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THE ELECTRONIC BRAIN FOR INTELLECTUAL SYSTEMS AND ROBOTS

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Анотація. *Пропонується технологія створення електронного мозку для інтелектуальних систем і андроїдів. Наше рішення проблеми розвитку електронного мозку – це нова архітектура, розроблена на основі нового типу нейронних мереж, які не мають аналога. На основі багатовимірних рецепторно-ефекторних нейроподібних зростаючих мереж створено теорію і технологію розробки систем зі штучним інтелектом. Технологія призначена для створення інтелектуальних систем і роботів різного призначення, а також для управління об'єктами, що мають датчики і виконавчі механізми. У перспективі – отримання повноцінного штучного інтелекту. Мета полягає в реалізації штучного інтелекту з новою активною, асоціативною, однорідною, матричною структурою. Це дозволить створити робота-помічника для людини, який може розуміти людину і повністю замінити його в повсякденній роботі або в небезпечних місцях. Електронний мозок може бути використаний у будь-якій сфері робототехніки, стати віртуальним помічником у звичайному комп'ютері або у незалежній інтелектуальній системі.*
Ключові слова: *електронний мозок, розумні роботи, штучна причина, нейронні мережі, нейроподібні зростаючі мережі, багатовимірні рецепторно-ефекторні нейроподібні зростаючі мережі.*

Аннотация. *Предлагается технология создания электронного мозга для интеллектуальных систем и андроидов. Наше решение проблемы развития электронного мозга – это новая архитектура, разработанная на основе нового типа нейронных сетей, которые не имеют аналога. На основе многомерных рецепторно-эффекторных нейроподобных растущих сетей созданы теория и технология разработки систем с искусственным интеллектом. Технология предназначена для создания интеллектуальных систем и роботов различного назначения, а также для управления объектами, имеющих датчики и исполнительные механизмы. В перспективе – получение полноценного искусственного интеллекта. Цель состоит в реализации искусственного интеллекта с новой активной, ассоциативной, однородной матричной структурой. Это позволит создать робота-помощника для человека, который может понимать человека и полностью заменить его в повседневной работе или в опасных местах. Электронный мозг может быть использован в любой сфере робототехники, стать виртуальным помощником в обычном компьютере или в независимой интеллектуальной системе.*
Ключевые слова: *электронный мозг, разумные роботы, искусственная причина, нейронные сети, нейроподобные растущие сети, многомерные рецепторно-эффекторные нейроподобные растущие сети.*

Abstract. *The technology of creation of the electronic brain for intellectual systems and androids is offered. Our solution of the problem of development of the electronic brain is the new architecture developed on the basis of a new type of the neural networks which do not have analog. On the basis of the multidimensional receptor-effector neural-like growing networks the theory and technology of development of systems with artificial intelligence is created. The technology is intended for creation of intellectual systems and robots of different function, and also for object management, having sensors and executive mechanisms. In the long term it is expected the receiving of full-fledged artificial intelligence. The purpose consists in realizing development of the artificial intelligence with new active, associative, uniform matrix structure for robots of various applications. It will allow creating robots assistants for the person which can understand the person and completely replace him in routine work or in dangerous places. The electronic brain can be used in any sphere of robotics, to be the virtual assistant in the normal computer or independent intellectual system.*

Keyword: *the electronic brain, intelligent robots, artificial reason, neural networks, neural-like the growing networks, the multidimensional receptor-effector neural-like growing networks.*

1. Introduction

In the modern world the development of robotics is a key question. The mankind enters the era of robotization.

In the solution of the problem of creation of artificial reason a huge amount of money is invested. The Human Brain Project – the amount of financing – 1 billion euros. The SpiNNaker project (Spiking Neural Network Architecture) – the amount of financing is £5m. The NeuroGrid project (Grid technology for neurosciences) – the amount of financing is $4,9 million; The BrainScaleS Project (Brain-inspired multiscale computation in neuromorphic hybrid systems) – the amount of financing is €9 200 000. The SyNAPSE project (Systems of Neuromorphic Adaptive Plastic Scalable Electronics) – the amount of financing is $102 million.

Now the USA is the leading country in the field of military robotics. The army of the USA locates more than one thousand military robots which took part in a war in Iraq and in Afghanistan. According to forecasts of military experts, in some years the army of the United States for 30% will already consist of robots. Development of androids goes fast rates. They are already able to go quicker, than the infantryman, to be wrung out, do knee-bends, to walk upstairs, to open a door, to drill the electric drill wall and to do many other things. To make of them the real soldiers, it was necessary to enclose it in hands the weapon and to teach to use this weapon. They could in dangerous areas go ahead of soldiers, taking the first blow. When cleaning buildings the first to open a door and to enter the room, to protect people in dangerous situations and to carry out other tasks, saving lives of fighters [1].

According to a solution of the manual of the Ministry of Defence of the Russian Federation in each military district and on fleet groups of fighting robots are created, their regular structure and governing bodies formed. Russia aims to robotize battle completely. The first experiment of use of robots has been made in operation against fighters Igil. Fighting robots have been thrown to Syria and tested in fighting conditions [2].

However, availability at the opponent of means of suppression of systems of remote control interferes with successful conducting combat operations. In this regard, the creation of independent intelligent robots which could make independent decisions and carry out objectives is particularly important. Such robots have to possess the nervous system similar to the nervous system of the person.

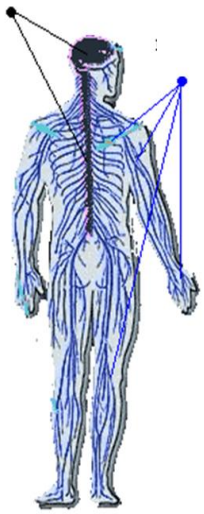

Fig. 1. Nervous system of the person

For the development of the methodology of creation of androids the analysis of works of psychologists and neurophysiologists on a research of functioning of the brain of the person has been carried out. As a result of the systems concept the main functional structures of the brain have been selected.

