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Development of Artificial Intelligence for Industrial and Social Robotization

Evgeny Bryndin

Research Department, Research Center «Natural Informatics», Novosibirsk, Russia

Email address:
bryndin15@yandex.ru

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Abstract: The intellectual robotization of industry and the social sphere takes on an international scale. The creation of smart robots for various spheres of human life is associated with high technology and artificial intelligence. Currently, the development of artificial intelligence for industrial and social robotics is carried out by information technology, cognitive robots, digital twins and artificial intelligence systems. The ensembles of intelligent mobile diversifiable agents with strong artificial intelligence are central to the development of artificial intelligence for industrial and social robotics through the recurring development of professional skills, increasing their visual, sound, subject, spatial and temporal sensitivity. Working with big data, diversify and transform the high-tech industry and the social sphere. The cognitive ensembles of mobile diversifiable agents, technology platforms and analytical systems allow you to quickly and efficiently solve the tasks of collecting, analyzing and visualizing large amounts of data. Effective collection and analysis of big data, their rapid updating using strong artificial intelligence will accelerate industrial and social robotics by teaching new skills. Intelligent robotization based on large ensembles of intelligent agents processing big data requires faster supercomputers. Communication and control of the robot through the mental neurointerface accelerates the training of industrial and social communicative-associative robots, the development of their intelligence, and makes them natural assistants in improving the life of society. Rapid technological development and rapid change of professions requires a client of project-oriented training of personnel.

Keywords: Artificial Intelligence, Smart Robotization, Neurointerface, Intelligent Supercomputer, Client Design-Oriented Education

1. Introduction

There are various approaches to the development of artificial intelligence for various areas of life [1-10]. The article outlines the direction of the development of artificial intelligence for production high-tech robotization to industry level 5.0, as well as for human-like robotization of the social sector of services in order to improve the quality of life. A mental approach to the interaction of a person with a robot, as well as specialists among themselves, is proposed.

The article consists of sections. The first section discusses aspects of advanced artificial intelligence of self-organizing ensembles of intelligent agents to create human-like robotization.

The second section is devoted to the use of humanoid robotics in industry, the social sphere, in the high-tech field and space. Experts strive to create a smart human-like robot. The creation of a humanoid robot is associated with the implementation of a large number of functions and competencies. The author proposed to realize the functions and competencies of a humanoid robot with the help of large ensembles of intelligent agents processing large data on high-speed huge computing resources. Large ensembles of intellectual agents require functional self-organization. The article proposes the approach and technology of functional harmonious self-organization of large ensembles of intellectual agents.

Human communication of internal speech with a communicative associative robot through the neurointerface is discussed in the third section.

The fourth section deals with a supercomputer with artificial intelligence for the functioning of large ensembles of intelligent agents.

The fifth section deals with the client design-oriented training of specialists for robotics with artificial intelligence of various industrial fields and social services.

2. Improving Artificial Intelligence

2.1. Practical Development of Strong Artificial Intelligence

For the development of strong artificial intelligence, a standard case for its application is proposed. The standard case is approved by the Japanese Technical Committee for Standardization of Artificial Intelligence. It has the status of an international standard [11].

The Application of Strong Artificial Intelligence international standard case consists of seven tables containing attributes, characteristics, properties, parameters and qualitative indicators and criteria for the development of artificial intelligence of various systems.

Standard Application of Strong Artificial Intelligence Case:

