Understanding of intelligence formation by logic circuits

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Abstract   The concept of intermittent and instantaneous logic circuits is useful to explain how computer or neural network works. Individual conditional reflex reaction is the elements of intelligence. It is tended to be considered analog because they apply to similar situations. However, the activity of real intelligence is carried out in large number of multiple open loop control. The operation of each element connects simultaneously occurred reactions by an AND circuit., and the input which is temporarily formed separately when the muscle is shared by various operations at different times is connected by the OR circuit. Computers that use addresses and address decoders to put data in and out temporarily work with external devices and other computers to realize the Internet.

Keywords   Formation of intelligence, Impulse, Logic circuit, Stored program system, Robotics, Internet.

1. Introduction

Since programming education is started at elementary school in FY2020, robots developed as teaching materials are attracting attention [1],[2]. The students in elementary school hear the word of AI and IoT, but many of them will not try to understand the electronic schematics and logical symbol drawings. The explanation using the technical term is difficult for beginners. The explanation of the term using the technical term is more difficult. It's normal to learn programming there and make the mechanism a black box.

However, it is human beings who make decisions. There are no living organisms in the world of information. The main purpose of this report is that the mechanism of intelligence can be explained by intermittent logic circuits.

The address of the information is written in the program of computer. So, CPU put it on the address bus and let the address decoder open the gate between the common line and the memory of an appointed address, and let the data be input or output. To send or hold information to the memory specified using the address in a moment is the most important step of intermittent intelligence movement.

Neurons output impulses at thresholds unlike linear circuits. The impulse transmits only in one direction by the residual effect of the reaction. The neural circuit is an intermittent open-loop control in which the neuro cell functions only at moment of the impulse.

In the past, some researchers had studied the shape of impulses that travel through neural circuits to see if they contain information, but no evidence equivalent to signals was found in the impulse waveform. In addition, there had not been no rule like Morse-signal in the serial arrangement of impulses in the neural circuit.

Organisms are maintaining the life by replacing molecules and ions in it [3]. The impulses transmitted by the neural circuit simply mean that the nerve cells satisfied the preconditions for the firing. In other words, the impulse is the sampling data, which informs that the nerve cells are in the state of firing conditions. There are multiple nerve cells that decode the pattern of impulses occurred at the same time. So, an information in a neural network is dynamically processed by such nerve cell where a nerve cell functions as relay points in a neural network.

On the other hand, the program of stored program computer is stored in the memory, and intelligent action is realized by the "call and return system. i.e. the main program calls a subroutine and it returns to the next step. The outline of processing of the computer is simple.

Today, teaching materials for programing on computers or robots are available.

Today, teaching materials for learning computer and robot are available. So, we have planned an "experiment of electronic circuits" to learn how the program system works.

The mechanisms of fundamentals of stored program system were learned through experiment of electronic circuits. The circuits were explained by schematics and real photographs. The electronic devices were inserted into the breadboard. The reaction is displayed by light-emitting diode(LED) [4].

This paper was written through the attempt to explain the mechanism of intelligence that intelligence is achieved by intermittently transferred activities.

2   The activities of life in the primitive Earth

Life activities were born with intelligence and evolved

together.

Cell membrane singing the starting point of the birth of life is mainly composed of $C_{16}H_{34}$(melting point 18℃, boiling point 287℃) or $C_{18}H_{38}$((melting point 30℃, boiling point 317℃). No biochemical reactions have been found that synthesize such long linear molecules of hydrocarbons. It must have been produced in the environment of early Earth. Because, atmosphere of the early Earth contained thousands of times of carbon dioxide (CO_2) compared with current atmosphere. And large amounts of CO_2 were contained in the sea water. So, large amount of hydrogen ions (H+) of the solar wind came from the Sun, and those collide with CO_2 in the atmosphere and produce hydrocarbon molecules.

