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EMOTION AND BODY MOVEMENT

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ABSTRACT

Human needs shift from material to mental with time. And the final need is Self-Actualization. In other words, our needs shifts from product to process. We actualize ourselves to satisfy our emotions. Emotions are interpreted as our feelings toward outside stimuli. But as the fact that etymologies of emotion and motivation come from the same Latin “movere” indicates, emotion means that we are stimulated and motivated by the environment and situation, so that we “move out” into the Real World to establish our own world. It is said that only humans can think about the future. That created “Engineering” to make our dreams come true. As our needs started from material, we eventually looked for better products and for better technologies. And it brought the Industrial Revolution. But the Industrial Society is getting to its ceiling and we need to explore a new society which is emotion-focused. Another important point which we discuss here is the importance of body movement. Although DX is getting wide attention these days, Analog plays an important role in the Real World. Blood is analog and it carries signals and keeps our body organ running after brain death. And Blood and Body Movement plays a crucial role in arousing emotion. When our heart leaps up, our blood boils. And the idea of weight, length are based on our deep sensation of our body movement. This paper discusses how emotion and body movement are deeply associated.

Keywords: Emotion, Body Movement, Self, Proprioception, Instinct

1 MOVEMENTS

Living things are called “Creatures”. Why? It is because we. Living things, “Create Movement to Survive”. Movement is indispensable for living. Human movements are divided into two: One is Motion, which can be observed from outside. The other is Motor, which is the movement inside our body, such as muscles, etc.

Nikolai Bernstein clarified the behavior of Motion (Bernstein, 1967), (Figure 1).

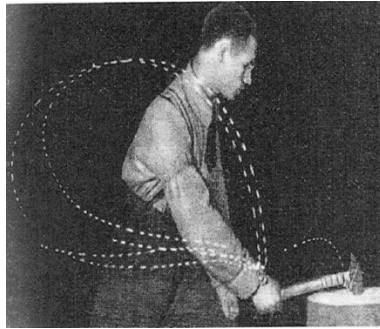


Figure 1. Motion

At first, our motion trajectories vary widely from time to time. But as we get close to our target object, muscles harden and move together with the skeleton. So, we can easily identify parameters in this musculoskeletal system and control its trajectory. Most studies on human movements focus on this stage and discuss control.

But why does it vary so widely at first. It is to cope with the continuously changing environments and situations. We coordinate all parts of our body to deal with the changes. So, although we are observing motion, we mobilize motor to make strategic decision what actions we should take. We “sense” the situation by “feeling” body movement. Motor, such as muscles, plays a very important role.

2 WHAT WE CAN LEARN FROM THE OCTOPUS

Peter Godfrey-Smith published a very interesting and enlightening book (Godfrey-Smith, 2016). He tells us we can learn many things from the octopus. They die immediately after their babies are born, So, they do not inherit knowledge from their previous generation. They have no other way but to live on their own instinct.

They have eight arms, and they coordinate them very skillfully. Their heads are very large, but these heads are used for coordinating the arms. They are known as the “expert of escape”. They can escape from any environments and situations. Surprisingly enough, they can escape even from a screwed container. If we, humans, put in the same situation, we would be panicked and may not do anything.

Although their heads are very large, the brain is small, and its capability is about the same level as that of a dog. But it is Body that interacts with the outside world directly. And Body interaction is not only direct, but also it is done in real time.

Brain receives information from Body and accumulates them and structure them into Knowledge. Thus, knowledge is a thing of the past and it is very much personal. Our body builds and the ways to move our bodies are different from person to person. So, Knowledge is just “feedback”. To move appropriately, we need “feedforward”. The octopus teaches us how we can make the most of our Instinct

The octopus is invertebrate, and the human is vertebrate. They are positioned on the opposite side of the Evolution Tree. But humans rely on Brain, while the octopus rely on Body. Thus, intelligence of the octopus is Body Intelligence, while that of the human is Brain Intelligence. We should remember that the word “Intelligence” originates from the Latin “to understand the situation”. So, the octopus is truly intelligent.

Further, the octopus can recognize self in a mirror. In invertebrates, only they can. In vertebrates, only humans and apes can. Why they can recognize themselves in a mirror is because they can “feel” the movement of their bodies. They see the mirror and the image there moves in the opposite way. So, they understand the image is theirs. They can “feel” how their bodies are moving. Dogs can see their images in a mirror, but they cannot be aware that the image is theirs (Figure 2).