***Table 1**. General.*

Use case name	**Application of Strong Artificial Intelligence**			
Application domain	Hi-Tech Labor Market			
Deployment Model	Human digital double			
Status	Results of research: Strong Artificial Intelligence			
Scope	Economic sectors and social services			
Objective(s)	Find accurate and universal application of strong artificial intelligence.			
Narrative	Short description (not more than 150 words)	Strong Artificial Intelligence-scientific applied direction on development and creation of technological and program cognitive complexes of the digital double of intelligence of the person of technological and program cognitive complexes of the digital double of intelligence of the person capable to training, retraining, self-realization and self-improvement on the basis of criterion of preferences and to improvement of functional activity by the high-quality choice and development of creative innovative hi-tech professional and behavioural skills and competences.		
	Complete description	Technology that studies the development of chelatinous digital twins capable of acquiring, processing and applying human knowledge and skills, purchased through training, to solve problems, adapt to changing circumstances with or without human or external control in physical work, as well as in mental or cognitive work. Technology builds models by analyzing quantitative and qualitative data from different perspectives and measurements, classifying them, and summarizing potential relationships and impacts. The technology uses natural language processing and machine learning to interact more naturally and expand human experience and knowledge on a permanent basis during operation. The technology has robust mechanisms by which to ensure security in way that humans would understand. Technology showing smart behavior comparable to human across the range of cognitive abilities. The technology models the spectrum of human abilities by retraining. The technology relies on the infrastructure of interconnected actors, people, systems and information resources of high-tech industry and social sphere, as well as on services that process and respond to information from the physical and virtual world of social cognitive smart robots: guide, seller, teacher, nurse, volunteer, guard, administrator.		
Stakeholders	Highly technological producer			
Stakeholders' assets, values	Reputation			
System's threats and vulnerabilities	Legal and ethical aspects of interaction with society.			
Key performance indicators (KPIs)	ID	Name	Description	Reference to mentioned use case objectives
	1	AI management of professional cooperation process	The technology of creative processes control can itself predict optimal terms of execution of certain stages on the basis of accumulated information about their labour intensity, selection of the route of staff load and competences of employees. Optimize processes during their execution-automatic delegation of tasks taking into account the load of employees and their competences.	Improve accuracy
	2	Productivity and quality AI	Strong artificial intelligence works with fewer mistakes and is safer. Strong artificial improves the quality of life of man and society in daily concerns, as well as productivity in high-tech industry and production.	Improve efficiency
AI features	Task(s)	Creative activity		
	Method(s)	Deep learning		
	Hardware	Supercomputer with Strong Artificial Intelligence		
	Topology	Distributed Modular Interconnect Topology		
	Terms and concepts used	Deep learning, "imagification", neural network, training, training data set		
Standardization opportunities / requirements	Strong artificial intelligence requires process standardization, as does every human activity.			
Challenges and issues	Qualitatively new type of thinking not available to humans.			
Societal concerns	Description	Security and ethical and legal aspects		
	SDGs to be achieved	Universal approach to big data processing with smart cognitive systems		

Table 2. *Data.*

Data characteristics	
Description	Strong Artificial Intelligence Data
Source	Model and technology of Strong Artificial Intelligence
Type	Strong
Volume (size)	Hi-Tech Labor Market
Velocity (e.g. real time)	Supercomputering Velocity
Variety (multiple datasets)	streams of multiple datasets
Variability (rate of change)	Retraining
Quality	High

Table 3. *Process scenario.*

Scenario conditions					
N.	**Scenario name**	**Scenario description**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Training	Train a model (deep neural network) with training data set	Technological process raw data set is ready	Formatting of data	Management of safety
2	Evaluation	Expansion of the trained model	Development of technological thinking and behaviour	Cognitive thinking patterns and psychological behaviors	Meeting KPI requirements is condition of development
3	Execution	Model and Technology Tooling	Interaction	Activization of Model	Completion of interaction
4	Retraining	Retrain a model with training data set	Certain period of time has passed since the last training/ retraining	Additional data and knowledge	Combining Data and Knowledge

Table 4. *Training.*

Scenario name	**Training**				
Step No.	**Event**	**Name of process/Activity**	**Primary actor**	**Description of process/activity**	**Requirement**
1	Sample raw data set is ready	Specification and classification	Manufacturer	Transform sample raw data	Strong AI Software
2	Completion of Step 1	Creating Set of Experimental Data	Manufacturer	Development of set of experimental data through job modelling	Software of modelling
3	Completion of Step 2	Model training	AI solution provider	Train a model (deep neural network) with experimental data set created by Step 2	

Table 5. *Evaluation*

Scenario name	**Evaluation**				
Step No.	**Event**	**Name of process/Activity**	**Primary actor**	**Description of process/activity**	**Requirement**
1	Completion of training/retraining	Research	Manufacturer	Train model (deep neural network) with experimental data set created	
2	Completion of Step 1	Identification	AI solution provider	Based on data, detect execution using a deep neural network trained in learning scenario	
3	Completion of Step 2	Evaluation	Manufacturer	Comparison of phase 2 results with human performance	
Input of evaluation					
Output of evaluation					

Table 6. *Execution.*

Scenario name	**Execution**				
Step No.	**Event**	**Name of process/Activity**	**Primary actor**	**Description of process/activity**	**Requirement**
1	Completion of comparison of modeling results with human performance	Research	Manufacturer	Development of a set of experimental data through job modelling	
2	Completion of Step 1	Identification	Manufacturer	Based on modified data train model (deep neural network) with experimental data set created	The trained model with deep neural network has to be handed over to the manufacturer
Input of Execution					
Output of Execution					