Methane has melting point of -183℃ and boiling point of -162℃. The hydrocarbon molecules with a small number of carbon atoms remain in the sky as gas molecules. On the other hand, hydrocarbons with a lower melting point than the temperature of the earth's surface become solids. However, molecules of hydrocarbons with 16 or 18 carbon atoms exist as liquids over a temperature range of 20 to 300℃. Since the temperature range of liquid state did not over the that of the Earth, such molecules had been existed as liquid state. Since the hydrocarbons are lightly than water, those molecules were accumulated as oil film and those molecules formed a membrane by hydrophobic bond.

The author proposed a scenario that activity of life was born in macroscopic organization of long hydrocarbon molecules at the vicinity of the surface of water. [6], [7].

In the water surface, long hydrocarbon molecules were gathered by hydrophobic bonds and the arrangements are strengthen by cooperative effects among the arrangements. If the hydrocarbon molecule becomes a R-base of an amino acid, the amino acid binds the other amino acid by peptide bond and it becomes a filamentous molecule of the protein. The membrane was stitched by the filament of protein. The tissue of the membrane molecules also affects adjacent surrounding molecules.

The membrane is a tissue of intermolecular bond. The nature of it can be observed by bubbles generated in the water. When a fine powder of iron is added to carbonated water, the hydrogen-bonded HCO_3^- column and Fe^{2+} are intermolecularly coupled into a planar structure, so bubbles are formed and float in water [8].

In addition, small bubbles of carbon dioxide occur in the liquid during thawing of the ice of carbonated water. There, we can observe pairing of bubbles and coalescing of bubbles. The image was uploaded at web site of

https://www.youtube.com/watch?v=8uXA0pbUmhU under the title of systematic activity of molecules by intermolecular bonds that can be observed by adding iron powder to carbonated water.

The phenomenon such as coalescing of bubbles are explained by arrangement of the water molecules in the vicinity of the membrane paralleling to the surface of membrane as shown in Fig 1. This arranged structure brings the condensed structure with low energy.
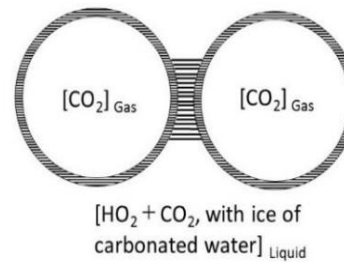

Fig.1 The condensed structure of liquid water that connects paired bubbles of CO_2

The liquid water is dynamically organized at the interface of the tissue of molecules such as bubbles and membranes on the surface of the water. Fig.2 shows a dynamic structure of liquid water proposed by the author.
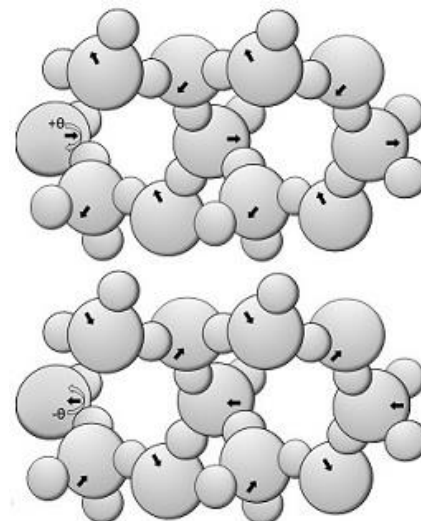

Fig.2 Dynamic structure of water that is helical thermally oscillating accompanying with expansion and contraction

This model has the same lattice structure as α quartz [9]. That is the most condensed structure of SiO_2 in which tetrahedral units are arranged a spiral structure, where thermal vibrations rotate around the three-way of electrical

axis as rotating axes. The change of rotation on tetrahedron in spiral structure are accompanied with the change of the electric dipole moment at the same time as expansion and contraction.

It is observed that the narrow intermediate area between bubbles becomes opaque at the moment when the bubbles and bubbles coalesce. It is also observed that bubbles such as flying disk type moves rapidly at contact[10]. Therefore, it is thought that the structure shown in Fig. 2 can be formed between the membrane and the membrane shown in Fig.1.

