conference on Intelligent Robots and System (IROS) 2013 [14]. While several studies focus on his notion of uncanny valley [15–17], most of them are unaware that Mori is a Japanese scholar with a rare interdisciplinary combination of a robotics engineer, an educator as an originator of the Robot Contest, and a practitioner and teacher of Zen Buddhism.

Mori is one of the earliest generations of robotics engineers to work and teach at a university in Japan since 1960s. In his profession in robotics and engineering, he chose not to follow and imitate the so-called latest research in America that other young Japanese scholars went abroad to learn, and instead conducted his research and experiments in Japan. His intellectual attitude thus reflects his conviction that a Japanese engineer could be creative and innovative without imitating American studies. However, Mori has never been in any sense a narrow-minded scholar, but has rather been confident in the cultural and religious traditions he later discovered.

While serving as the President of Japan Society for Robotics from 1987 to 1989, Mori studied Mahayana Buddhism and practiced Zen for many years. He has written several books on the teaching of Buddhism, not as a Buddhist scholar or a Buddhist monk, but as a robotics engineer and a lay Buddhist. His role as an engineer enabled him to see, read, and experience Mahayana Buddhist teachings in a new adoptive way in relation to secular and technological society, and he regards his Buddhist experience as a source of technological innovation. By learning the teaching of Buddhism and practicing Zen meditation, Mori enables people to become technologically creative by releasing the mind from being embedded with epistemological and linguistic duality.

From the perspective of a scholar of religion, Mori's case is particularly interesting and instructive for studying what religion is today because, as an engineer and a practitioner of Buddhism, he shows how to recognize religious meaning in technology. Additionally, his case also illustrates the problematic natures of the modern study of religion because Mori interprets the traditional teachings of Buddhism in an unexpected, non-religious, and secular setting, where ordinary scholars of religions have never imagined to locate religious meanings. Mori's approach might be similar to what Stephen Batchelor calls “Secular Buddhism” [18], while a common Western view of the relationship between techno-secular society and its religious aspect is, as Szwerszynski argues, rather antagonistic [19]. Furthermore, according to Rustom Roy, what makes the relationship between religion and technology more complicated is the view of technology as “the world's most power-

ful and fastest growing religion” [20]. Roy argues that since both technology and religion involve and control human practice and experience differently, they could be antagonistic or ignore each other [21]. Studies on the relationship between religion and technology such as Koslowski's edited book tend to be oriented toward the issue of nature [22]. As readers will find below, this paper's overall focus is a little bit similar to what Jeremy Stolow writes that “modern technologies have thus come to be understood as possessing transcendent or uncanny features, the encounter with which is phenomenologically comparable with the performative techniques of prayer, ritual action, or magic, or with the ‘religious’ experiences of ecstasy and awe” [23], though any papers included in his edited volume do not cover any robotics. Recently, a group of scholars of religions accepted the challenge posed by these new technologies such as digital technologies and AI, and began to examine the significance of them for religion [24]. In 2017, the author published an article on the relationship between religion and robot/AI from the perspective of sociology of religion [25].

Because this paper is addressed to English-language readers mainly both in robotics and Buddhism studies, and Mori's engineering career was in Japan, this paper requires a cautious approach to his view of the relationship between Buddhism and technology in the contemporary global intellectual context. A certain uncritical assumption among some Western philosophical studies of Buddhism is that a culturally assumed uncritical acceptance of Western philosophy and recent cognitive science could be an intellectual norm through which either analytical or interpretative studies of Buddhism could be possible [26]. Quite often, some Western scholars of Buddhism are unaware of relatively long modern critical studies of Western philosophy in Japan. Furthermore, they are quite unfamiliar with social criticism of the Western intellectual traditions by the Western scholarship.

In this paper, I approach Mori's view of the relationship between Buddhism and robotics in a more retrospective and organized manner than a chronological and developmental order because most readers are robotics engineers rather than humanities religious scholars. A few words are necessary regarding how to evaluate Mori's writings in the contemporary scholarly context since many of them were written in Japanese from the 1980s up until the early twenty-first century. Since he was one of the leading scholars in robotics and industrial design, he was well informed with the then cutting-edge technology that had just been invented and constructed by a selected few specialists but afterward became parts of the everyday technological scene. In addition, his views and ideas on the relation-

ship between Buddhism and robotics, including AI, which he expresses in rather casual written forms, were later examined and written in English by Western scholars. For example, James Hughes examines the Buddhist approach to compassionate AI and selfless robots in 2012 [27]; however, his main points were already discussed by Mori in the late 1980s [28]. In this paper, I locate Mori's works in the contemporary scholarly context, but it is essential to keep in mind that Mori was ahead of his time.