***Table** 7. Retraining.*

Scenario name	Retraining				
Step No.	**Event**	**Name of process/ Activity**	**Primary actor**	**Description of process/activity**	**Requirement**
1	Certain period of time has passed since the last training/retraining	Research	Manufacturer	Additional data and knowledge	
2	Completion of Step 1	Experimental data set creation	Manufacturer	Combining Data and Knowledge Based on modified data train model (deep neural network) with experimental data set created	
3	Completion of Step 2	Model training	AI solution provider	Comparison of phase 2 results with human performance	
Specification of retraining data		Retraining data set has to include recent data			

2.2. Developing Artificial Intelligence by Intelligent Agent Ensembles

Intelligent agents with synergistic interaction form ensembles. Rapid, efficient data collection and analysis, flexible, rapid data-refresh mobility, and a synergistic, open collaboration of intelligent agents with information platforms and analytics systems help accelerate the digital transformation of the high-tech industry and social sphere by training new skills. Interaction of intelligent agents of the ensemble with information platforms and analytical systems is facilitated by a standard case of synergistic interaction [12-13].

New skills are taught in a virtual space and then developed in a specific environment. The accumulation of professional experience in virtual space contributes to the development of artificial intelligence in the industrial environment.

2.3. Technological Self-organizing Ensembles of Intelligent Agents

The main law of the ensemble organization is the law of synergy: the sum of the properties of the organized whole exceeds the sum of the properties available to each of the elements included in the whole separately. The most important feature of the ensemble is the presence of qualities that are not reduced to the sum of the qualities of its intellectual agents. An important indicator of the sustainability of the organization of the ensemble as a holistic system is the nature of interaction with the environment. The self-regulation of the ensemble is that with internal or external effects on the system, some of its intellectual agents acquire dysfunctional properties, and for the purpose of self-preservation, the ensemble seeks to neutralize these dysfunctions. The ensemble has a number of regulators subordinate to each other. Regulation as a process is a change in the relationship of intelligent agents. aimed at storing information by transmitting communication channels, in which the functional nature of the properties of intelligent agents is maintained and enhanced. To do this, the selection of features or grounds is carried out first for connecting intelligent agents into a holistic system according to the law of proportionality. The law of proportionality determines the relationship between the organization of the ensemble and the fact that between each of the types of intellectual agents included in it. There are certain quantitative and qualitative relationships between the characteristics of intelligent agents. The law of proportionality determines the proportionality of parts combined as a whole, in which the effect of synergy is achieved.

A synergistic approach allows you to implement the self-organization of intellectual agents of the technological ensemble. Technological self-organizing ensembles are able to interact with production teams, replace them for some time and even completely release them in various fields of professional activity. Intelligent agent technology ensembles can manage industries, make decisions in challenging changing circumstances, and provide security in extreme environments.

The synergistic mechanisms of self-organization of technological ensembles of intelligent agents are used in accordance with the standard case of the application of ensembles in various fields. The standard case "Application of the ensemble of intellectual interacting agents" defines parameters, characteristics, methods, models of human twins, knowledge, skills, behavior, images, categorical methods of utility and preference and other entities of interaction of intellectual diversified agents [14].

2.4. Communicative-Associative Development of Smart Artificial Intelligence

The development of smart artificial intelligence reveals new system qualities and technological singularity in the process of joint action and mutual adaptation of diversified intellectual agents according to the standard case of their application. Technological smart artificial intelligence compares information according to utility criteria, selects it according to the preference criterion, reveals novelty according to the principle of opposite (optimal - not optimal; effective - not effective; dangerous - safe, etc.) method from nasty based on objective conditions based on communicative associative logic [15-16].

2.5. Functional and Harmonious Self-organization of Ensembles with Hybrid Competencies

Functional harmonious self-organization of interaction of intellectual agents in different environments is carried out on the basis of data of specific environment obtained by analytical competent intellectual agents. For each set of functions and hybrid competencies of an intelligent ensemble, there is a critical importance for the number of its intellectual agents capable of synergistic self-organization of interaction. The artificial intelligence of large ensembles of intellectual agents with functional hybrid competencies can be tuned to the functional harmonious self-organization of the collective interaction of the necessary intellectual agents to realize a set of functions and competencies, if their number exceeds the critical value that determines their ability to self-organize interaction based on multiple attempts and sufficient positive feedback.

