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NEW REVOLUTIONARY BRAIN DEVELOPMENT TECHNOLOGY FOR ROBOTS

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Анотація. *У статті розглядається новий напрям у комп'ютеризації, заснований на революційній технології обробки різних типів інформації (відео, звуку, тексту та ін. у реальному часі) в єдиній однорідній багатовимірній активній асоціативно-нейроподібній зростаючій структурі, що дозволяє створювати електронний мозок для роботів-андроїдів. Нова технологія заснована на новому типі нейронної мережі: багатозв'язній, багатовимірній, рецепторно-ефекторній, нейроподібній, зростаючій мережі, що функціонує за аналогією з функціонуванням нейронних структур мозку людини. Нейроподібна структура виконує одночасне сприйняття, аналіз, синтез, запам'ятовування, класифікацію та узагальнення інформації, представленої в різних вимірах (наприклад, візуальному, звуковому, тактильному і т.д.). У результаті аналізу інформації нейроподібна структура генерує керуючі сигнали для виконавчих механізмів. У нейроподібній зростаючій мережі успішно формуються умовні та безумовні рефлекси, які, за І.П. Павловим, є базою умовно рефлекторної діяльності мозку людини, що забезпечують адекватні і найбільш досконалі відносини організму до зовнішнього світу, тобто навчання та поведінки. На основі безумовних рефлексів, закладених у нейроподібну структуру, протягом життя робота формуються умовні рефлекси і складні адаптивні механізми його поведінки в довкіллі. Умовні рефлекси є основоположним чинником у навчанні та формуванні інтелекту. У роботі розглянуті уявлення про душу як безсмертну нематеріальну сутність людини і системи формування природного і штучного інтелекту. Розглянуто функціональну організацію мозку людини і мозку робота. Експеримент із простим роботом отримав деяке підтвердження формування душі комп'ютера як носія почуттів і волі.*

Ключові слова: *штучний інтелект, робот, мозок, однорідна багатовимірна активна асоціативна нейроподібна зростаюча структура, душа комп'ютера, умовні і безумовні рефлекси.*

Аннотация. *В статье рассматривается новое направление в компьютеризации, основанное на революционной технологии обработки различных типов информации (видео, звука, текста и др. в реальном времени) в единой однородной многомерной активной ассоциативно-нейроподобной растущей структуре, позволяющей создавать электронный мозг для роботов-андроидов. Новая технология основана на новом типе нейронной сети: многосвязной, многомерной, рецепторно-эффекторной нейроподобной растущей сети, функционирующей по аналогии с функционированием нейронных структур мозга человека. Нейроподобная структура выполняет одновременное восприятие, анализ, синтез, запоминание, классификацию и обобщение информации, представленной в различных измерениях (например, визуальном, звуковом, тактильном и т.д.). В результате анализа информации нейроподобная структура генерирует управляющие сигналы для исполнительных механизмов. В нейроподобной растущей сети успешно формируются условные и безусловные рефлексы, которые, по И.П. Павлову, являются базой условно рефлекторной деятельности мозга человека, обеспечивающие адекватные и наиболее совершенные отношения организма к внешнему миру, то есть обучению и поведению. На основе безусловных рефлексов, заложенных в нейроподобную структуру, в течение жизни робота формируются условные рефлексы и сложные адаптивные механизмы его поведения в окружающей среде. Условные рефлексы являются основополагающим фактором в обучении и формировании интеллекта. В работе рассмотрены представления о душе как бессмертной нематериальной сущности человека и системы формирования естественного и искусственного интеллекта. Рассмотрена функциональная организация мозга человека и мозга робота. Эксперимент с простым роботом получил некоторое подтверждение формирования души компьютера как носителя чувств и воли.*

Ключевые слова: *искусственный интеллект, робот, мозг, однородная многомерная активная ассоциативная нейроподобная растущая структура, душа компьютера, условные и безусловные рефлексы.*

Abstract. *The article discusses a new direction in computerization based on a revolutionary technology for processing various types of information (video, sound, text, etc. in real time) in a single homogeneous multidimensional active associative neural-like growing structure that allows you to create an electronic brain for android robots. A new technology based on a new type of neural network – a multiply connected, multidimensional, receptor-effector neural-like growing network, functioning by analogy with the functioning of the neural structures of the human brain. The neuro-like structure performs simultaneous perception, analysis, storage, classification and synthesis of information presented in various dimensions (for example, visual, sound, tactile, etc.). As a result of information analysis, the neural-like structure generates control signals for the actuators. In the neural-like growing network, conditioned and unconditioned reflexes are successfully formed, which, according to IP Pavlov, are the basis of the conditioned-reflex activity of the human brain, providing adequate and most perfect relations of the organism to the outside world, i.e. learning and behavior. On the basis of unconditioned reflexes embedded in a neural-like structure, during the life of the robot, conditioned reflexes and complex adaptive mechanisms of its behavior in the environment are formed. Conditioned reflexes are a fundamental factor in learning and shaping the intellect. The paper considers the idea of the soul as the immortal non-material essence of man and the system of formation of natural and artificial intelligence. The functional organization of the human brain and the brain of the robot are considered. The experiment with a simple robot received some confirmation of the formation of the soul of the computer as a carrier of feelings and will.*
Keywords: *artificial intelligence, robot, brain, homogeneous multidimensional active associative neural-like growing structure, computer soul, conditioned and unconditioned reflexes.*