While I refer to a few roboethical topics that emerge from within Mori's Buddhist philosophy of robotics, the primary interest is not so much on Ethical, Legal, and Social Issues aspects of his robotics as on issues such as the ethical personality, quality of minds, and experiences of engineers as key components in and for an "ethical design" of robots. This paper will shed light on the significance of intrinsic relations between the engineers' minds and the way they think of robotics. This paper is divided into three sections. In Section 2, we examine Mori's view of Zen as a spiritual source for technological creativity. In Section 3, we examine his view of the robot contest as a location of a realized teaching of Buddhism, especially in relation to the Diamond Sūtra, to ascertain Mori's educational contribution. In Section 4, we explore how Mori became engaged to learn and practice Buddhism and came to the realization of Buddhahood in relation to robotics.

2 Intuition and learn the backward step: Zen as a spiritual resource for technological creativity

Due to the recent popularity of mindful meditation, many people in Western society already understand how meditation allows a person to focus and release the mind. However, the effect of meditation is not limited to this psychological wellness. Recently, both theoretical and empirical studies of the relationship between intuition and creativity have been conducted. Officer suggests that the relationship between intuition and innovation is a new topic to be explored [29]. Schwartz focuses on the relationship between intuition and creativity/innovation as one of the unexplored areas of research by referring to historical cases such as Einstein, Paul Ehrlich, and Mikola Tesla [30]. Schwartz summarizes factors leading to intuitive creativity as follows: intellectual excellence, the deep knowing that a solution to the challenge does exist, strategies of inward looking, surrender, the moment of illumination, and intellectual explanation and verification. In their em-

pirical study, Raidl and Lubart define creativity as "a capacity to produce work that is both novel and appropriate, given task or situational constraints" and explain three types of intuition: socioaffective intuition, applied intuition, and free intuition [31]. The first type of socioaffective intuition concerns interpersonal relations and operates typically when seeking to understand a person or a situation. The second type is directed toward the solution of a problem or accomplishment of a task. The third involves a feeling of foreboding concerning the future. Raidl and Lubart employ Rational-Experiential Inventory (REI) and the Intuitive Behavior Questionnaire (IBQ) for their empirical research and argue that the IBQ shows a strong co-relationship between intuition and creativity. Furthermore, Marder makes an interesting scholarly development in the study of intuition by arguing that intuition is becoming increasingly important, since rational thinking cannot deal with the huge amount of data and information that technology, such as IT and AI, accumulates [32]. Recently, Eling, Langerak, and Griffin attempted to explore the temporal sequence between intuitive and rational evaluation in early New Product Idea Evaluation Decision by recognizing the importance of both approaches [33].

In light of this context, Mori already advocated in the 1980s, without any hesitation, that Zen or Zen meditation could be the spiritual resource for grasping an idea intuitively for designing a new technology, an industrial design, or a new device. His innovative works in robotics engineering in the early 1970s, such as a robotic hand and a robot walking with two legs, were cutting-edge scholarly achievements at that time. However, his area of scholarly work is not confined to what is known as robotics today; he also helped a company to redesign a chemical factory as a controlled autonomous system. Since Mori was regarded as one of the leading scholarly innovators during his active career, he was approached by various companies to provide advice and suggestions for obtaining clues into developing new technology.

After teaching at the Tokyo Institute of Technology, Mori established and managed the private Institute of Mukta (Jizai) for a few decades from 1987, where he taught his visions to many engineers from various companies. The records of his lectures to these engineers indicate that Mori explains Zen Buddhism by referring to cases of industrial design and robotics. This approach is certainly Mori's distinctive and original contribution to a contemporary view toward understanding Buddhism compared to the religious and Buddhist scholars who most likely refer to cultural, literal, and religious materials when explaining the teachings of Zen and Mahayana Buddhism. From the viewpoint of religious scholars, Mori teaches Zen and

Mahayana Buddhism not only as a way of life, but also as an invaluable resource of creativity and innovation in engineering and robotics. Mori has the opinion that religious intuition and scientific/technological intuitions are the same (Kimura T., an interview with Dr. Masahiro Mori at his house on 12 August, 2015). He sees the source of creativity and innovation leading to a new technology out of a Buddhist experience of non-duality-oneness that Zen teaches.