If a part of helix structures is deformed, the electronic state of the region becomes excited state. The excited state is transferred by thermal motion. The transfer of excited state is important factor to create activities of a creature.

But, the confirmation of the idea has not been obtained, because the average life span of the structure of water is about 10^{-12} seconds, and it is difficult to observe the structure of the molecules of water because the sequence of water molecules changes depending on the slight impurities of molecules and observation conditions [11].

3. Decoder as the Mechanism of Intelligence

The circuit shown in Fig.3 is able to indicate the polarity of battery by lighting LED. The experimental circuit was made by electronic components embedded in a breadboard. Here, as digital data obtained by sampling in threshold logic by replacing the polarity of the storage battery, it can be considered to decode the polarity of the data.

Assuming that selecting a specific state is a function of recognition, the formation of the function of recognition is realized by the connection of the decoder. Then, it can be said that a simple connection model was experimented with a decoder.
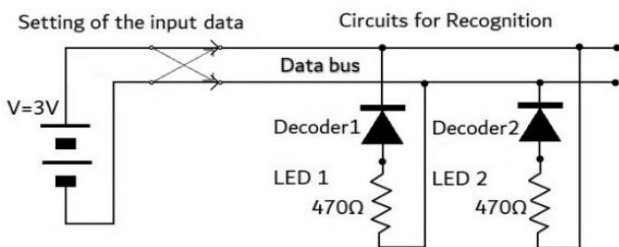

Fig.3 The LED circuit that experiment a connection model

The meaning of the phenomenon depends on the way of thinking. To control is to activate the environment that causes it. If the environment in which molecules are made is activated, then the molecules are synthesized. Therefore,

it is possible to control the operation by the decoder which operates according to the preconditions.

4. Development of neural networks
4.1. Formation of a state transitions system

A decoder is automatically formed in PLA(Programable Logic array) [12]. That is, non-inverted and inverted inputs are prepared for each input, and every H-level [1] are automatically connected by AND circuit.

Fig.4 shows a circuit that decodes two-digit binary numbers in decimal. Here A is the upper digit and B is the lower digit in the binary number.
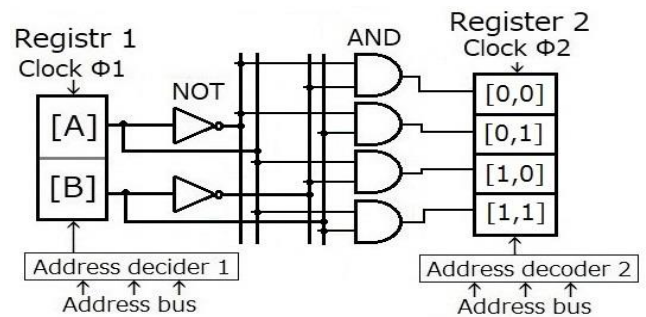

Fig.4 Decoders of two-digit binary numbers

Fig.4 also shows the timing control circuit of the process. Digital information processing involves holding data in flip-flop circuits and combinational logic circuits. In order to each state transition affects in the next state transition, it is necessary to avoid the state transition progressing at once. To do this, the control signal that opens the gate sets the delay time between the previous and subsequent. In the two-phase clock system, the data is transferred in one direction by opening and closing the gate by two types of clock pulses of $\Phi 1$ and $\Phi 2$ [12].

In this way, the computer is also referred to as a register machine because registers play an important role.

4.2. Intelligence system with hierarchical file names

A neural network is the intermittently operating open-loop control system that transfers the excited state from the sensor to the actuator by positive impulses. Each neurons fire at a threshold, but the fire is intermittent due to the after effect of the reaction. Each nerve cell forms decoder on simultaneously reached impulses by an AND circuit. And, those cells form a network. The network can be formed a layered structure by connecting the outputs of

lower decoders.