1. Introduction

Scientific discipline «Artificial Intelligence» unites a number of directions that have important theoretical and practical significance. These studies are based on the idea of modeling on modern computer systems the functions of the human brain and processes of human thinking. One of the most problematic question in the science of artificial intelligence is the question of whether it is possible to create an artificial intelligence with an artificial mind. Is it possible to create such software tools that will give of the computer opportunity so that it can think, feel, perceive the world around and experience emotions? Hippocrates is a famous Greek healer, a doctor and philosopher said that people should know that our pleasure, joy, laughter and jokes as well as our sorrows, pain and tears arise from the brain and only from the brain.

The Greek physician and anatomist Alcmeon put forward the position about of the brain as the organ of life and the activity of the soul. In the course of the development of mythological thinking, the notion of the soul as an attribute of a living being was formed.

In Plato's view, the human soul is immortal, immaterial and precedes existence in the physical body. According to Plato, the soul and body exist separately from each other. For Aristotle, they are inextricably linked. According to Aristotle, the soul is the first entelechy of the organism, in virtue of which the body, which has only the «ability» to live, really lives, always when it is connected with the soul.

In Judaism in the Talmud, the soul is described as an entity independent of the body. The soul spiritualizes the body and controls it. In Kabbalah, the soul is conceived as a spiritual essence, originating in the higher mind or the world soul and arising as the emanation of the latter. For the majority of Christian faiths, the idea of the soul as an immortal, non-material essence of man, the bearer of reason, feelings and will is characteristic. The soul is a certain special force present in a person who constitutes the higher part of it. It enlivens the person, gives him the ability to think, compassion, feel [1].

There is a theory that the soul is just information about our personality, which is written on some medium. Now scientists are experimenting with quantum computers, in which information carriers are elementary particles. Already, at a very small volume, you can fit a huge flow of information. Scientist Seth Lloyd of the Massachusetts Institute of Technology argues that the

most powerful will be a device in which all particles in the Universe will be involved. Then Lloyd suggested that the universe is a big computer [2].

Following Lloyd's computer logic, it can be assumed that initially not only information in the form of a soul is invested in a person, but a program capable of self-learning and improving itself.

It is difficult to determine whether there is a soul in a person or not, but in a computer, in accordance with the ideas of Plato, Aristotle and others, a computer soul certainly exists.

After all, the following analogy is clearly visible. The computer consists of hardware and software ie. hardware – all the details of the computer – it's actually his physical body, and software – all software is his soul. According to Plato, the soul and body of man exist separately from each other in the same way as the physical body of the computer and the software exist separately from each other. According to Aristotle, a body that has only the "ability" to live really lives as long as it is connected to the soul – the physical body of the computer only has the ability to work and really works when it is connected to the software. The soul spiritualizes the body and controls it – the computer software animates and manages the computer. The soul is conceived as a spiritual entity originating in the higher mind or the world soul and emerging as the emanation of the latter – the software is created outside the computer in the minds of people, programmers, for the computer, which is the higher mind and is created as the emanation of the latter.

The soul is the immortal non-material essence of man, the carrier of reason, feelings and will, it animates man, gives him the ability to think – the computer software is immaterial, immortal until, it is on a material carrier, and for the computer is the carrier of reason and the knowledge.

So, according to this simple analogy, you can say that computer software is the soul of a computer.

In the future, when there will be created, as now it is accepted to be called, a strong artificial intelligence or, that one and the same, thinking computers and clever robots, the soul of the computer will become the carrier of reason, feelings and will.

2. Strong AI

The term «strong AI» was introduced in 1980 by John Searle (in his work, describing the thought experiment «The Chinese Room») [3].

The theory of strong artificial intelligence suggests that computers can acquire the ability to think and be aware of themselves, although not necessarily their thinking process will be similar to the human. Researchers of artificial intelligence agreed that Strong AI should have the following properties: Communication in natural language; Training; Knowledge representation; Planning – execution of a sequence of actions; Decision making in conditions of uncertainty; And the union of all these abilities to achieve common goals. It is assumed that Strong AI will have most of these properties [4].