Engineers who have worked at those engineering companies need to receive the lessons and teachings of Zen Buddhism in an engineering manner. Mori strongly believes that his understanding of experiencing non-duality oneness as the source of creativity and innovation could be the basis for many engineers from a variety of disciplines to receive ideas intuitively and create new innovative technology that would contribute to solving global problems.

However, many engineers and industrial designers face difficulties obtaining such ideas in the process of designing and developing a new technology. In response, Mori teaches them to learn the backward step (退歩, taiho). According to Mori, scientists and engineers are both trapped in the myriad of progress and epistemological duality that made people blind, preventing them from being able to see things as they are. The backward step is taken from the Zen master Dōgen's words (E. Dōgen, *The Zen Site: Fukanzazengi* [Universally Recommended Instructions for Zazen]) and means that, instead of looking for a solution outwardly, it is necessary to sit still and look for a solution inwardly. By turning conscious attention from an external to an internal view and by focusing attention inwardly, it is possible to be released from the entangled web of duality that appears to obscure intuition. As the epistemological duality does not enable people to see things clearly, it is necessary to see things as one; for example, for a car to run, it requires both the accelerator and brake, whose functions are oppositional. It is a sort of religious awakening to be able to see things as dualistic oneness in his explanatory terms for engineers, where duality represents technological oppositions and oneness represents a sort of holistic perspective. Mori's explanatory term of dualistic oneness is equivalent to non-dualistic oneness in religious terms, which allows engineers and robotics scholars who need to design new technology to see non-dualistic oneness, since engineers and robotics scholars need to learn the circular relationship between technological duality and Zen oneness.

Technological duality inevitably leads to a question regarding the relationship between good and bad in designing and employing technology. One roboethical question is whether an individual robotics scholar should bear

the ethical and social responsibility of designing and developing a new technology that could be employed with a harmful intention. With the rapid progress of AI, an important and rather urgent question is whether it would be possible to install AI to acquire an ability to make a good-bad judgement or make a judgement that would prevent harm to humans. Mori's position in relation to roboethical issues is summarized as the Buddhist notion of the Principle of the three kinds of natures: good, bad and neutral (三性の理, san-shō-no-ri), which could be interpreted to represent a view of technology in essence as value-neutral (無記, muki), and that it is a human's intention to decide whether a certain technology is good or bad. However, the kind of technology Mori refers to is a rather simple kind, such as a knife, which could be good if a doctor uses it for an operation, but could be bad if a gang uses it for stabbing and harming a person. Mori sees no difference among the simple level of technology and complicated technology such as robotics and AI in terms of ethical evaluation of technology. However, as technology becomes increasingly complicated and powerful, Mori sees the increased danger and destructive force of these technologies once they are used with an evil intention. In this context, Mori emphasizes the necessity for human society to learn religious teachings, especially Buddhism, because the coexistence of human and robotic technology is inevitable. Human society needs to learn how to design, control, and utilize certain kinds of robotics technology to promote a good society. However, Mori does not merely advocate mere ethical employment of robot technology: he advocates a religiously-grounded-roboethics, more precisely the roboethics grounded in Zen Buddhism. Mori does not feel any contradiction between being a robotics engineer, which is often regarded as a secular profession, and being a Zen practitioner and scholar of Buddhism. Being a Zen practitioner allows him to be not only technologically productive but also ethically sound by recognizing the problematic nature of being a human in accordance with the traditional Buddhist teaching. Nevertheless, in a Kantian manner, he does not provide any sense of ethical categorical judgement.

A question arises regarding why Mori emphasizes the importance of grounding technological intuition and designing a religious worldview. Through his writings, he implies that some engineers and technological researchers might focus solely on designing and constructing a kind of technology according to economic and corporate reasoning, a sort of instrumental reasoning without considering the significance of intentional and unintentional consequences by separating an external perspective from an internal reflective thinking. Those engineers who are

employed by military companies feel obliged to design and create a new technology which could become part of a weapon to ensure economic stability. These engineers should learn to meditate, and withdraw themselves mentally from the company and its epistemological and moral framework to reorient their perspective toward the internal mind so that they can regain perspective into who they are ontologically, although Zen Buddhism does not necessarily ask any ontological questions.