If the situation doesn't change so much, it will continue to fire intermittently as if it were temporarily remembered. It is not necessary a circulation of impulse for temporarily stored of impulse. The decoders in the upper layers are multi-multiple, but each decoder proceeds separately. Without nerve cells above the threshold, the progress of the activity stops. But the inputs from outside of neural system are always exist. The same part of the input or output can be used in the other routes in a nervous system. The activity of nerve cells in the upper layer of the neural circuit enables prediction and creative activities. Masao Ito, an international authority on cerebellar research, points out that the network of the cerebrum is different from hierarchical backpropagation [13]p.12.

In a human brain, association area occupies 2/3 of cerebrum. The association area can be understood as the activities of the upper layered representative (file name) such as linguistic expressions. There are representatives of representatives in a network of representatives and it becomes a tree structure as shown in Fig.5.
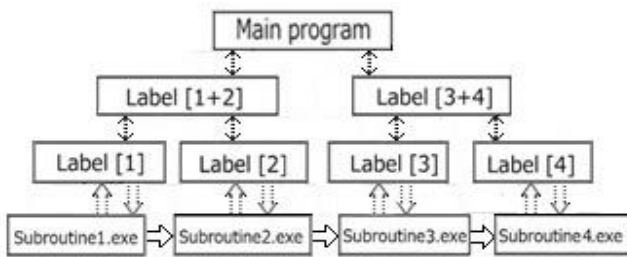

Fig.5 Layered representatives (file names) in intelligence

File names in a computer and linguistic representations in a brain have the same structure, and both operations are controlled along the progress of time. On the other hand, vision is intermittent, one-way, parallel control, with a large amount of data flowing in. as an example: NEC's μ PD7281 (Image Pipelined Processor, 1984) was adopted for seal verification, and fingerprint matching.

4.3. Construction of intelligence by language use

Human being has constructed the world of language. They expressed the common things of facts by linguistic expression. The creativity of human being has been yielded by the universality of the words. Although recognize of human language involves context and environment, the associational area of human cerebrum makes it possible. The implementation of the intelligence is supported by the intermittent transfer of reactions.

Noam Chomsky's standard theory has a deep structure as a semantic department and a surface structure as a phonological department. And activities of deep structure are sent to the deformation department and it changed into a surface structure[14]. So, the structure of phonetic representation and structure of sematic representation were considered [14]. Based on his theory, the computer has been used to deal with many tree structured linguistic expressions. Now, computer is possible to read sentences, listen to human speeches, and write them into sentences.

4.4. A stored -program computer

The main constituent of stored-program computer is shown in Fig.6. CPU and memory are connected in parallel to a common address bus and data bus. The address on the address bus distinguishes devices and the data on the control bus programmatically open the gate of indicated address. So, the data are transferred by the program.
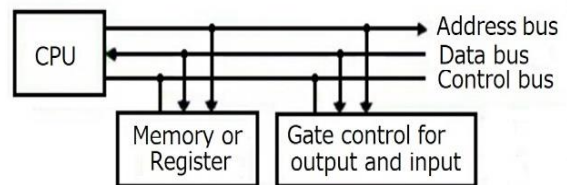

Fig.6 Circuit configuration for data transfer

The data are placed on a data bus temporarily by using register, and the data on the bus are processed by combinational logic circuits as shown in Fig.7.
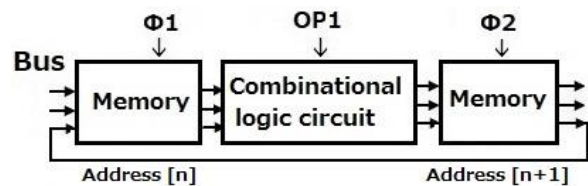

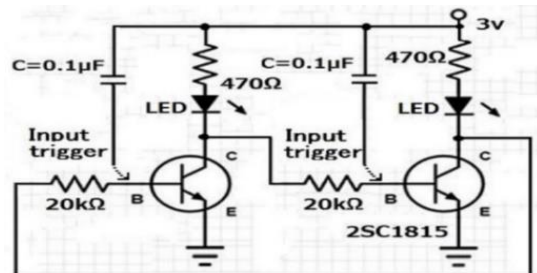Fig.7 Register transfer circuit with feedback circuit

Fig.8   Experimental circuit of a flip-flop circuit

Register is composed of flip-flop circuits. Fig.8 shows the experimental circuit of flip-flop.