2. Main function of neural structures of person brain

2.1. Nervous system of the person

The nervous system divided on central and peripheral (fig. 1). The Central Nervous System (CNS) consists of the accumulation of nervous cages (neu-

rons). The CNS main function is the implementation of the simple and difficult reactions of the organism which have received the name of reflexes. The peripheral nervous system in the basis is a link between the central nervous system and bodies [3].

2.2. Functional organization of brain

In works of physiologists P.K. Anokhina, A.R. Luriya, E.N. Sokolova, etc. from a position of the system organization of functions of activity of brain distinguish the following functional systems and subsystems. The classical option of integrative activity of brain is presented in the form of interaction of three main functional units (fig. 2):

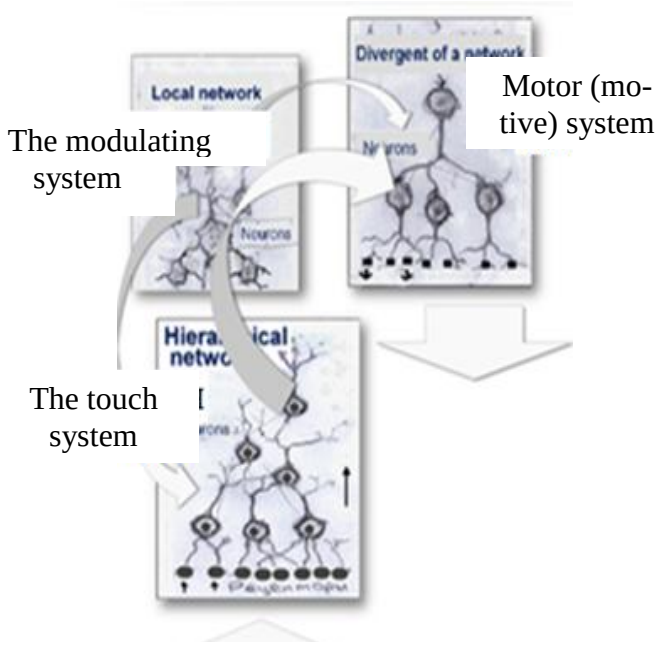

Fig. 2. Main functional units of nervous system of the person

1) The block of reception and processing of touch information – the touch system (analyzer).

2) The block of modulation, activation of the nervous system – the system modulating (limbic-reticular system) of the brain.

3) The block of programming, start, and control of behavioral acts – the motor system (the motives analyzer) [3, 4].

Basic functions of touch system: detection, perception, detecting of signs, identification of images; transfer, conversion and coding of signals.

Receptors perceive to detect and distinguish primary signals. Detection and identification signals implement neurons of the cerebral cortex. Transfer, conversion and coding of signals are carried out by neurons of all layers of touch systems. In touch systems, hierarchical arrangement of neurons has the ascending character.

The device which is executing wakefulness level adjuster role, and also carrying out selective modulation and updating of priority of this or that function is the modulating system of the brain. The first source of activation is the internal activity of the organism or its requirement. The second source of activation is connected with the influence of irritants of the external environment. Restriction of contact with external environment leads to a considerable decrease in tone (excitability) in a bark of brain.

"… It is established that the cerebral cortex along with specific functional contribution renders the "nonspecific" activating and brake influences on underlying nervous educations. The cortical influences arriving on the descending fibers represent the rather differentiated organization and can be considered as the additional third source of activation" [4].

Motive systems of the brain are organized by the principle of the descending hierarchy. The special place in the functional organization of the brain is taken by the motive analyzer or integrative and starting systems. For motive areas, first of all, synthesis of excitation of different modality with biologically significant signals and motivational influences is characteristic. Further, final transformation of afferent influences in qualitatively new form of activity directed on the fastest output of efferent excitation on the periphery, i.e. on devices of implementation of a final stage of behavior is inherent to them.

2.3. Reflex activity of nervous system

The physiologist with world name I.P. Pavlov conducted the research of separate functions of the organism from positions of self-organization system. The entity of the Pavlov doctrine does not consist in the one-sided impact of the environment on the organism, and in the active interaction of the organism with Wednesday. Balancing the organism and the environment is carried out thanks to the unconditioned reflex activity of the nervous system. Unconditioned reflexes are activated by both internal and external agents; perfection of equilibration is provided. But the external environment is not constant and unconditioned reflexes are not enough, as stable, stable nervous relations. There is need of addition their conditioned reflexes [5].

2.4. Unconditioned reflexes

Unconditioned reflexes are genetically set. Inborn reflexes are characterized by a stereotypic sequence of implementation of the behavioral act. They arise at their prime necessity, at the emergence of "specific" irritant, to each of them, providing thereby steadfastness of execution of the most vital functions of organism irrespective of accidental conditions of the environment. Characteristic of unconditioned reflexes is that their implementation is defined internal determinants, and the external stimulus program.

2.5. Instincts

Difficult complexes of unconditioned reflexes are carried out in the form of instincts. Their realization defined as internal determinants and external modular program**.**

2.6. Conditioned reflexes

Conditioned reflexes are got by the organism in the course of its life activity. The conditioned reflex activity of the organism is reduced to the transformation of indifferent stimulus in the annoying signal, thanks to repeated reinforcement of irritation by unconditional incentive. Thanks to the reinforcement of conditional incentive previously indifferent unconditioned stimulus are associated in the life of the organism with the biologically important event and by that signals about the approach of this event.

2.7. Development of brain

Development of brain happens due to the emergence of the new connections. All interactions with the environment and functions of an organism are controlled by the brain and are caused by its structural changes. The newborn child has a brain approximately one quarter than at the adult.