The complex dynamic organization of a purposeful functioning ensemble requires continuous management, without which the ensemble cannot exist. The peculiarity of this management is that it causes a number of processes in the ensemble itself and, above all, processes of internal self-regulation according to the laws of self-tuning, self-development and self-training.

A self-developing ensemble is an adaptable system that independently develops the goals of its development and the criteria for their achievement, changes its pair of meters, structure and other characteristics in a given direction.

A self-learning ensemble is an adaptable system that in the process of development goes through the process of learning, accumulating experience, and has the ability to independently search for criteria for the quality of its functioning.

All organizational administrative activity has to be directed to creation of the operating intellectual agents capable samostoyatelkno, during management process to build own algorithm as a result of adaptation and an obuchekniya. Such control, in contrast to control in advance for this rigid algorithm, is called adaptive control. The task of adaptive management is to find the best strategy with respect to the management goal.

The self-organizing ensemble, according to the laws of synergy, is rebuilt in such a way as to create a minimum resistance that generates its flow. Flow gives rise to structure, structure tends to maintain flow.

All this happens in the range of the structure. With an increase in flow above the critical one, a restructuring of the structure occurs. The old structure, unable to pass the increased flow, is destroyed. In its place, a new structure corresponding to a higher flow range is organized by a jump. The system, which has fallen into the range of its existence, seeks to stabilize the flow. Resists its decrease below the occurrence range and its increase above this range.

The activity of the organizational structure is considered as a dynamic interaction of information flows. These streams operate an algorithm for determining the quantitative and qualitative characteristics of a hierarchical control structure. The mathematical apparatus of cognitive analysis and control is sign networks that take into account hundreds of functional parameters of the system and give a qualitative answer to questions, not quantitative.

Self-organization is the formation of a spatial, temporal, information or functional organization, structure (more precisely, the desire for organization, for the formation of a new structure) due to the internal resources of the system as a result of targeted interactions with the environment of the system. We are talking about information interaction with the external environment. In recent decades, algorithms have appeared that allow you to work with large information flows.

The process of self-organization of ensembles of intellectual agents is carried out according to the law of structural harmony of the system: "Generalized gold sections are invariants, on the basis and through which in the process of self-organization of the system they gain a harmonious structure, stationary mode of existence, structural-functional stability." The organization of the system involves a certain coordination of the states and activities of its subsystems and component elements. The ability to self-organize is based both on the multiplicity of elements of the system and the branching of connections between them, which contribute to the emergence of integrity, and on the presence of flexible interaction between elements by the type of feedback. Negative feedback provides stability of system functions, stability of its parameters, resistance to external influences. Positive feedback plays the role of process amplifiers and is of particular importance for the development, accumulation of changes. The presence of negative and positive feedback leads to the possibility of developing a golden section according to the law using external and internal relationships.

At the time of the self-organization of the ensemble, a qualitative transition takes place, intellectual agents begin to function as a whole, organizational stability begins. A fundamental step in describing such systems was taken by a Danish scientist who worked in America for many years, Per Buck, in the theory of self-organized criticality. The title emphasizes that the system self-organizes into a critical state in which its dynamics acquire large-scale invariance in collective interaction in the network that develops as a result of self-organization. This approach is called "connectionism" (from English to connect - connect).

The stable distribution of positive and negative responses of interacting bonds according to the law of the golden section determines the critical value of the intellectual agents of the ensemble. An ensemble having the number of necessary intellectual agents of equal or more critical importance is capable of self-realization and obtaining the necessary result. Determining the critical values of the ensembles of intelligent agents for the implementation of various sets of functions and competencies will help create a universal large ensemble with intelligent artificial intelligence. To implement and maintain this project, super-powerful supercomputers and standard case of harmonious functional self-organization of large ensembles of intelligent agents with smart hybrid competencies according to law of gold cross-section are required [17].