4.5 Control of a shared device by OR logic

The input of a muscle-like device that runs in various operations is independent of each operation. When the input circuit group is connected by wired OR as shown on the right side of Fig.9, the input circuit becomes not independent. In this case, diode or transistor is inserted in the input side of OR circuit. The diode or transistor transmits signal one directionally. So, each input of OR circuit affects the output independently.

The OR circuit, which converts the decimal number 0-3 to a two-digit binary number, is shown in the left circuit in Fig.9.
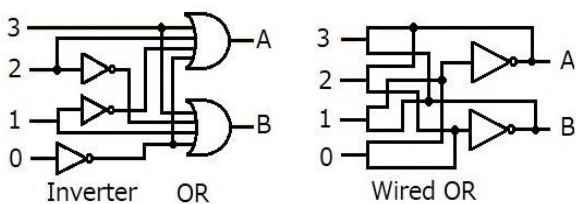

Fig.9 Control of shared system by OR logic connections

The cerebellum is known to help drive muscle cells. The nerve cells that characterize the cerebellum are Purkinje cells. It became clear that this cell outputs substances that suppress stimulation[13]p.8. If the neurotransmitters are released when excitatory stimuli do not come, we can understand the function of cerebellum based on the de Morgan's theorem. That is, there exist many excitatory stimuli in a living body. The suppressive stimulation is released into excitatory stimuli when any excitatory stimulation does not come. So, Purkinje cells controls the excitatory stimulation by suppression of OR logic.

5. Programing language
5.1 Programing language C and Assembly

If we use an address of memory as a variable, we can use the same program by changing data of variable. Therefore, the data is separate from the program. Usually a file is the data and the file name express the program as an extension.

Program language assembly describe the address of memory. It has the advantage of allowing less memory, because the memory is possible to use as registers repeatedly.

On the other hand, the programming language c is a language developed to allow porting on CPUs of different architectures. So, the program of c-language becomes layered configuration. Variable are declared at first, defines the contents of the specified variable, and calls it

to use. The address is not specified. .Fig.10 shows a program of addition written in c-language (A(10) + B(20) -C).

```
#include <stdio.h>
int add(int a, int b);  //function declaration
int main()
{
        int a=10,b=20;
        int c=add(10,20);  //function call
        printf("Addition:%d¥n",c);
        getch();
}
int add(int a,int b)   //function body
{
        int c;
        c=a+b;
        return c;
}
```

Fig.10 Example of a program written by c-language

The entire text of c-language program is combined into an execute file. This type is called a compilation type. The assembly programming language is also a compilation type. On the other hand, there is a program of the interpreter type (simultaneous interpretation type) to execute when one line is called. This type has Python. The interpreter type is used for robot programming.

5.2 Visual   programming system [Scratch]

Scratch is an integrated development environment for soft systems developed by M IT Media Lab. This programing system need to remember the instruction name, function name, we can move the display (icon) on the screen with the mouse.

Fig.11 shows a screen of the scratch program.
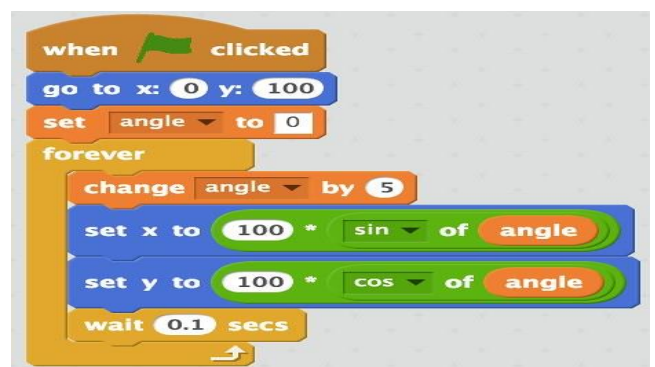
https://c1.staticflickr.com/3/2819/9461183065_9b58e060f2.jpg

Fig.11 A sample of scratch program

[Arduino]

Arduino is a microcomputer board developed in Italy

suitable for controlling robots. Install a firmware of S4A makes possible to program by scratch [15].