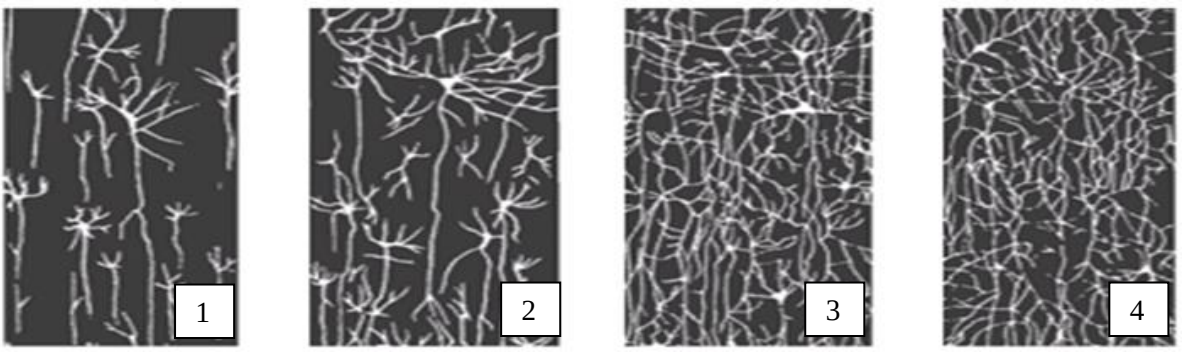

Fig. 3. Increase in Number of Communications between neurons in process of cerebral cortex at children (1-1 months, 2-2 months, 3-1god, 4-2 years)

The sizes of the neural network of brain increases and nature of nervous communications become complicated in process of growth of the child, his communication with people, subjects of the outside world. And a child needs constantly to make decisions. (F. Blum, etc., 1988). In fig. 3 development of neurons and increase in a number of communications between them in process of cerebral cortex at children during the period from the birth till two years (F. Blum, etc., 1988 is shown; Conel, 1939, 1959).

2.8. Decision-making

From the moment of the birth and to the death of people is constantly in a status of a need to make these or those decisions one of which are carried out automatically at the subconscious level, others become subject of long thought, choice of one of the possible options.

Decision-making process is the derivative of the uncertainty of the situation in which it is made. At full determinacy when there is no opportunity for alternative actions: the decision is made unambiguously, automatically, often even without affecting the sphere of consciousness. Selection process becomes a problem only when – at the system of people – environment is present uncertainty in relation to the implementation of the actions directed on achievement of definite purpose, the end result.

The process of decision-making is the universal principle of the analysis, synthesis and processing of input touch information and forming of output reaction. Decision-making is the key act in the activity of any rather complex biological system functioning in actual practice external environment. The essence of process of decision-making is reduced to by several moments: perception, reception and processing of afferent information, education, forming of field of alternatives (set of possible options for the subsequent choice), comparative assessment of alternative actions for the purpose of implementation of rational choice and actually alternative choice – the culmination of solution. Such representation confirms the hypothesis of decision-making as a result, the inevitable result of the integrative process when from a set of alternatives the organism aims to select one, only, a best providing solution of the task facing them.

The choice at decision-making is considerably caused by the current motivation. Clarification of the neurophysiological mechanisms which are the cornerstone of operation of choice in the alternative situation is directed on further increasing knowledge of the nature of perception and processing of information in communications systems of the brain. Perception, selection, fixing and extraction from a memory of the relevant information, contrastive analysis of the biological importance of signals, choice and implementation of the specific propagation path of excitation in nervous networks, forming of the efferent command signals arriving to effector bodies – all this the most important components of difficult process of decision-making.

In the course of decision-making two essentially different phases differ: 1) variety generation (of a variety of actions the class of possible solutions is selected) and 2) restriction of this variety for the purpose of selection of the one and only option of action. The structure and sequence of the actions characterizing the decision-making mechanism are presented usually in the form of some treelike process in which in process of solution, unpromising branches are cut. Such unpromising branches are the actions resulting in recurrence of the intermediate result, violation of statements of the problem etc.

Thus, the brain is the universal remedy of a solution of a wide range of tasks, especially unformalized for which there is no standard, in advance is known methods of solution. The brain of the person possesses such qualities as learning capability, adaptivity, the distributed information representation and mass parallelism of its processing, tolerance to errors, low energy consumption. These qualities are absent in machines with von Neumann architecture.

3. Requirements to nervous system of the electronic brain of android.

Leaning on above-mentioned functional structures of the brain of the person, we will formulate requirements to the structure of the artificial intelligence (AI) of the robot – the android.

3.1. The nervous system of the electronic brain of the robot

The nervous system of the electronic brain of the robot – the android is subdivided on central and peripheral. The central nervous system consists of a set of neural-like elements and represents active associative memory. The CNS main function – implementation of simple and difficult reactions of organism – reflexes. The peripheral nervous system is a link between the central nervous system and executive bodies of the robot. The architecture of such system essentially differs from the existing systems, providing mass parallelism and incomparable performance (fig. 4).

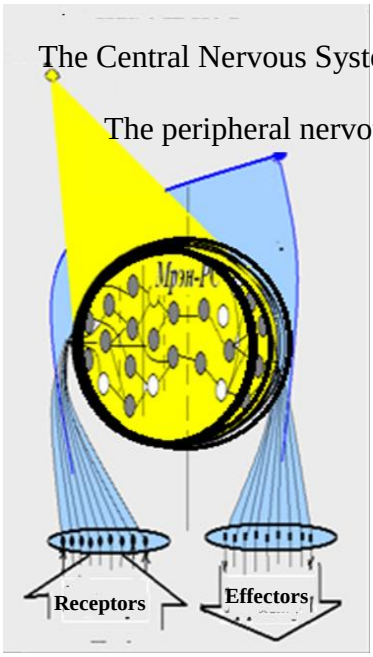

Fig. 4. Nervous system of the electronic brain of the robot

3.2. Functional activity of the artificial intelligence

Functional activity of the artificial intelligence is presented in the form of interaction of three main functional units: the block of reception and processing of touch information – touch system (analyzers); block of modulation, activation of nervous system of the artificial intelligence; the block of start and control of behavioural acts – motor system (the motive analyzer).