Despite these positive outlooks, some might call attention to an unrecognized view expressed by Mori's employment of Zen meditation as a potential source of technological intuition and innovation that would contribute to transform Zen meditation into a potential form of social capital - a spiritual resource for enhancing industrial society. Instead of encouraging an engineer to learn to sit, to experience a deeper meaning of being a human as taught by these Mahayana texts, and to release him or her from the complicated web of techno-society, Mori's approach might appear to some untrained eyes of those engineers as an instrumental approach to a Zen teaching, even though such an interpretation might be opposite to his intention. However, those engineers might accept the Zen teaching merely as another form of secular Buddhism.

3 A robot contest for experiencing the teachings of the Diamond Sūtra

Mori is also known as the initiator and originator of the Robot Contest, which is an educational occasion for young junior high school students, high school students, and college engineering students to form a team to design, construct, and create a kind of robot that responds to the contest requirements [34]. Interestingly and unexpectedly, Mori sees Buddhism's wisdom working in the developmental and experiential processes these young students have gone through by referring to the text of the Diamond Sūtra. Furthermore, he coined the term Gido (Gi=技, Do=道, an approximate translation is the way of technology) for these young students, surely alluding to Japanese traditions such as the Tea Ceremony (Sa-do, Sa=茶=Green Tea and Do=道=Way) and Flower Arrangement (Ka-do, Ka=華=flower and Do=道=Way).

Mori introduced the robot contest first at the Tokyo Institute of Technology in 1981. Similar robot contests were later introduced at 62 National Colleges of Technology. At the university level, robot contests began at the Tokyo In-

stitute of Engineering and MIT in 1990, and the university level Robo-Con became the International Design Contest in which 20 countries now participate. As the National Broadcasting Association (NHK) broadcasts Rob-Con every year in Japan, it became very popular not only among engineering students and engineers, but also among ordinary citizens. Anyone who has a chance to see any of these Robo-Cons would agree that they are quite secular, engineering-based, and non-religious social gatherings.

One intriguing case Mori often refers to is the case of a robot contest from a junior high school in Aomori, which did not have a good reputation [35]. In 1991, a young teacher named Shimoyama introduced a robot contest to his junior high school. He planned to do it for just one year, but the principal urged him to continue the contest the following year. Since then, the robot contest has become a unique educational program at this junior high school. Students of the school write essays about their experiences of the robot contest. One student wrote that he could think about nothing but robots all day throughout the preparation period and the robot contest because he became completely absorbed by the task. Another student began writing his essay by saying that it was "stressful but enjoyable," and another student wrote that he learned to be cooperative with other students to achieve a shared goal. There are many other interesting essays Mori likes to refer to, but the point he makes is that these young students grow emotionally, intellectually, and personally through participating collectively in designing, constructing, and making robots for the competition. Mori emphasizes that a robot contest is not just a matter of creating technology, but it could be a unique experience for young students. Students become more internally mature through participating in a robot contest. These students experience a sort of Zen experience, referring to Dōgen, a Zen master's statement: "To learn oneself is to forget oneself" (Dōgen, The Zen Site: The Shōbōgenzō).

Mori further explains that these students were guided to be engaged in designing, constructing, and changing a robot, through which they were drawn to a state of consciousness of becoming one with the robot. Viewed from a different perspective, the robot to be designed, constructed, and made by students is actually the one that guides them to reach a state analogous to beyond division between "subject" and "object," or "I" and "it," therefore, functioning as if it is Bodhisattva (One who seeks awakening) [36]. Mori shows that in this secular and technological society, those who are engaged in making secular and non-religious technology can experience a sort of "religious experience." What these young students experience when designing and constructing a robot becomes symbolic of

what Zen Master Dōgen taught, without their acknowledgement. Dōgen wrote in the Manual of Zen Meditation as “To undertake enlightening the whole universe through one’s training while carrying the burden of a self is a delusion: to enlighten oneself through training while urging all things onward is an awakening from delusion. (Dōgen, On the Spiritual Question as It Manifests Before Your Very Eyes (Genjō Kōan), The Zen Site: The Shōbōgenzō.)