[Raspberry Pi]

Raspberry-Pi is a small computer suitable for learning programming. It is provided by the Raspberry Pi Foundation in the UK [16].

[Micro:bit]

Micro:bit is an educational microcomputer board developed by the BBC in the UK, allowing you to program as well as scratch.

5.3 Learning of programing by using Robot

Play with robot of stored program system is one of the ways to learn the programing for student of elementary school. Now, Integrated Development Environment (IDE) is prepared that makes it easier the programing of robot. Fig.12 shows a part of an editing screen on a development environment of Robovie-nano[17].
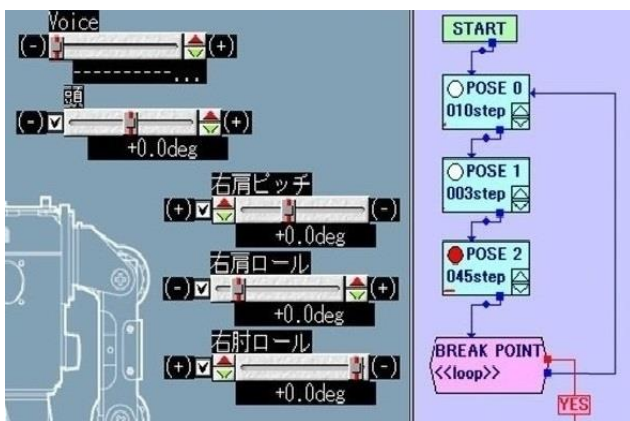
Reproduced from an editor [Robovie Maker II], V-stone [17].
Fig.12 Programing Editor 「Robovie Maker II 」

Serial series of [POSE] are shown in the left side of the Fig.12. The transition time of the action is displayed in the lower column. In the looping program, there are branches and jump instructions. In such case, the address of the memory to be returned should be assigned.

The left side of Fig.12 shows every angle of joints on the step of the pose is marked by red circle on the right side of Fig.12. The humanoid robot has servo motor at each joint. It sets the angle of joint automatically by detecting the angle of the axis of rotation by the sensor and eliminates the difference between the specified angle.

The sample programs on some performances are prepared, and we can use the example program as a guide to create new behaviors.

6. Computer networks of Internet

The computer's network sends and receives data in small packets, separated by a certain capacity. If you want to send and receive information intermittently, you do not need to be connected to the line at all time similarly as a power line . Humans recognize continuous movement by looking at still images sent by frame by frame as seen at movies. In a computer network, the stored program computer can process data at high speed, so time lag does not make trouble. Inside the computer, parallel data placed on the bus, which is a common parallel line, is converted into time-series data (serial data) and sent and received on a single wired line. A serial communication method of RS232C has been used for a long time at serial communication. When serial communication between the robot and RS232C, the COM terminal of the personal computer is used.

Internet is a network of computers that are connected by address. In the transmission of information, a mail is sent in an SMTP packet to the mail server shown following of @ mark. In the reception, the authenticated recipient by sending name of user and password to the mail server receives the mail in the POP3 packet.

If you have more than one Wi-Fi router that connects wirelessly to the Internet, specify a distinguished name (SSID) to connect to your computer and one of its Wi-Fi, and then enter the password to connect.

On the other hand, in order to enable Local Area Network (LAN) to enable computers and printers to communicate data with each other, such as cables and wireless radio waves, stop the function of the Wi-Fi router (access point mode) and set it to send and receive data between the devices inside of the LAN. Such technologies are built-in to solve this difficulty.

7. Conclusions

This article described the intelligence of a brain and computer by a concept of intermittent instantaneous operations. The stored program computer communicates using an address at the time of operation. The neural system achieves intelligent action by release of neurotransmitters at the instant.

We hope to contribute to the development of visual devices that multiple large amounts of parallel data collected by this report.

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