3.3. Reflex activity of the nervous system of the robot

Unconditioned reflexes are created when designing the robot. Conditioned reflexes, are got by the robot during his life. Development of the artificial intelligence of the robot happens due to the emergence of new communications. All interactions with the environment, cerebration, functions of an organism are caused by its structural changes. The process of decision-making is the universal principle of the analysis, synthesis and processing in the central nervous formations of input touch information and forming of output reaction.

The multiconnected the multidimensional receptor-effector neural-like growing networks (mmren-GN) are developed according to the above-stated requirements. In work only some functions mmren-GN are described for the purpose of the explanation of the functioning of EB of the robot or intellectual system. Their more complete description is provided in the monograph [6] and in many publications, for example in [7–17].

4. The multiconnected the multidimensional receptor-effector neural-like growing networks

As a result of systems concept in studying the physiology of brain on the basis of the multidimensional receptor-effector neural-like growing networks the theory, methodology and architecture of the electronic brain of reasonable systems is created.

The multiconnected the multidimensional receptor and effector neural-like growing networks represent structure in which process of formation of unconditioned and conditioned reflexes is possible and the principle of unity of processes of the analysis and synthesis as a part of the reflex reaction.

4.1. Neural-like growing network

Set of the interconnected neural-like elements intended for reception and information transform in the course of interaction with objects of the real world and in the course of reception of information the network changes the structure, increases in sizes – grows is called as the neural-like growing network (n-GN).

The neural-like growing network is the parallelized dynamic system with the topology of the directed acyclic graph which executes processing of information by means of change of the status and structure in response to influences of the external environment.

4.2. The multidimensional receptor and effector neural-like growing networks

The great number of the interconnected double-sided acyclic graphs describing the status of the object and the actions developed by it in different information spaces called the multiconnected the multidimensional receptor and effector neural-like growing networks (mmren-GN).

The multiconnected the multidimensional receptor and effector neural-like growing network is represented the graph (fig. 5) and are formally described as follows.

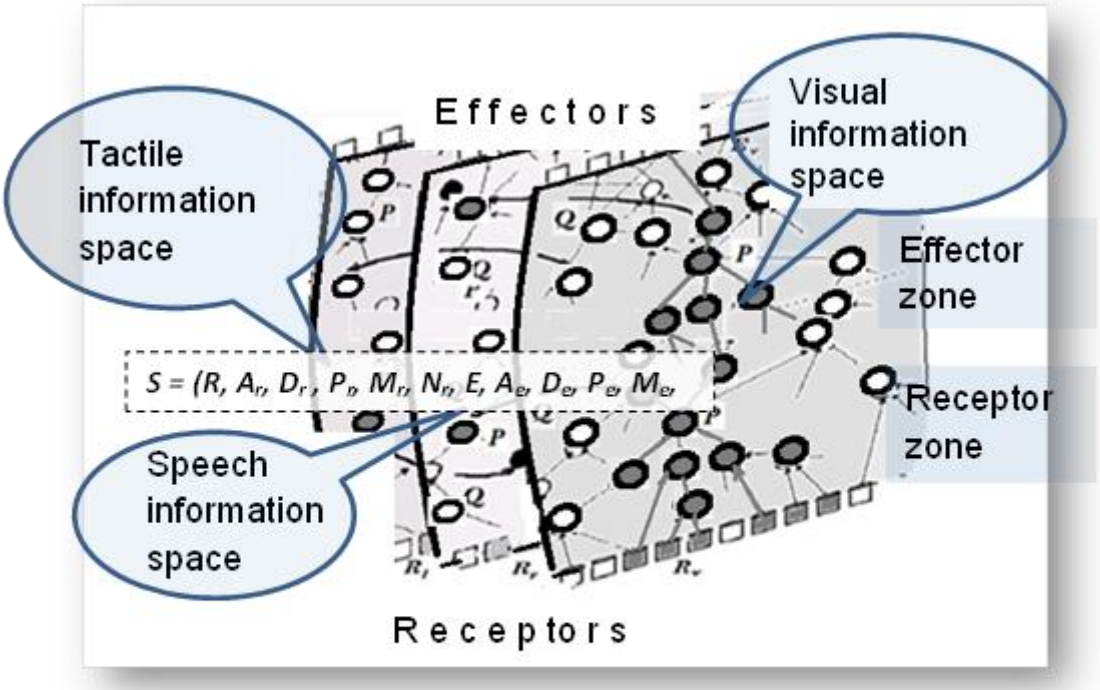

Fig. 5. The multidimensional receptor and effector neural-like growing networks

$S=(R, A_r, D_r, P_r, M_r, N_r, E, A_e, D_e, P_e, M_e, N_e)$, где $R \supset R_v, R_s, R_t, A_r \supset A_v, A_s, A_t, D_r \supset D_v, D_s, D_t, P_r \supset P_v, P_s, P_t, M_r \supset M_v, M_s, M_t, N_r \supset N_v, N_s, N_t, E \supset E_r, E_{d1}, E_{dn}, A_e \supset A_r, A_{d1}, A_{dn}, D_e \supset D_r, D_{d1}, D_{dn}, P_e \supset P_r, P_{d1}, P_{dn}, M_e \supset M_r, M_{d1}, M_{dn}, N_e \supset N_r, N_{d1}, N_{dn}$, here: R_v, R_s, R_t – final subset of receptors of set R; A_v, A_s, A_t – final subset of set of Ar of the neural-like elements of receptor zone belonging, for example, visual – v, sound – s, tactile – t to information spaces; ***Dv,***