Furthermore, Mori emphasizes that these young students experienced the teaching of the Diamond Sūtra (Vajracchedikā-prajñāpāramitā-sūtra [金剛般若經, Kongōhannyakyō]), unknowingly. The Diamond Sūtra is one of the oldest Pāramitā Sūtra (prajñāpāramitā-sūtra), even older than the Heart Sūtra (Prajñāpāramitā-hṛdaya) [般若波羅蜜多心經, Hannyaharamitta-shingyō]. The Diamond Sūtra is known for the dialogue between Buddha and an elder Subhūti, expressing the concept of emptiness (suññatā, 空), without using the concept. Even though those young students have never read the Diamond Sūtra, their experiences during the robot contests indicate that their experiential dimension is interpreted as reflecting the teaching of the Diamond Sūtra. Mori’s engaged life as a Zen practitioner and robotics engineer allowed him to recognize that what these young students were experiencing exactly represents the world of the Diamond Sūtra [37].

The Diamond Sūtra and the Heart Sūtra are known for their contradictory logic. According to Nagatomo, the Sūtra “presupposes that the perfection of wisdom is realized by letting the practical take precedence over the theoretical... it centers on the idea of practically perfecting the goal of wisdom that functions like a diamond or a thunderbolt, such that it severs ‘all doubt and attachments’ from the cognitive activity of the human being where the metaphors ‘diamond’ and ‘thunderbolt’ designate the non-discriminatory activity of the mind” [38]. To express the idea of practically perfecting the goal of wisdom, a logic employed in the Diamond Sūtra is called the “logic of not” in the words of Hajime Nakamura. Throughout the dialogue, the basic concept is stated in a propositional form: “A is not A, therefore it is A.” To understand its logic, Nagatomo argues that it is necessary to shift from an Aristotelean dualistic, egological stance to a non-dualistic, non-egological stance. Examples from the Diamond Sūtra are (1) “the world is not the world, therefore it is the world” (section 13-c); (2) “All dharma are not all dharma, therefore they are all dharmas” (section 17-c); (3) “The perfection of wisdom (pāramitā, prajñāpāramitā) is not the perfect of wisdom, therefore it is the perfection of wisdom” (section 13-a); and (4) “A thought of truth (bhūtasajña) is not a thought of truth, therefore it is the thought of truth” (section 14-a). These quotations are taken from the conver-

sation between Buddha and Subhūti, the Venerable Elder; therefore, it is not so easy for ordinary readers such as ordinary junior high school students who lack basic knowledge of the literature of Pāramitā (prajñāpāramitā) to understand. Yet, experientially speaking, those students experience the teaching of the Diamond Sūtra.

This case highlights the importance of the Mahayana teachings in the secular and non-religious activity. In this regard, the Diamond Sūtra finds unexpectedly its acceptance in the Beat Generation in the USA. According to Menefee, Jack Kerouac “synthesizes Buddhist concepts from the Diamond Sūtra and Dostoevskian motifs from *The Brothers Kamarazov* to articulate his vision of universal compassion and brotherhood” [39]. Taking literary work as a secular and non-religious activity, it is interesting to note that the Diamond Sūtra has deep implications because it provides religious insights into a secular creativity. Writing literary work and constructing a robot are both quite secular activities, yet both show a possible contribution of the Diamond Sūtra to modern secular lives. With the case of Jack Kerouac in mind, Mori’s view of the hidden teaching of the Diamond Sūtra in the experience of young school students who were fully engaged with designing and making a robot makes more sense to some Western readers.

Nevertheless, a question arises about the minds of other engineers participating in robot contests who come from different religious backgrounds, such as Christianity and Islam, since the robot contest became a worldwide competition. Mori’s view would be easily acceptable to Japanese students, but it would be difficult for non-Japanese engineering students to understand and accept what Mori attempts to explain. It would be an interesting cross-cultural and religious research idea to examine how different religious contexts enable teachers and professors to find any religiously verifiable meanings to these young engineering students’ experiences of designing, making, and constructing a robot.