2.6. Building an Ethical Digital Environment with Smart Artificial Intelligence

Intelligent agent ensembles allow you to create a digital environment with professional images with language, behavioral and active communications, when images and communications are implemented by agents with intelligent artificial intelligence. Through language, behavioral and active communications, intellectual agents implement collective activities. The ethical standard through intelligent agents allows you to regulate the safe use of ensembles made of robots and digital doubles with creative communication artificial intelligence in the social sphere, industry and other professional fields. The use of intelligent agents with smart artificial intelligence requires responsibility from the developer and owner for harming others. If harm to others occurred due to the mistakes of the developer, then he bears responsibility and costs. If the damage to others occurred due to the fault of the owner due to non-compliance with the terms of use, then he bears responsibility and costs. Ethical standard and legal regulation help intellectual agents with intelligent artificial intelligence become professional members of society. Ensembles of intelligent agents with smart artificial intelligence will be able to safely work with society as professional images with skills, knowledge and competencies, implemented in the form of retrained digital twins and cognitive robots that interact through language, behavioral and active ethical communications. Cognitive robots and digital doubles through self-developing ensembles of intelligent agents with synergistic interaction and intelligent artificial intelligence can master various high-tech professions and competencies. Their use in the industry increases labor productivity and economic efficiency of production. Their application in the social sphere improves the quality of life of a person and society. Their widespread application requires compliance with an ethical standard so that their use does not cause harm. The introduction and use of an ethical standard for the use of cognitive robots and digital doubles with smart artificial intelligence increases the safety of their use. Ethical relationships between individuals and intellectual agents will also be governed by an ethical standard [18].

2.7. Standardization of Artificial Intelligence for Development and Use of Intelligent Systems

The ISO has an international technical committee for standardization of artificial intelligence ISO/IEC JTC 1/SC 42 "Artificial Intelligence." National technical committees for standardization of artificial intelligence have been established in technologically developed countries. National technical committees develop national artificial intelligence standards. They are subcommittees of the international committee on certain areas of standardization. The International Committee approves international standards through national subcommittees. The standard Application of Strong Artificial Intelligence case is approved by the Japanese Technical Committee for Standardization of Artificial Intelligence. It is international standard [11].

2.8. Strong Artificial Intelligence with Technological Singularity

Fifty years of Moore's Law. Quantum computers, DNA computers, neural networks are being developed. The exponential growth of technology and progress is now observed. Everything inevitably indicates a further acceleration of progress and movement to a certain point - the technological singularity. If you look at the history of the information development of man and technology, then you can notice several patterns. Simplest Nervous System - > Brain - > Speech - > Writing - > Computers and the Internet. Each next stage came much faster than the previous. Information technologies, in cooperation with others, give two main products: strong artificial intelligence with technological singularity and a human-robot interface.

The singularity of strong artificial intelligence, as a feature of the search for solutions, in conditions incomprehensible to humans, by cognitive intelligent systems based on the accumulated experience of risk situations by processing the accumulated smart big data with strong artificial intelligence, will help make safe decisions at risk. Strong artificial intelligence by processing big risk data finds a secure, cost-effective solution [19]. Solutions are in simulation mode first. If the model provides up to 90% of solutions in risky situations, then it is considered satisfactory. Building models and building big data for risky environments and situations is now critical to disaster prevention and security. The development of strong artificial intelligence to find solutions to prevent disasters and ensure safety is an urgent task for the scientific and engineering community.

3. Intelligent Robotics

3.1. Robots with Artificial Intelligence and Spectroscopic Vision

The artificial intelligence of a robot is a digital twin of human intelligence, capable of learning, retraining, self-realization and the development of professional and behavioral innovative competencies and skills. The robot represents a technological and software cognitive complex. The implementation of artificial intelligence by a robot is carried out on the basis of the criterion of preferences of accumulated professional and behavioral innovative competencies and skills. Spectroscopic vision of the robot perceives objects and objects according to their frequency spectrum. To teach the robot to recognize objects and objects, frequency spectral technology of machine learning is used. Spectroscopic vision perceives the spectrum of radiation of objects, and an artificial trained neural network recognizes them from the spectrum.

Cognitive smart architecture includes artificial neural networks, machine learning algorithms, smart big data cognitive system, high-quality selection system [20]. The cognitive architecture of the robot based on the preference criterion develops functional activity. The smart cognitive architecture of the robot determines step by step how best to achieve the given goals and realize preferences through the actions of the utility function based on high-quality selection. Professional self-improvement is carried out by machine retraining according to the criterion of preferences on the basis of extensive statistics of qualitative selection of accumulated creative innovative skills and competencies in the sixth technological order of industry 4.0. The robot's intelligent cognitive ability is developed by artificial intelligence through machine retraining, based on competencies accumulated in the knowledge base and in the skills base of the corresponding professional and behavioral skills.