Ds, Dt – final subset of arcs of set of ***Dr*** of receptor zone; ***Pv, Ps, Pt*** – final subset of set of ***Pr*** of thresholds of excitation of neural-like elements of receptor zone; ***Nv, Ns, Nt*** – final subset of set of ***Nr*** of float factors of connectivity of receptor zone; ***Er, Ed1, Edn*** – final subset of set of ***E*** effectors belonging, for example, to speech information space – *r* and space of actions – *d1*, *dn*; ***Ar, Ad1, Adn*** – final subset of set of ***Ae*** of neural-like elements of effector zone; ***Dr, Dd1, Ddn*** – final subset of arcs of set of ***De*** of effector zone; ***Pr, Pd1, Pdn*** – final subset of set of *Pe* of thresholds of excitation of neural-like elements of effector zone; ***Nr, Nd1, Ndn*** – final subset of set of ***Ne*** of float factors of connectivity of effector zone.

The neural-like growing networks are a dynamic structure which changes depending on value and arrival time of information on receptors, information spaces (for example, visual, sound, tactile and so forth) and also the previous network condition. In it information on objects and situations is submitted ensembles of the excited neural-like elements and communications between them. And, the perceived object or situation is at the same time described and remembered in different information spaces. Storing of descriptions of objects and situations is followed by input in a network of new neural-like elements and communications upon transition of any group of receptors and neural-like elements to excitation status. Excitation process wavy extends on the network.

5. Functional organization of the artificial intelligence of the robot

As it was already mentioned, according to physiologists the classical option of integrative activity of the brain (natural intelligence) is presented in the form of interaction of three main functional units: sensory, modulating and motor.

The functional organization of the electronic brain of robots has also represented the interaction of three functional units. In the structure of the neural-like growing network the sensory, modulating and motor functional systems form. In receptor zones is the sensory, modulating system and system of the motivation of purposeful behavior. In effector zones – motor system. In the course of the functioning of the network, continuously there is analysis and synthesis, as the arriving information, and responses.

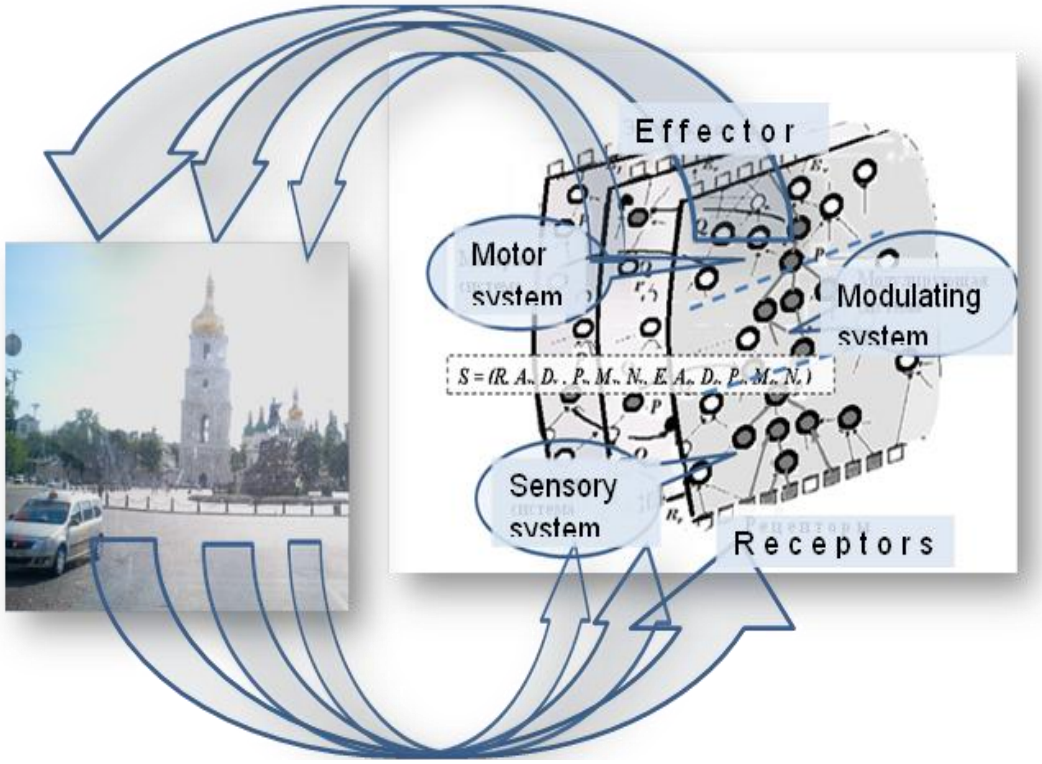

Fig. 6. The functional organization of the electronic brain of robots

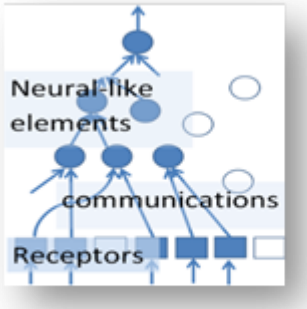

Fig. 7. Sensory network

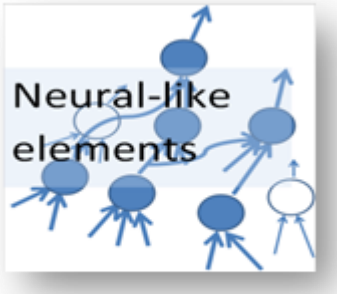

Fig. 8. Local network

In fig. 6 block representation of "brain" of a system of artificial intelligence is shown.

The scheme is provided by three functional areas multidimensional ren-GN. The first area of reception and processing of sensory information is sensory systems (analyzers). The second area of modulation, activation of a system is the modulating systems and the third area of start and control of behavioral acts – motor systems.