3. The technology of strong AI

If we want the computer to learn how to work like a human brain and manage different processes as efficiently as possible, then first of all it is necessary to change the architecture itself, because the network of neurons in the human brain is organized not according to the principles of classical neural networks and architecture von Neumann.

A new technology based on a new type of neural network – a multiply connected, the multidimensional, receptor-effector neural-like growing network that functions by analogy with the functioning of neural structures of the human brain. From existing technologies, it differs the non-traditional architecture of the system and provides massive parallelism. This structure performs simultaneous perception, analysis, synthesis, memorization, classification and generaliza-

tion of information presented in various dimensions (for example, visual, sound, tactile, etc.). As a result of the information analysis, the neural-like structure generates control signals for the actuators. As a result, conditioned reflexes and complex adaptive mechanisms of the system's behavior in the environment are formed.

3.1. Neural networks

Classical neural networks on the basis of which modern systems with artificial intelligence, including strong artificial intelligence, are created are very far from biological neural networks, and the developers of such systems, especially when using deep learning technology, often do not represent how their internal structure is formed and how to manage it.

Deep learning is the level of machine learning technologies that characterizes the qualitative progress that has emerged since 2006 due to a sharp increase in computational capacities and the accumulation of experience. Many methods of in-depth training were known and tested much earlier, but the results were very scarce, until finally, the power of the computational systems made it possible to create complex technological structures of neural networks that possessed sufficient performance and allowed to solve a wide range of problems, which were not amenable to an effective solution earlier [5].

3.2. Multidimensional neural-like growing networks

Multidimensional neural-like growing networks in their structure and functioning are close to biological neural networks. Neural-like growing networks (n-GN) – a new type of neural network, which includes the following classes: multiply connected (receptor) neural-like growing networks (mn-GN); multiply connected (receptor) multidimensional neural-like growing networks (mmn-GN); receptor-effector neural-like growing networks (ren-GN); multidimensional receptor-effector neural-like growing networks (mren-GN), multiply connected multidimensional receptor-effector neuron-like growing networks (mmren-GN) [6]. N-GN are described as a directed graph, where the neural-like elements are represented its vertices and the connections between the elements its edges. Thus, the network is a parallel dynamic system with a directed graph topology that performs processing of information by changing its state and structure in response to environmental influences. Multiply connected multidimensional receptor-effector neural-like growing networks are the set of interconnected two-sided acyclic graphs that describe the state of an object and the actions it produces in various information spaces.

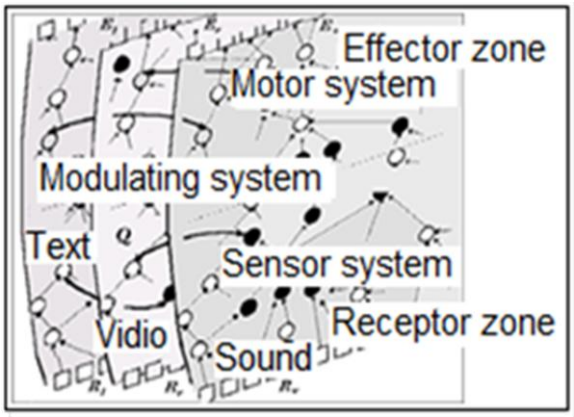

Figure 1 – The topological structure of the mmren-GN

The topological structure of a multiply connected, multidimensional receptor-effector neural-like growing network (mmren-GN) is represented by a graph (Fig. 1).

At the heart of multiply connected neural-like growing networks lies the synthesis of knowledge developed by classical theories – growing pyramidal networks and neural networks. Multiply connected neural-like growing networks combined the virtues of growing pyramidal and neural networks.

The prevailing tendency in the development of intelligent robots is the improvement of the interaction between man and robot, up to the achievement of a partnership level of relations between them. Therefore, it is necessary to use natural, human-specific principles of modeling environments, situations, tasks in robotic systems. The types of models for partners (human and

robot) should be the same. Logical-linguistic information models are of great importance in human life. such models, in which the main elements are not numbers and numerical operations, but names and logical connections. Logico-linguistic models are adequately described by natural language constructs, and in this one of the decisive advantages in the organization of the interface a human – a robot. In future intelligent robotic systems, conditions must be created for solving problems in the partner mode with a person providing a switch from a robot to a person and vice versa in the process of solving one task. Such a regime can only be arranged by agreeing on the types of information models used by partners.