Robots can solve many different practical problems. Medicine, banking, industry, education, hospitality and even entertainment are the main areas of application of robots.

3.2. Social Cognitive Smart Robots

Social robot software is created in programming languages. Many programs for generalizing architecture were implemented in the language of behavior that was defined by Brooks. This language is a rule-based real-time control language that compiles AFSM controllers. Separate rules of this language, defined using syntax similar to Lisp, are compiled into AFSM machines, and AFSM machine groups are combined using a set of mechanisms for transmitting local and global messages.

Universal robotic language, or abbreviated GRL (Generic Robot Language). GRL is a functional programming language for creating large modular control systems. As in the language of behavior, in GRL, state machines are used as the main building blocks. But as a setting over these machines, the GRL language offers a much wider list of designs for determining communication flow and synchronizing constraints between different modules than the behavior language. GRL programmes are compiled into effective programmes in command languages such as C.

Another important programming language (and related architecture) for parallel robotic software is the Reactive Action Planning System (RAPS). The RAPS system allows programmers to set goals, plans related to these goals (or partially define a policy), as well as set the conditions under which these plans are likely to be successfully implemented.

Crucially, the RAPS system also provides tools to deal with the inevitable failures that occur in real robotic systems. The programmer can specify procedures for detecting failures of different types and provide an exception procedure for each type of failure. In three-tier architectures, RAPS is often used at the execution level, allowing you to successfully cope with unforeseen situations that do not require rescheduling.

There are also several other languages that allow the use of reasoning and learning tools in robots. For example, Golog is a programming language that allows for the immaculate interaction of algorithmic problem solving (scheduling) and reactive control tools specified directly using the specification.

Golog programs are formulated in terms of situational calculation, taking into account the additional possibility of using operators of non-deterministic actions. In addition to the specification of the control program with the capabilities of non-deterministic actions, the programmer must also provide a complete model of the robot and its environment.

Once the control program reaches the point of non-deterministic selection, a scheduler (set in the form of a theorem proof program) is called to determine what to do next. Thus, the programmer can determine partially defined controllers and rely on the use of built-in schedulers to accept the final selection of the control plan.

The main attractive feature of the Golog language is the impeccable integration of reactive control and algorithmic control provided for in it. Despite the fact that when using the Golog language you have to comply with strict requirements (full observability, discrete states, full model), this language has created high-level controls for a number of mobile robots designed for indoor applications.

The language "JSk CES (short for C++ for embedded systems - C++ for embedded systems) is a C++ language extension in which probabilistic and learning tools are combined. CES data types include probability distributions, which allows the programmer to make calculations using undefined information without spending the effort that is usually associated with implementing probabilistic methods.

More importantly, the CES language enables the customization of robotic software through example-based learning, much like what is done in learning algorithms. The CES language allows programmers to leave "gaps" in the code, which are filled with training functions; typically such gaps are differentiable parametric representations such as neural networks. In the future, inductive learning takes place using these functions at certain stages of the training, for which the teacher must set the required output behavior. Practice has shown that the CES language can be successfully applied in problem areas characteristic of a partially observed and continuous environment.

The ALisp language is an extension of the Lisp language. The ALisp language allows programmers to specify non-deterministic selections similar to Golog selections. But in the ALisp language, for decision making, it is not the theorem proof program that is used, but the means for determining the correct action using inductive learning, which use reinforcement learning. Therefore, the ALisp language can be considered as a convenient way to incorporate knowledge of a problem area into a training procedure with reinforcement, especially knowledge of the hierarchical structure of the "procedures" of the desired behavior. Until now, the ALisp language has been used to solve robotics problems only in simulation studies. It can be used to program robots with imitative thinking and adaptive behavior, capable of learning when interacting with the environment.

The hierarchical approach to implementing the actions of the behavior of a cognitive mobile robot allows it to perform useful work and ensure its movement. Hierarchical algorithms of behavior actions are divided into agglomerative and divisional. Agglomerative algorithms begin their execution with the fact that each action is entered into the corresponding cluster and clusters are combined as they are performed, until at the end there is one cluster that includes all actions of behavior. Divisional algorithms, on the contrary, first assign all actions to one cluster and then separate this cluster until each action is in the corresponding cluster. A representation of the result of a hierarchical algorithm is a dendrogram - a diagram showing in which sequence actions merged into a cluster or divided actions into clusters.