4 Robotics and Buddhism

As the recent case of a robot monk named Xiwen at a Buddhist Temple near Beijing, China shows, some Buddhist temples approach the latest technology and incorporate it from a practical viewpoint. The relationship between robot technology and Buddhism is interesting not only in terms of the philosophy of mind and cognitive science but also in relation to spiritual growth [40]. The funeral service at a Buddhist temple for the old type roboto dog AI-

BOs, whose parts for repair were no longer available [41], is another interesting and eye-catching case, but Mori's case shows deeper and more philosophical issues. The following section briefly examines how Mori's engagement with the teaching of Buddhism would address an issue of ethical personality for a robotics engineer, how it would nurture and deepen his quality of mind, and why and how it would be relevant to an "ethical design" of robots.

Mori became interested in learning Buddhism after he became a professional robotics engineer. It was not any existential concern that gave Mori the impulse to study Buddhism. It was at a social occasion that he heard a humanities scholar giving a lecture to a group of engineers and saying that engineers had no philosophy. In reaction, Mori decided to study philosophy personally and chose Buddhism. Back then, most people thought that Buddhism and robotics had nothing in common; however, Mori came to know a Rinzaï Zen master Eizan Gotō in 1969, with whom Mori began to study the Mahayana Buddhism and practiced Zen [42]. By doing so, Mori constructed a cultural frame with which he could interpret the potential significance of technological advancement within the teaching of Buddhism.

His books on Buddhism are original in that he refers to many examples of engineering and robotics in his explanations of the teachings of Mahayana Buddhism compared to most other books on Buddhism written by Zen monks and Buddhist scholars, whose references are mostly from cultural and social items. Precisely in his reference to these mechanical examples, one of his original thoughts is found in his understanding of the Mahayana teachings of Buddhism. It is important to emphasize the Mahayana aspect of Buddhism since Mori was primarily an engineer, who became a practitioner and writer of Buddhism.

Mori's books can be classified into several categories. The first category is engineering and robotics, which includes mainly the products of his professorship at the Tokyo Institute of Technology, targeting mainly college students [43, 44]. The second category is educational books for robotics engineers with some Buddhist insights [45, 46]. The third category is his books on Mahayana Buddhism [47–49], where Mori explains the teaching of Mahayana Buddhism and references many cases of engineering, technological innovation, and electronics. The second and third categories are more important than the first for the purpose of this paper, although he wrote many of the books in these categories after retiring from the Tokyo Institute of Technology. In the second and third categories, Mori covers the variety of issues, yet due to space limits, I will only refer to a few relevant topics below.

Throughout his writings, it is evident that Mori's understanding of Mahayana Buddhism teachings deepens, develops, and grows alongside his career as a robotics engineer. Since his first objective was to create a robotic hand in the 1960s, it is important and necessary for him to grasp structures and functions of biological entities and life forms to design and construct a robotic machine. While he was attempting to make a robotic hand, while gazing at a crab, he recognized the structures of the crab's scissors and the asymmetrical sizes of the right and left sides [50]. He attempted to incorporate this finding into his design of a robot hand, and by doing so, he gained a deep insight into the structure and meaning of biological entities. His approach could be considered the beginning of what later became known as biomimicry thinking (Biomimicry Institute). While recognizing that evolutionary and functional explanations of these developmental differences are common, Mori looked for something beyond sheer scientific explanation.

Mori's interest in the relationship between life-form and technology led him to a new insight into the Mahayana teachings of Buddhism. For example, when he was a small boy, he wondered why a dog walked on four legs. After he began to design and build a robot, one day he suddenly understood intuitively why a dog walked on four legs. When he was totally absorbed in thinking about how to design his new robot, he realized that it is a dog's Buddhahood; therefore, a dog walks on four legs. Although he does not refer to any kōan, a metaphorical story for Zen practice, when referring to this episode, there is a well-known kōan from The Gateless Barriers. A monk asks, "Does a dog have Buddhahood?" The master replies, "Mu (Nothing)" [51]. The novice monk spent all of his time in a monastic life while Mori worked at the secular and technological environment. However, Mori reached a somewhat similar realization to the monk at the Zen monastery.