The sensory system (analyzer) is a multi-level neural-like network with the hierarchical principle of the organization.

The hierarchical arrangement has the ascending character (fig. 7). The modulating system (local area network) regulates the level of excitability of neural-like elements and carry out selective modulation and updating of priority of this or that function (fig. 8).

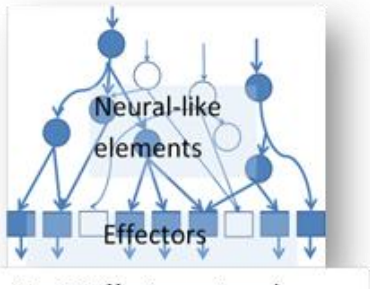

Fig. 9. Effector network

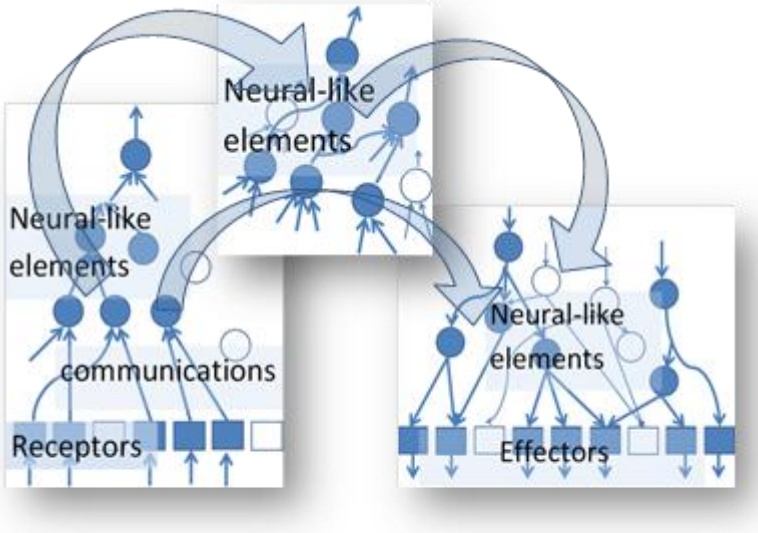

Fig. 10. Scheme of interaction of sensory, motor and modulating system

The first source of activation is a priority of internal activity of subsystems of the system. It is put at a creation of the system, to similarly unconditioned reflexes. Any deviations from the vital indicators of the system lead to activation (change of threshold of excitability) of certain subsystems and processes.

The second source of activation is connected with the influence of irritants of the external environment. Priority of certain activity is gained in the course of «life cycle», similar to forming of conditioned reflexes. Neural-like elements of local area networks hold information stream within someone hierarchical level. Local area networks render the exciting or braking action on neural-like elements of efferent type.

The motor (motive) system is organized by the principle of the descending hierarchy (fig. 9). The motive system consists entirely of ensembles (chains) of neurons of efferent (motive)

type and is under continuous inflow of information from afferent (touch) area. Unlike afferent area in the field of start and control of behavioural acts activation processes go downstream, beginning with the highest levels. In the highest levels chains of command neurons (motive programs) form, and then pass to neural chains of the lowest motor levels and motor neurons – effectors of sections of motive efferent impulsation.

Thus, these systems provide perception of information from the outside world, its analysis, processing, storing, updating of priority of this or that function, development of control signals on executive mechanisms and impacts on the outside world (fig. 10).

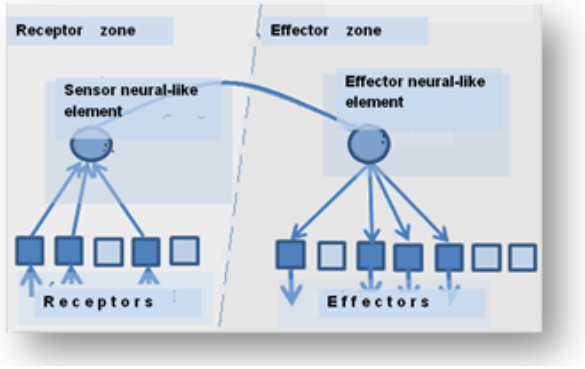

Fig. 11. The scheme of two-neural unconditioned reflex

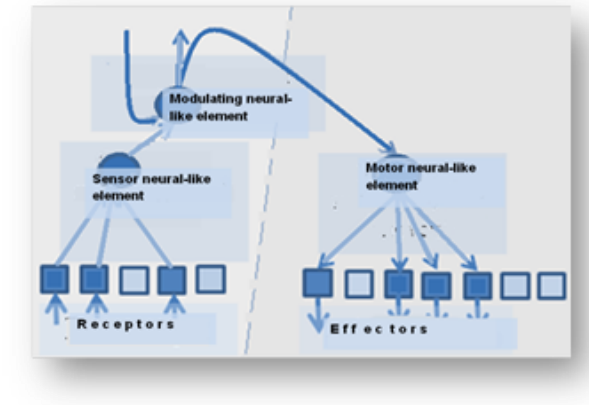

Fig. 12. The scheme of three-neural unconditioned reflex

According to the reflex theory of I.P. Pavlov in the multiconnected the multidimensional receptor and effector neural-like growing network three fundamental principles are implemented.

The first principle – the principle of determinism (causality) says: "There is no action without the reason". In mmren-RS management signals are developed by executive mechanisms in motor system according to information arriving on receptors of touch system. The external information arriving on bodies of perception of the robot is the reason of development of control signals.

The second principle – the principle of structure – each physiological act of nervous activity is dated for structure. In mmren-RS information processing (perception, the analysis, synthesis, storing and so forth) is followed by input of new neural-like elements and communications between them i.e. the structure of network changes.