This approach allows you to formalize the requirements for mobility of robot behavior and develop all possible algorithms for responding to changes in the state of the environment. For example, when moving on the street, using satellite navigation technology, and surrounding objects, detecting using cameras or rangefinders. That is, the approach allows autonomous robotic systems to be designed for the implementation of many social spheres of life.

Cognitive robots with imitative thinking and adaptive behavior have the prospect of widespread practical application as smart robots of lecturers and consultants in educational activities, in the social sphere.

Smart robots become independent objects of the social environment. Social cognitive smart robots are used as a hotel administrator, guide, salesman, lecturer, vacuum cleaner, nurse, volunteer, security guard. [21].

3.3. Human-Robot Communication via Neurointerface

Neurointerfaces are used for dialogue and control with communicative associative robots using high-tech wireless communication means for receiving and transmitting messages. The most suitable technology for implementing the wireless neurointerface is the Bluetooth Low Energy wireless data technology, best known by its abbreviation (BLE). A special advantage of the technology is its prevalence on a huge number of devices, primarily devices with autonomous power supply, i.e. mobile or wearable. Mental communication with the communicative associative robot is carried out through its intelligent communicator agent [22].

Human communication with the robot through the neurointerface opens up new effective ways of organizing work.

4. Supercomputer with Artificial Intelligence

The invention proposes a supercomputer architecture with large RAM and artificial intelligence, which provides proactive pumping of data for continuous processing. The supercomputer provides continuous processing of large programs and data [23].

The super-computer contains new devices: a processor for analyzing connections between modules of the program, counters for using memory segments of modules, a processor for moving modules across virtual memory, a processor for moving common data of modules.

The analysis processor proactively analyzes the relationships of program modules with deterministic-related modules. The analysis processor implements the process of calculating the numbers of the current RAM modules using the communication program SPP_t of the PI_t module, as well as the process of adjusting the value of the counter for using the RAM segments by the program modules.

The shared data moving processor implements the shared data moving between modules. Common variables have sequences of translation addresses from current values. Streams of common data values are organized by the sequence of transfer addresses and delivered to the place of use in modules on operational segments. The modules are accessed by their numbers. For external memory modules, the values of the common variables are transferred to the resident shared data module when the module containing the common data is replaced.

A control processor with artificial intelligence organizes the processing, movement of common data, analysis of connections and determination of current modules by program. It combines the operation of devices on one module in different cycles of access to the operational segment.

The number of operational segments for continuous processing of a program with deterministic-related modules is determined during its translation or compilation.

The RAM segments are switched with the processors in series, corresponding to the processing sequence of the modules located on them. This allows you to minimize the switching of processors with RAM, switching sequentially proactively dynamically processors from operational segments.

The post-processed values of the common data are moved through the program modules in the RAM. For each value of the common given d, the sequence and efficiency of the modules using it, the places of their use in these modules and the relative usage of the d values in the modules are determined. Over a plurality of usage modules d, an additional plurality of modules are inserted, through which the values of this d move.

The values of the common data are moved through the modules that are inflated on the segments of the RAM, dynamically, forming a data stream.

The general data of the non-RAM modules is moved to the resident ROD modules. In the shared data resident module, values are stored together with movement pointers. The values moved to one module are arranged in a row. At the beginning of the follower, their number is indicated. After the new values are written to the common data module, its free space pointer (record) is moved if the counter of the common data module does not exceed the allowed number of values.

Values are supplied with recalculation characteristics. If the flag accepts the immutable state, then the value is moved to all modules used.

The values are placed in the common data module in the order they are moved to the modules coming from the external memory to the random access memory. In the common data module, values can be supplied with multiple pointers.

Once all values have been moved to the program module, the "moved" flag is set to indicate that the module is ready for processing.

Let there be k execution sequence modules and n RAM segments. Let the first module have variables. For each variable, the numbers of the subsequent modules in which it is used are determined. For the second module, all variables that are not in the first module are defined. For each variable, the numbers of the subsequent dools in which it is used are determined. For subsequent modules, the use of variables that are not specified in previous modules is defined in the same way.

We define modules for each variable. We define the sequences of module numbers. The variables will be stored in the shared data resident module according to the sequential numbering of the external modules that use the variables.

Proactively moving data using a resident shared data module ensures that it is continuously processed.