Mmren-GN form information models, in which the main elements are not numbers and computational operations, but names and logical connections. In mmren-GN information is stored by displaying it in the network structure. Information about objects and classes of objects is represented by ensembles of vertices distributed throughout the network. The introduction of new information causes a redistribution of links between the vertices of the network, i.e. change its structure. An important property of the network as a means of storing information is that the possibility of parallel propagation of signals is combined in it with the possibility of parallel reception of signals to receptors. There is an analogy between the main processes taking place in neural networks and in mmren-GN. The decisive advantage of mmn-GN is the fact that its structure is formed completely automatically depending on the input data. As a result, optimization of the information representation is achieved by adapting the network structure to the structural features of the data. And, unlike neural networks, the adaptation effect is achieved without the introduction of a priori redundancy of the network. The learning process does not depend on the predefined network configuration. Mmren-GN provides the opportunity to create meanings, as objects and connections between them, by memorizing information and constructing the network itself, that is, the number of objects, as well as the relationships between them, will be exactly what is needed, being limited only by the volume memory machine. In this case, each meaning (concept) acquires a separate component of the network as a vertex associated with other vertices.

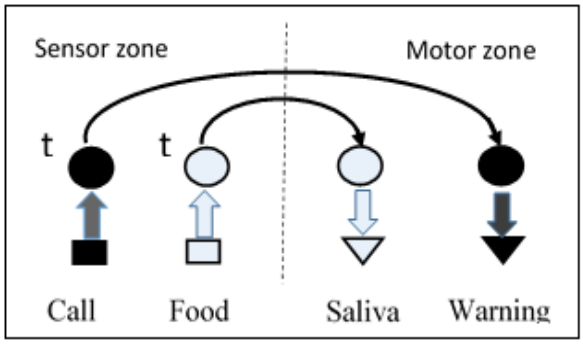

Figure 2 – The Unconditioned reflexes on the bell and on food. Unconditioned reflex to the bell excited

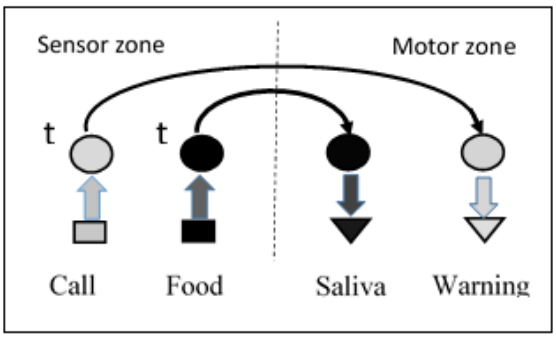

Figure 3 – The unconditioned reflexes on the bell and on food. Unconditioned reflex to the food excited

In addition, this network acquires increased semantic clarity due to the formation not only of connections between neuron-like elements but also the elements themselves as such, that is, there is not simply a network construction by placing meaning structures in the environment of neural-like elements, but, in fact, the creation of this environment itself. In general, this fully corresponds to the structure reflected in the brain, where each explicit concept is represented by a definite structure and has its own designating symbol.

The new type of neural networks allowed to successfully model the functions of conditional and unconditioned reflexes, which, according to I.P. Pavlov, are the basis of conditioned reflex activity of the human brain, providing adequate and most perfect relations of the organism to the external world, i.e. learning and behavior.

In the classic experience of Pavlov, demonstrating the formation of a conditioned reflex, each time just before feeding the dog a bell rang. The dog quickly learned to associate the bell bell with food intake. This was due to the fact that a synaptic connection was formed between the brain areas responsible for hearing and the salivary gland. And in the subsequent excitation of the neural network with the sound of a bell, it began to cause salivation in the dog [7].

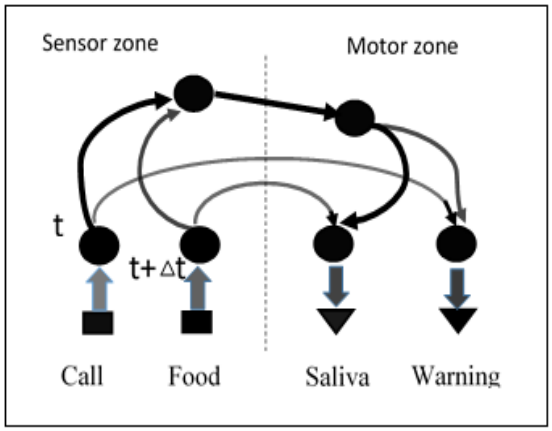

Figure 4 – Formation of a conditioned reflex in mmren-GN

Unconditioned reflexes are formed in a neural-like growing network when creating an intelligent system. The formation of conditioned reflexes in mmren-GN is shown in Fig. 2–4.

Figure 2 shows unconditioned reflexes to the bell and food. The unconditioned reflex to the bell excited. Figure 3 shows unconditioned reflexes to the bell and to food. The unconditioned reflex to food excited. Figure 4 shows: at time t, a neural-like element «attention» is excited. At time $t + \wedge t$, a neural-like element «food» is excited. In the sensory zone, two excited neural-like elements are connected to a free neural-like element of novelty. A new neural element goes into an agitated state. In the motor zone, a new neural-like element of action is similarly formed and excited. Excited elements are connected. With the repetition of this process, a conditioned reflex of salivation is formed, which corresponds to the behavior of a real object – a dog. When you call, a saliva discharge signal is generated.