The third principle – the principle of the analysis and synthesis, in brain continuously occurs the analysis and synthesis, as the arriving information, and responses. In the course of functioning mmren-RS in receptor and effector zones continuously there is analysis, synthesis and information transform.

5.1. Unconditioned reflexes of the robot

Unconditioned reflexes of the robot is simple reactions of the robot to the certain irritants put at its creation. The unconditioned reflex is always carried out at the action on the robot of certain irritants. The scheme of two-neural unconditioned reflex of the robot is given in fig. 11.

The scheme of three-neural unconditioned reflex of the robot is given in fig. 12. Implementation of unconditioned reflexes is defined as internal irritants (signals) which are responsible for normal functioning of internal systems of the robot, and the external irritants stimulating primary behavior in the external environment.

5.2. Instincts

Difficult complexes of unconditioned reflexes are carried out in the form of instincts.

5.3. Conditioned reflexes of the robot

Conditioned reflexes of the robot are reflexes which are got by the robot during “life” and are formed on the basis of unconditioned reflex of fig. 13.

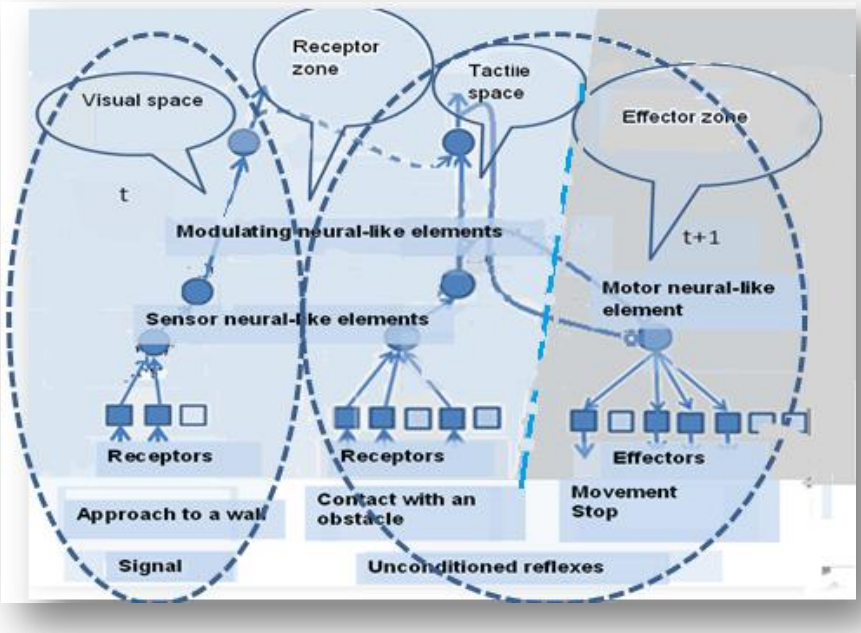

Fig. 13. The conditioned reflex

The neutral irritant is the signal which precedes unconditioned reflex necessary for the development of conditioned reflex. Thanks to a reinforcement of conditional incentive unconditional earlier indifferent irritant are associated in robot life with the important event and by that signals about the approach of this event. Let's consider forming conditioned reflex of the mobile robot. Multiple repetition alarm (the approximation to the obstacle) formed horizontal temporary connections between the visual and sensitive centers. The conditioned reflex is formed. Now the neutral signal (approach to a wall) starts off conditioned reflex.

5.4. Development of brain of the robot

Development mmren-RS (brain) of the robot happens due to activation of new neural-like elements and emergence of new communications. All interactions with the environment, functions of the robot and its activity are controlled mmren-RS and are caused by its structural changes.

5.5. Decision-making

From the moment of “birth” and to “death” the robot resides in status of need to make these or those decisions some of which are carried out automatically at the “subconscious” level (on unconditioned reflexes), others become subject of choice of one of the possible options (choice of ensemble of neural-like elements with the greatest excitation).

At full determinacy when there is no opportunity for alternative actions, the robot makes decision unambiguously, automatically, selecting the only excited sequence of neural-like elements. Selection process becomes a problem only when the robot – environment is present uncer-

tainty concerning the actions directed on achievement of definite purpose, end result at the system. The process of decision-making is the universal principle of the analysis, synthesis, and processing of information in touch system and formations of output reaction in the motor system. The essence of process of decision-making is reduced to perception, reception and processing of input (afferent) information and education, forming of field of alternatives (set of possible options for the subsequent choice) in motor system and comparative assessment of alternative actions for the purpose of implementation of rational choice and actually alternative choice in the modulating system on the basis of last experience.

Fig. 14. The virtual robot “VITROM”

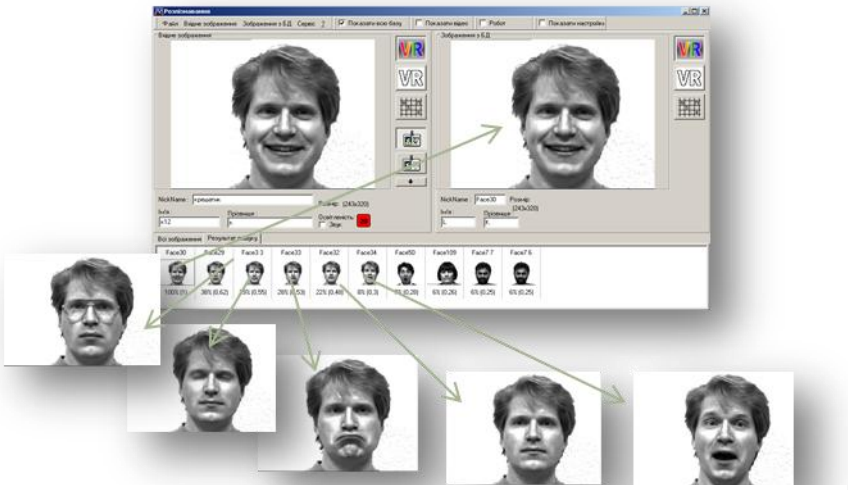

Fig. 15. Object Recognition from the file

Thus, in the course of decision-making from a variety of the excited neural-like elements of action, there is a choice of class of the possible admissible solutions meeting conditions of the solved task. Then a selection of one option of most excited neural-like elements of the action for the achievement of the goal. In the case of the wrong achievement of the goal, there is a correction of execution of action due to excitation of the receptors controlling the course of achievement of the goal (for example, visual receptors or receptors of executive mechanisms) and developments of correction signals of action.