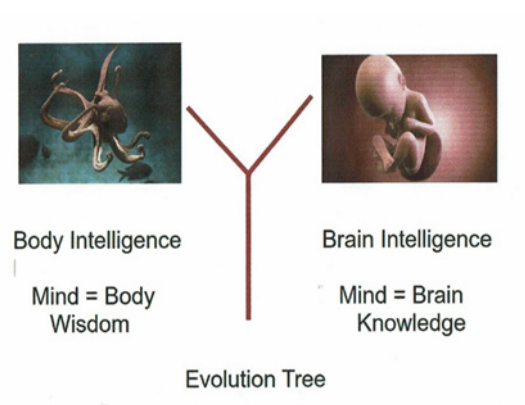


Figure 2. Body Intelligence and Brain Intelligence

3 EMOTION, MOTIVATION

The etymology of Emotion and Motivation is the same. They originate from the Latin “movere (motion)”. Thus, emotion means to move out (e=ex=out).

So, we cycle the loop (Figure 3). We perceive the environment holistically and become aware of the environment and the situation. That motivates us to act, and we make a decision what actions we will take. The action brought us emotional excitement and motivate us to go further (Figure 3).

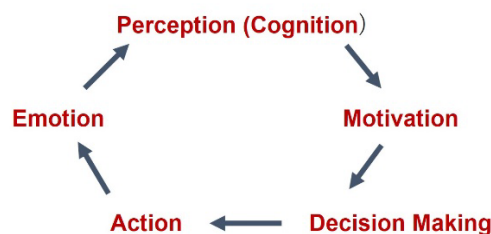


Figure 3. PMDAE cycle

4 DIGITAL, ANALOG

As described earlier, movement is indispensable for living. Another important thing we should remember is blood is analog. Blood carries signals to all parts of our body. We are focusing on Brain too much. Indeed, Brain plays a very important role. But even after brain dies, blood circulates all over our bodies and we are still living. That's why we can transplant body organs even after brain death.

Medical doctors watch blood flow. They can understand the situation and come up with the diagnosis. Current computers, however, are processing numbers, based on 0-1 framework. So, DX works well with the current cardinal based Euclidean approaches. Their approach is discrete. But most objects are hard, and analog. So, not much attention has been paid to direct interaction with the outside world until recently. We could identify what it is by our eyes alone, even from a distance.

But with remarkable progress of material engineering, materials are getting softer and softer. So, to identify what it is and to find out how to handle it, direct interaction becomes necessary.

5 HUMAN NEEDS

Maslow clarified Human Needs (Maslow, 1943). He pointed out that our needs shift from material to mental with time, and "Self-Actualization" is the highest. "Self-Actualization" is nothing other than emotion and it interests us to know that his paper is titled "A Theory of Human Motivation". He clarified what needs motivate us to action (Figure 4).

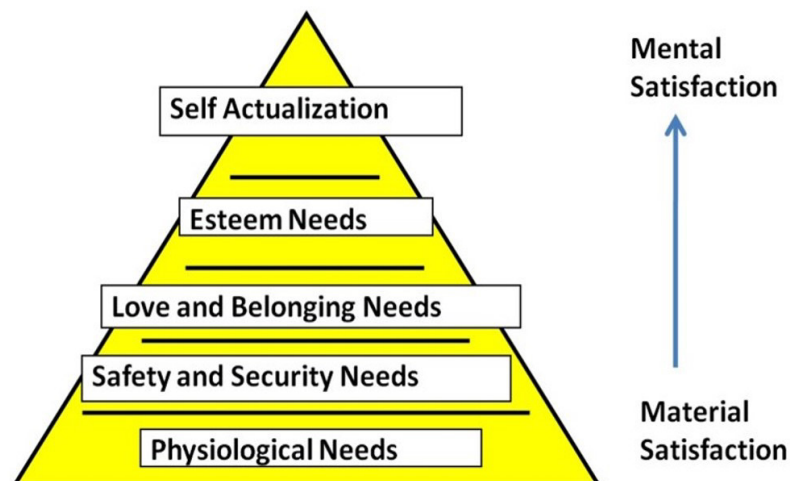


Figure 4. Maslow's human needs

6 HEART, MIND

Figure 5 shows Mind-Body-Brain. As Mind contains Body and Brain, and we say "Make up your mind" when we ask somebody to decide, so the topic of Mind often comes up. Mind is rational. When our needs are material- or product-centric, we needed cardinal and logical thinking. In another word, Euclidean space approach.

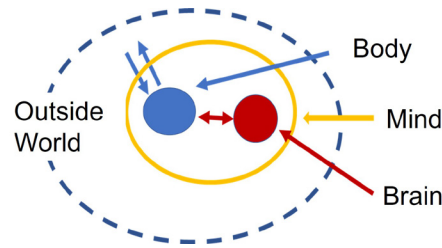


Figure 5. Mind-Body-Brain

But as Maslow points out, our needs shift from material to mental, i.e., emotional. Then, it is better to discuss Heart more. Such expressions as “My heart leaps up”, “My heart beats fast” indicate that Heart is deeply associated with Emotion. But our shifts from products to emotion occur recently, so that Heart is rarely discussed in engineering.

In the field of technology, rational or quantitative approaches are important. But technology and engineering are different. Engineering started to make our dreams come true. So, engineering is a matter of Heart. We should focus more attention to Heart. Thus, we should keep in mind technology is rational. but engineering is emotional.