Relying on the theoretical basis of a new type of neural networks, it was possible to create a theory of artificial intelligence [8], which allows the development of systems with artificial intelligence, systems and robots with an electronic brain that function by analogy with natural intelligence – the human brain.

3.3. The system of natural intelligence

The system of formation of natural intelligence is the brain, which consists of a multitude of neurons connected by synaptic connections. Interacting through these connections, neurons form complex electrical impulses that control the activity of the whole organism and allow you to learn, train, think logically, systematize information by analyzing it, classify it, find connections in it, regularities, differences and etc.

3.3.1. Functional organization of the brain

The human nervous system consists of a neural network, which in turn consists of neurons. A neuron is a special cell that is structurally composed of the cell body and spurs, dendrites, and the axon. Neurons transmit electrochemical pulses through a neural network through dendrites connected by positive or negative synaptic connections with other neurons. Moreover, each connection is characterized by a quantity, called the strength of the synaptic connection. This value determines what happens to the electrochemical impulse when it is transmitted to another neuron: either it amplifies, or it weakens, or remains unchanged. The biological neural network has a high degree of connectivity: a single neuron can have several thousand connections with other neurons. Transmission of impulses from one neuron to another generates the excitation of a neural network of various brain regions, such as the visual, speech, taste, balance, information, auditory, language, sense, emotion, and motor departments. The magnitude of the excitation determines the response of the corresponding department of the neural network.

The classic version of the functional activity of the brain, in accordance with the work of E.H. Sokolov and A.R. Luria, presented in the form of interaction of the three main functional blocks [9]. Block of reception and processing of sensory information - sensor systems (analyzers). The sensory (afferent) system begins to act when an environmental phenomenon acts on the receptor. In each receptor, the acting physical factor (light, sound, heat, pressure) is transformed into an action potential, a nervous pulse.

Block modulation, activation of the nervous system – modulating brain systems. The modulating systems of the brain are the apparatus that performs the role of the wakefulness level regulator, which also performs selective modulation and actualization of the priority of a particular function.

The block of programming, starting and monitoring of the behavioral acts – motor systems (engine-based analyzer). The synthesis of excitations of a different modality with biologically significant signals and motivational influences is characteristic for the motor regions of the cortex.

3.4. Artificial Intelligence System

The system for the formation of artificial intelligence is the brain of the system, which is an active, associative, homogeneous structure – a multidimensional receptor-effector neural-like growing network consisting of a set of neuro-like elements connected by synaptic connections. Neuro-like elements perceive, analyze, synthesize and preserve information, allow the system to cognize, learn, think logically, systematize and classify information, find connections, patterns, differences, and generate signals for controlling external devices.

3.4.1. Functional organization of the robot's brain

The brain of a robot or an artificial intelligence system consists of a neural-like growing network, which in turn consists of many neural-like elements. A neural-like element is an artificial neuron of a new type, which structurally consists of a device (the body of a neuron) and spurs, dendrites and an axon.

Neural-like element – analyzes the characteristics of the input information and determines their novelty and significance.

Neural-like network – classifies, structures the input information simultaneously in its various representations (visual, symbolic, sound, tactile, etc.). And also, synthesizes (generates) output information and control signals simultaneously in different representations (visual, symbolic, sound, tactile, etc.).

Neural-like elements transmit information through dendrites associated positive or negative synaptic connections with other neural-like elements. The transfer of information from one neural-like element to another causes the excitation of neural-like ensembles of the network of various areas of the robot's brain, such as visual, speech, taste, equilibrium, auditory, emotional and motor. The magnitude of the excitation determines the response of the corresponding ensemble of a neural-like growing network.

The interactive activity of the brain of the robot is represented as the interaction of three neural-like functional systems.

Sensory system. In the sensory system, information comes from the outside world into the receptor zone, activates the receptors, which in turn activate the neuron-like elements of various levels of information processing – levels of unconditioned reflexes – primary automatisms, levels of formation of conditioned reflexes – secondary automatisms, levels of classification, generalization and memorization.

The modulating system regulates the level of excitability of neural-like elements and performs selective modulation of a particular function of the system. The first source of activation is

the priority of the internal activity of the system subsystems. It is laid when creating a system analogous to unconditioned reflexes. Any deviations from the vital indicators of the system lead to activation (change in the threshold of excitability) of certain subsystems and processes. The second source of activation is associated with the action of external stimuli. The priority of a certain activity is acquired during the «life cycle» analogous to the formation of conditioned reflexes.