Mori's episode is instructive because it shows how technology and robotics are not just a matter of mechanical engineering. His serious and detailed observation of structure and function of living creatures provides a clue to his design and construction of a robotics engineer, which in turn offers him an intuitive comprehension of his childhood question. His childhood question does not take any form of Zen. Yet, he reached an answer through his intellectual experience as a robotics engineer, and it appeared as a sort of Buddhist insight reaching an existential dimension. It is possible to recognize a triangular interrelationship among biological observations, robotics design and the development of an ethical personality.

An interesting point is the difference between his interest in the form and mechanism of a dog's walking style

and the traditional reading of the kōan from The Gateless Barrier. One of the traditional readings of the kōan is that it is important not to cling to one's pre-conceptual notion of making a distinction between a human and a dog. Focusing on the concept of a dog is surely a sign that the monk is still trapped within the dividing and classifying conceptualization. Yet, Mori's question is more likely a sort of bio-mechanical and engineering question about why a dog walks with four legs. He did not ask if a dog has a mind or not, nor if a dog has a Buddhahood or not. This non-religious questioning is instructive in interpreting Mori's approach to Buddhism.

In Mori's case, Mahayana Buddhism teaches ordinary believers how to attain awakening in the midst of this world, whereas robotics engineers are working to improve social life technologically. Mori knew well that a robot as a machine functions in and for a this-world-oriented secular society, where a human's worldly desire is an indispensable reality. In referring to the then latest advancement in AI, Mori as a Buddhist writes that though he felt sorry, he would like to see a robot feel a worldly desire or crave the passion to feel suffering if it could ever acquire AI or a mind-like intelligence. It is a different kind of question emerging from a view of a robot as a moral agent which could make inferential ethical reasoning. In discussing a self-interested robot, McDermott appears to come closer to a point similar to Mori [52]. Yet, Mori's argument is grounded in the view of Buddhism. On the surface, his statement appears strange, since worldly desire is a source of suffering from which a Buddhist tries to escape. On a deeper level, it seems to him that a philosophical and engineering scheme to install a rational epistemological cognitive function into a robot is a shallow view of the structure and function of the human mind, after whose model a robotic engineer has attempted to design and construct a mechanical humanoid. Some might ask if it would be roboethically acceptable for a robotics scholar to design and create a robot who feels craving, suffering, emotional pain and agony. A robot with AI that is capable of feeling craving, suffering and pain would become a better moral agent since there are many not-so-clear-cut situations in which a human and a robot need to interact with each other. Mori seems to imply that to make a robot-being an empathic companion for a human would require that it understands how a human feels craving, pain, suffering, and agony; otherwise, most humans would not accept a robot as their friend and close fellow.

5 Conclusion

In this essay, we attempted to examine the issues of the ethical personality, quality of minds, and experiences of engineers as key components in and for an "ethical design" of robots by examining some aspects of Masahiro Mori's Buddhist Philosophy of Robotics. In Section 2, we examined Mori's view of Zen experience as a source of technological innovation by referring to the notion of the backward step. In Section 3, we discussed Mori as an educator, especially as an originator of the Robot Contest. Mori does not regard this robot contest as a mere occasion of technological education, but rather as an important experiential occasion for youths who experienced the teaching of the Diamond Sūtra unknowingly. In Section 4, we examined Mori's basic view of the relationship between Buddhism and robotics and observed how Mori's career as a robotics engineer and a student of Buddhism went deeper side by side.

Mori does not shave his head, nor wear the attire of Buddhist monk, and he appears as an ordinary elderly person today. In several sections of his writing, Mori incorporates his knowledge of science and technology and the teaching of Buddhism into one broad view of the universe. His Buddhist philosophy of robotics is far broader and deeper than what I have examined in this article. Furthermore, the teaching of Buddhism helps robotics engineers to view technological learning, not only by acquiring material skills but also through mental and spiritual growth. Some might think that as a cultural tradition, Buddhism might be more suitable to Japanese students of robotics and robotics engineers than Western philosophy and ethics. Many Japanese robotics engineers read and study Western philosophy and applied ethics, and Mori's Buddhist philosophy of robotics stands out as a unique contribution.

Acknowledgement: The author is indebted to anonymous reviewers and editors for valuable comments on an earlier draft.

Funding: Part of this work is supported by JSPS KAKENHI Grant-in-Aid for Scientific Research (A) Grant Number 15H01708. English editing is financially supported by ICR, University of Tsukuba.

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