And if we pursue Emotion in engineering, we can develop another society for the next generation. It Is Self-Satisfying and Self-Sustaining Society (SSS). Then, we can come back to our old days and start to work for ourselves again. Now we are working for others in the Industrial Society. So, we cannot get the maximum satisfaction as Deci and Ryan pointed out in their SDT (Deci & Ryan, 1985).

But if our society goes emotional, then we will be happy, because we work for ourselves and we can satisfy our “Self”. And the society will shift from product-centric to process-focused. A typical example is Lego. They provide only blocks and customers build up their own products in their own way. They are no more consumers. They become truly Customers. They enjoy customizing the process. During this process of combination, their Heart is excited. It is no labor anymore. It is a joy.

7 MAHALANOBIS DISTANCE-PATTERN (MDP)

Based on the above discussion, Shuichi Fukuda developed Mahalanobis Distance-Pattern (MDP) Approach to process Analog data by combining Mahalanobis Distance and Pattern (Fukuda, 2022).

To process dynamic data, we can introduce Recurrent Neural Network (RNN). But RNN assigns links to nodes in a random manner. It is a black box. We cannot manipulate the system as we wish. Therefore, Reservoir Computing (RC) is introduced here. RC enables us to make adjustments at the output. So, we can manage the system as we wish (Figure 5).

Another great benefit of RC is it enables us to introduce micro technologies. So, we can make our sensors and actuators extremely small. In fact, we can make them part of our body. Up to now, machines and humans work in separate worlds. And machines follow human’s instructions. But now the true Things Team, which Ashton proposed in his IoT (Ashton, 2009), is realized.

Up to now HMI means Human Machine interaction. Their worlds were different. But now it means “Human Machine Integration”. Until now, we, humans, had to give instructions to machines, but since humans and machines are integrated, machines can play the role of humans. They can now understand what we want. If the handicapped needs help, they offer the help that is needed without any instructions. They can help the seniors to realize what they want. They can act spontaneously.

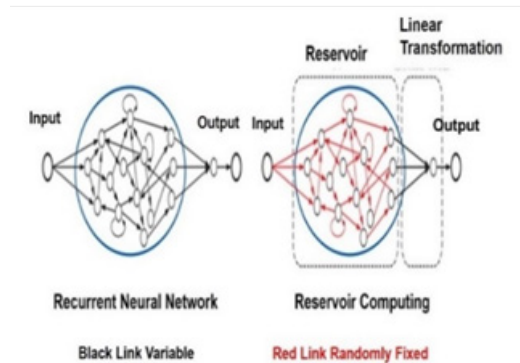


Figure 5. Reservoir Computing

7.1 Basic concept of MDP: Swimming as an example

Let us take swimming to explain how MDP works. In swimming, water changes from moment to moment. So, we cannot identify parameters and we cannot apply mathematical approaches. But if we put wearable sensors on the swimmer or take images of swimming, we can obtain the data sheet on the right (Figure 6). Each row represents individual muscle.

We apply MD to this sheet and compute MD between Time T_1 and Time T_2 . If MD is decreasing, that muscle is working all right. If MD is increasing, we need to change the moving style of that muscle to improve swimming. As our muscles and how we move them vary from person to person, there is no other way but to learn swimming on our own. Self-learning is the only way to learn swimming.

This MDP approach can be applied to other applications, such as in business, in team sports, and in many other fields. MDP approach is very useful for making strategic decision what action we should take.

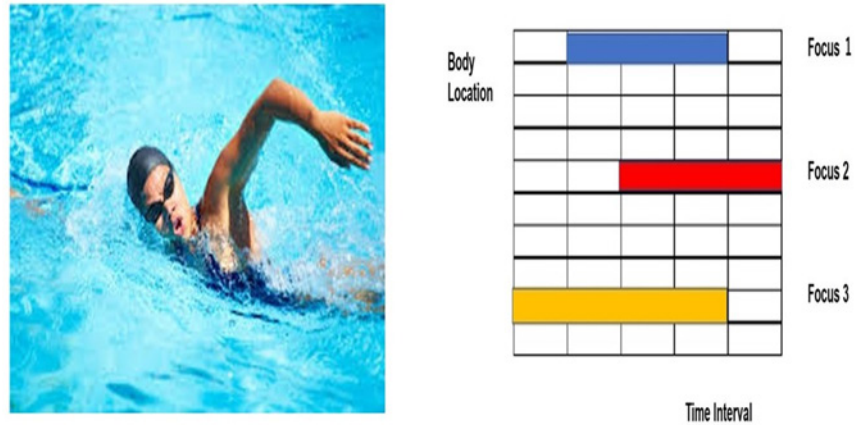


Figure 6. Mahalanobis Distance-Pattern (MDP)

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APPENDIX

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