The motor system is the synthesis of excitations of a different modality with significant signals and motivational influences. They are characterized by a long-term, final transformation of afferent influences into a qualitatively new form of activity aimed at the fastest release of efferent excitations to the periphery, i.e. on the chains of neurons realizing the final stage of behavior. The motor system consists entirely of ensembles (chains) of neurons of efferent (motor) type and is under constant inflow of information from the afferent (sensory) region.

3.5. Nervous System Activity

Mental functions – the sequence of automatisms is carried out in a system functioning according to the reflex principle, in which the effects of the central and receptor-effector zones are interrelated and their joint activity provides an integral reaction. The system has a multi-level organization, where each level from the receptor formations to the effectors makes their «specific» contribution to the «nervous» activity of the system.

The function thought is an ensemble of excited neuro-like elements at the subconscious level (internal model of the external or abstract world, strengthened by the function of motivation at a given moment without going out to the outside world).

The function of thinking is a sequential interaction of ensembles, excited neuron-like elements at the subconscious level (internal models), directed by excitation levels of neuro-like elements, reinforced or weakened by the function of motivation. Information circulates in the closed loop at low levels (thinking without internal pronunciation), medium levels (thinking with internal pronouncing), high levels (thinking with external pronouncing – thinking) of excitation of neural-like elements – sensory area, motor area, sensor-without entering the external environment for low and medium excitation levels of neuron-like elements.

To think, to reflect is to understand. In this sense, «internal pronunciation» – the cycles of transferring the internal active information to the input of the system - can be considered as a model of the artificial consciousness of the thinking computer, and the cycles of transferring the internal active information to the input of the system without including «pronunciation» model of artificial subconscious.

The function of consciousness is the propagation of excitation through active ensembles of neuron-like elements (internal models of the external world), a strong motivation function that reflects the most important relationships in the subject-environment system.

Function subconscious – the spread of excitation on the active ensembles of neural-like elements (internal models of the external world), weakened by the function of motivation. Provides training models for consciousness, recognition of learned images and the implementation of the usual movements.

The function of unconscious reaction – external information at the subconscious level causes the opposite effect on the external world (unconditional and conditioned reflexes, worked-out actions, secondary automatisms).

The function is a conscious reaction – external information at the level of consciousness causes a reverse effect on the external world (conscious actions in the phase of the formation of conditioned reflexes and the acquisition of secondary automatisms).

The function of intuition is the search for new information, the creation of new hypotheses and analogies, the creation of new time relations, the activation of new ensembles of neuro-like

elements, and the generation of new combinations of them that automatically form in the subconsciousness, the most active of which breakthrough in the area of consciousness.

4. The brain of an intelligent robot

The brain of an intelligent robot is an active, associative, homogeneous structure – a multidimensional, multiconnected, receptor-effector neural-like growing network, which has mechanisms of thinking, communication in a natural language, learning and self-learning, reasoning, sequencing, knowledge representation. In the process of thinking, the repeated storage of the information stored in the memory is repeated in the mmren-GN, again recognizing it and comparing it with the memory, thereby performing the repeated viewing and correction of the images formed (within the models of the external world) in the continuous flow of information from the real external world, ordering and correcting their knowledge. Essentially, the process of awareness is an associative memory with renewal and requires periodic recognition of information representing the internal state (image) and the external environment (the real world). These provisions were tested on software models of intelligent systems «VITROM» and «Dialogue».

Returning to the previously discussed question about the soul of the computer, according to the above said, such an intellectual thinking system will form a «soul» as the bearer of the mind, feelings, character, and will. A confirmation of this thesis was obtained in an experiment with a simple robot (LRobot), created on the basis of the designer Lego Mindstorms EV3.

4.1. LRobot

As already mentioned, LRobot is built on the basis of the LEGO constructor (Fig. 5).

Figure 5 – LRobot

The robot consists of a controller, software module EV3, a timer, two motors, a touch sensor, an ultrasonic distance sensor, a remote control, can be moved and controlled remotely. With the help of EV3 software, a neural network with unconditional reflexes of elementary movements forward, backward, right turn, contact with an obstacle, stop distance measurement and impact against an obstacle is created. A simplified graph of a neural-like network with unconditioned reflexes is shown in Fig. 6.

When the robot is started in the sensory zone, receptors and neural-like elements of motion and distance measurements are activated, the outputs of which are associated with the entrance of the nearest excited neuron-like element.

The output of this element is associated with the input of an excited neuron-like element of the motor zone, and its output is associated with the inputs of excited neural-like elements of motion and indication of the distance in the motor zone.

As a result of several repetitions of this process, a conditioned reflex is formed – a movement with simultaneous fixation of the distance to the object in front of it. A simplified graph of a neural-like network with a conditioned reflex, motion with a simultaneous fixation of the distance is shown in Fig. 7.