The theory and methodology are checked on program models of intellectual systems.

6. Models of intellectual systems

In the VITROM project, basic provisions of a model of technical sight and function of perception of visual information, the analysis, synthesis, recognition and storing are implemented. “VITROM” the program hardware complex works in the mode the robot and in the object recognition mode as directly from a video camera and the image of the object from the file.

The perception, the analysis and object recognition is carried out in real time.

Fig. 16. Recognition at loss of information

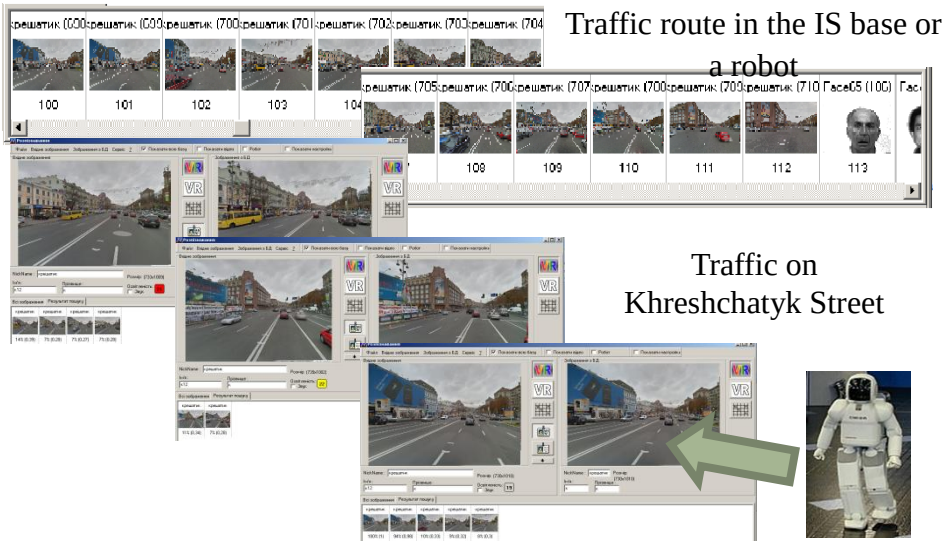

Fig. 17. Function the movement in the real environment

Fig. 18. Recognition of various objects

The virtual “VITROM” robot in the mode of communication draws to itself attention. Finds object. If this object is in memory of the robot, he distinguishes it and reports that he sees.

If it is the person, the robot communicates with it and remembers it if earlier did not meet it. If he recognizes the person, continues communication. The interface of the virtual VITROM robot is shown in fig. 14. In fig. 15 the object recognition mode interface from the file of the base of images of persons of Yale university “Yale FaceIMAGES _Data” is shown. In the knowledge base of the robot more than 1000 images of persons, letters, digits, streets and avenues.

In fig. 16 recognition at loss of information is shown: a) 25% – distinguishes surely; b) 50% – distinguishes surely; c) 75% – sometimes are mistaken.

In fig. 17 the movement in the real environment is shown.

In fig. 18 recognition of different objects is shown.

This technology is most effective at hardware implementation of the neural-like structure.

7. Hardware implementation

Currently, in the framework of the project “Electronic Brain” for robots and intelligent computers stand the task of a hardware implementation.

The amount of funding for the implementation of the proposed project differs from the above projects because the basic studies of brain function have been conducted and determined the system architecture. The project can be implemented in a short time.

Scope of the “electronic brain” – Robotics and all industries that require a reasonable intelligent systems. The technology of the electronic brain development can be used to create a new generation of intelligent computers. In addition to being the Electronic brain can be applied in any field of robotics, he can also be intelligent thinking assistant in a conventional computer, or an independent intellectual system of pattern recognition, information search system in the super-large information databases and so on. The need for such a development is confirmed in great demand on the system artificial intelligence.

8. Conclusion

According to the forecasts of specialists soon robots will be used everywhere – in the developed countries of robots production will be compared to automotive industry, and will be calculated by hundreds billions of dollars. Now robots are made by different firms in Japan, the USA, China and Europe. The problem of creation of the artificial intelligence for robots is the actual task the solution of which will bring billions of dollars.

For industrial robots the intelligence similar to the intelligence of the person is also necessary to what the following fact testifies.

Terry Gough, the CEO of the large plant of Foxconn electronics, one of the ardent supporters of replacement of people on robots. At plant tried to replace one million workers with robots not so long ago. However, the first attempt was not crowned with success. Specialists claim - the reason of failure is that robots cannot compete in sleight of hand with people yet and they do not have enough brains to estimate the quality of products on the assembly line. Usually, the first wave of robots automates manual and physical work. This class of work includes any work which can be unpredictable from one task to another. Such work demands from the worker of skills to see and react to changes of the environment to change the working orientation or in time to notice production errors. The key component is necessary for the analysis and adaptation to the changing conditions Computer sight which actively progresses now. Accuracy with which machines can recognize the image or video and to define that they see has improved doubled for the last year. However intellectual programs will be difficult replace people, especially in so-called “unqualified” work. As it has become clear, this work nevertheless demands certain skills which difficult are given to robots [18].

In the long-term plan, the one who already today will find the place in the unrolled technology race in the field of robotics will win.

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