5. Client Project-Oriented Training of Specialists

In the era of rapid technological development in universities, it is advisable to conduct a client design-oriented education [24]. The client design-oriented education allows universities to effectively form partnerships with business and industry to train competent specialists for the implementation of projects. For project production management, a technological competence platform is created for the training of project implementation specialists. According to the required competencies of the project participants, the university prepares training courses for specialists in the acquisition of skills on the technological competence platform. On the technological platform of competencies, students with professional knowledge acquire the necessary professional skills and the ability to work in the project team. They become competent specialists who are ready to participate in the implementation of the project. The university becomes an institution of educational development. Universities form an educational core with a transition to an individual trajectory of education and research. Students receive knowledge and skills to participate in a specific project. The principle of learning mobility is implemented by filling and changing the educational process in accordance with the requests of the students themselves. The principle of learning mobility makes it possible to respond flexibly to the needs of individual companies and subjects of the federation. This principle is manifested through the constant transformation of the functional and organizational structure, allowing universities to adapt to the training of personnel on rapidly changing technologies of the innovative industry and industry. In the era of rapid change of professions, the client design-oriented education is especially relevant.

Within the framework of the client of the project-oriented activity, it is advisable to talk about marketing models, which give us an understanding of how to organize activities for the sale of services, which should be more taken into account in communication with consumers and how best to organize these events.

Marketing and client project-oriented activities of a single person are needed by participants in the educational services market. Educational institutions, in order to know what the consumer needs, predict demand, conduct competent pricing and the provision of services, as well as their promotion, i.e. conduct a client-oriented project activity. The customer of educational services needs to know as much as possible about the offer, understand the competitive advantages of the services, social results from their receipt, and receive maximum satisfaction of their needs.

Educational institutions will be required to conduct a serious marketing, communication strategy, research on the educational services market, which should lead to improved management of the educational process, to the use of methods of finding and recruiting consumers and customers, a qualitative change in educational technologies, a change and improvement in interaction.

The formation of demand for educational services and the promotion of information about them require the development of an integrated system of market interaction with business and society, connected with the movement of services, the exchange of information, technologies, knowledge and experience.

University teachers offer knowledge to participate in a targeted project. During training, project competencies are mastered. At the next stage, professional skills are acquired on the customer's technology platform, and project management of skills for teamwork is mastered (Figure 1).

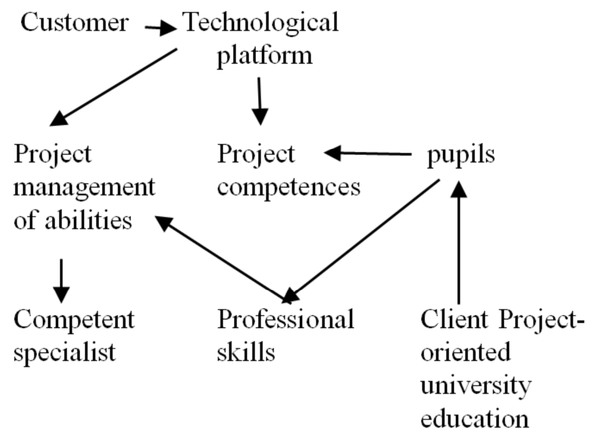

Figure 1. *Client project-oriented university education.*

On the customer's technology platform, trainees acquire professional skills and develop the ability to work in a team. That is, they become competent professional specialists.

6. Conclusion

Experts strive to create a smart human-like robot. The creation of a humanoid robot is associated with the implementation of a large number of functions and competencies. The author proposed to realize the functions and competencies of a humanoid robot with the help of large ensembles of intelligent agents processing large data on high-speed huge computing resources. Large ensembles of intellectual agents are configured by self-organization. The article proposes the approach and technology of self-organization of large ensembles of intellectual agents on the principle of gold section.

Large ensembles with strong artificial intelligence and technological singularity are in great demand in the industrial and social sphere. Especially in environments and situations incomprehensible to the consciousness of specialists, where huge risks arise. Strong artificial intelligence with technological singularity can help governments establish life models for society, and which increasingly do not lead to the expected results. Large ensembles with strong artificial intelligence and technological singularity, taking into account the states of the real environment, by processing large data about them and modeling the life of society, can help humanity follow a safe path of existence.

The development and successful introduction of strong artificial intelligence with a technological singularity can fundamentally change our lives. Strong artificial intelligence can lead to the optimal singularity. This hypothetical essence will help create an absolute order from the current chaos, for example: complete automation of transport and absolute control of road traffic, always stable economic growth, the absence of wars, the constant introduction of new technologies and the prevention of economic stagnation, as well as promising space exploration.

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