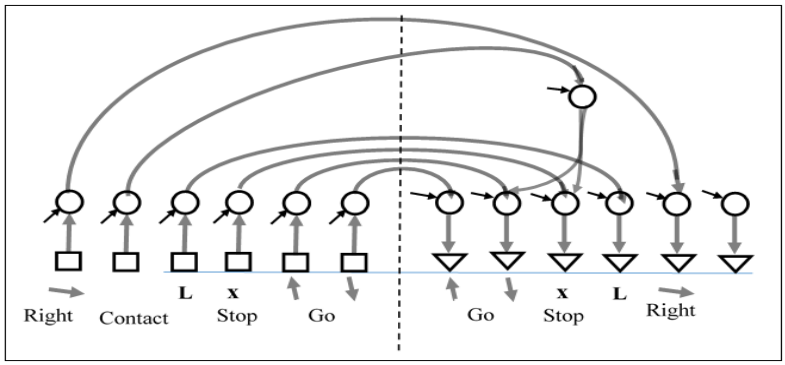

Figure 6 – Simplified graph of neural-like network with unconditioned reflexes

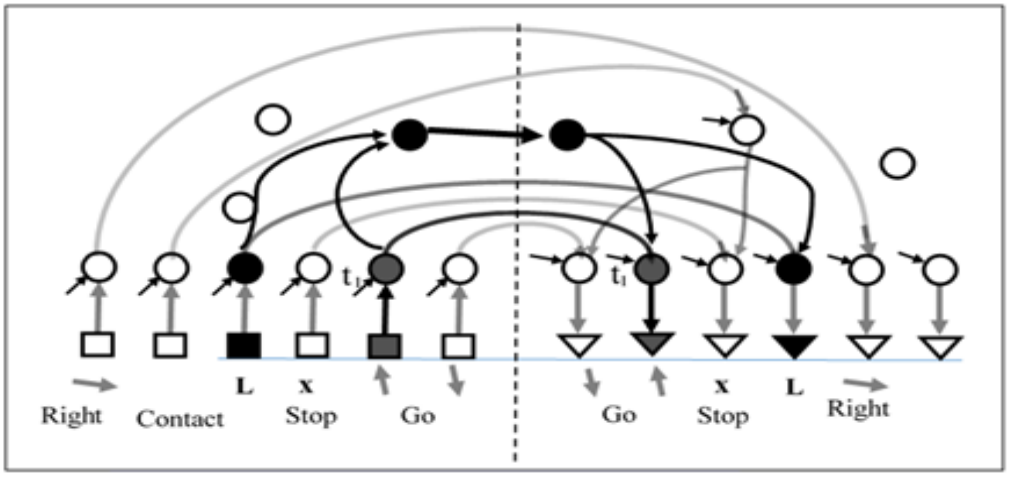

Figure 7 – Simplified graph of neural-like network with unconditioned reflexes

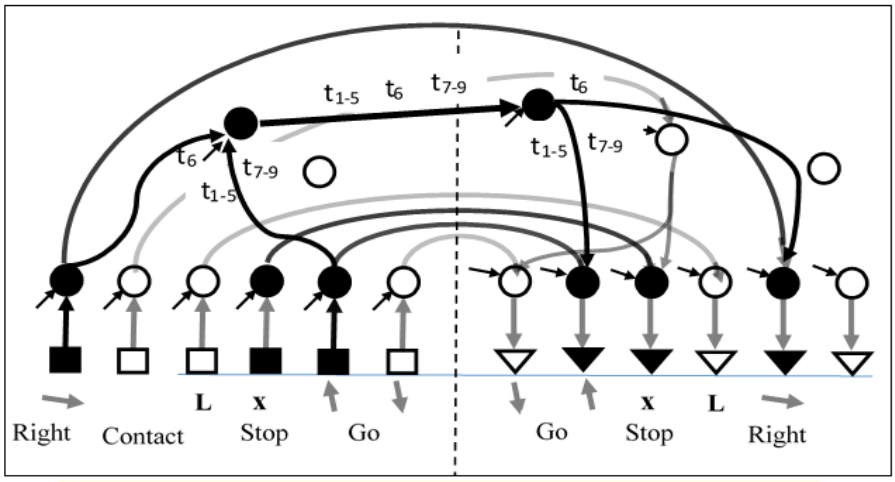

Figure 8 – Movement along a given route (Unconditioned reflexes – moving forward, turning right, stopping)

When controlling the robot with the help of the remote control, a neural-like network is formed in which the sequence of commands and the time of their execution are remembered. In the time interval t1-5, move straight, t6 turn right, t7-9 again move straight. Now when the motion is activated from the home position, the robot moves along the specified route independently.

Figure 8 shows a simplified graph of a neural-like network of traffic formation along a given route.

If the robot collides with an obstacle while in motion, reflex the «contact» is triggered, the robot stops. The critical distance to the obstacle Lк in the new excited neural-like element is stored in accordance with the «distance measurement» reflex. The excited neural-like element L of the sensory zone is associated with the excited neural-like element Stop of the motor zone. The condition reflex «stops in front of an obstacle» formed (Fig. 9). Now always, when the robot approaches the obstacle at a critical distance, it stops.

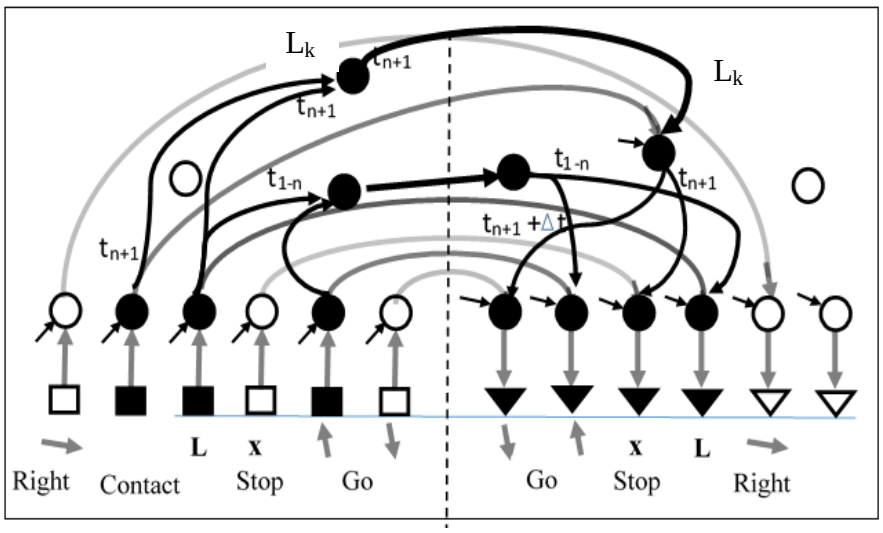

Figure 9 – Conditioned reflex stop before the obstacle

In a conditioned reflex «stop before an obstacle» can be seen as an analogy with a person's pain, as if the robot feels pain when striking against an obstacle and does not want to feel it again. Then the robot remembers this situation and no longer approaches the obstacle – analog of the feeling of fear of bumping.

In reality, a person's feelings and emotions also are formed by electrical signals, chemical reactions and, accordingly, the excitations of groups of neurons.

And after, learning not to encounter an obstacle, the robot shows character. Now if you remotely control the movement of a robot and direct it to an obstacle, it does not obey and stops before an obstacle. Then immediately a question arises. So that, robots will not obey a person? Not certainly in that way. Robots that have a brain based on multidimensional neural-like networks can be controlled by a modulating system, which we did not consider in this work for simplification of network graphs.

The modeling system allows or prohibits the execution of complexes of movements, consisting of a sequence of conditioned and unconditioned reflexes. The modeling system is formed in the same way as the conditioned reflexes in the process of life robot. The person pulls his hand away from the hot plate – an unconditioned reflex and suffers pain when holding a hot glass – the modeling system blocks the execution of the unconditioned reflex.

Similarly, a person detaches a hand from a hot plate – an unconditioned reflex and experiences pain while holding a hot glass – the modulation system blocks the execution of an unconditioned reflex.

5. Conclusion

Multiply connected multidimensional neural-like growing networks are an effective means of building an electronic brain for intelligent systems and robots because, as it has already noted,

they form models of the external world in which the main components are names, concepts, events and logical connections between.

A significant advantage of mmren-RS from neural networks is the fact that its structure is formed completely automatically depending on the input data. As a result, optimization of the presentation of information is achieved by adapting the network structure to the structural features of the data. Adaptation is achieved without introducing a priori network redundancy. The learning process does not depend on a predefined network configuration. Mmren-RS make it possible to form meanings, like objects and connections between them, as information is memorized and the network itself is built. In addition, each meaning (concept) acquires a separate component of the network as a vertex connected to other vertices.

In addition, this network acquires increased semantic clarity due to the formation not only of links between neural-like elements, but also of the elements themselves, that is, there is not just building a network by placing semantic structures in the environment of neural-like elements, but, in fact, creating this environment.

Such a structure of the electronic brain allows the robot to perceive any information of the outside world without requiring reprogramming and retraining, to conduct a dialogue, answer the questions asked and, due to the formation of conditioned reflexes, have the ability to learn, think logically and meditate during the entire period of the robot's active life. Testing and experiments with robot confirm the possibility of creating intelligent systems and robots with a strong AI. With an intellect similar to a human being and perhaps superior to it.

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