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Neural Network Management System for the Robot on the base of Raspberry Pi

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ABSTRACT

In current achievements robotics applied in in many areas human activity. Works created on the basis of higher education science and technology, they are not only capable perform monotonous routine operations, but also perform dangerous for a person's life jobs.Mobile devices jobs are found wide application including and in various industries industry. Variety solved problems using them tasks include as an automated system delivery of goods and products, so and work in the hard-to-reach sites or dangerous for a person's life zones.

Usage in robotics intellectual control systems allows you to do this successfully decide management tasks under conditions of uncertainty, when are the traditional ones ineffective methods or at all this option is not available their applications.Relevance research topics the problem is that what is offered in operation intelligent management system allows you to expand functional features mobile devices and robots efficiency performed tasks works by software their Autonomous status execution in partially nondeterministic values conditions. Proposed the project aims the creation universal management system mobile robot, able be the basis to create the whole line offline and visco-adaptive mobile robots that differ functional purpose cost and dimensions.

Key words : IT, robots, neural network, management.

1. INTRODUCTION

Perceptron it is the most common, but far from the only one how to build it neural networks. For today more is known 200 varieties (architectural) neural networks that are significantly they differ for your own properties, algorithms training, spectrum solved problems tasks. Consider some of them [1].
Radial-basic ad networks (RBF networks) include in multi-layer applications neural networks direct distribution and it was the first time they had met offered in 1988 by D. Broomhead and D. Lowe. Later it has been proven that what are these networks they are also universal approximators, that is with their help you can do whatever you want accurately approximate any continuous line multiple function variables [2-4].
Architecture RBF networks includes three layers of neurons. First (entrance) layer performs distribution functions. Second (hidden) layer 1 fixed value non-linear conversions vector of inputs $X = (x_1, x_2, \ldots, x_n)^T$ into a new space $E = (E_1, E_2 \ldots, E_p)^T$ without using it configured ones weight coefficients. Output layer combines the received data thus neuron outputs hidden layer by way of calculations their linear weighted combination [5]

2. MATERIALS AND METHODS

In the result training is provided such a neuron Kohonen layer, which one is being served on the input layer some image (vector) X^r it turns out violated more other (neuron – «winner»). This neuron it is the most closed to extended image, since everyone's output 2nd neuron the layer is defined as the sum of weighted assets network inputs [6-10].
In its simplest video network Kohonen works based on the principle of "Winner takes everything." This means that for this purpose the input vector X^r just one layer 2 neuron outputs at the output logical 1, all others give out 0. If neural network networks advance different images, neurons break down on subsets, each of which "responds" on the images quite of a specific type (that is, "similar" images), therefore, the network has classification skills (clusterization) submitted documents she's lucky [11].
Maps self-organizations Kohonen applied for visualization multidimensional ones data entry [12]. They give only the overall picture, but enough is enough blurred and subject to change distortions, because to design multi-dimensional selection to a plane without a border of distortion in General in this case, it is not possible [13-15]. However, maps of Kohonen allow to see the key features cluster structure sample. They used at the stage scouting data analysis, rather for General information understanding task than to get any accurate data results.
Idea the problem is that to design all objects selections on a flat map. more precisely, on the multiple nodes rectangular shape grids in advance the specified size M × N. In practice M and N are of the order of tens or hundred. To the map reflected cluster information structure close selections objects must hit to close nodes grids [16].
For each person the grid node attributed the Kohonen neuron with a weight vector w_{mn}, m = 1,. .., M, n = 1,..., N. Thus, the set Y matches with lots of them grid nodes, Y = {1,. .., M} × {1,..., N}. Algorithm classifications a (x) outputs a pair indexes (m, n) ∈ Y, showing, to the node the grid is being designed object.

But and in the Kohonen map there are disadvantages, such as:
– Subjectivity. It is not always clear, what features do you have maps are conditioned cluster structure data, and which ones – properties potential functions. From parameter selection significantly depends debugging cluster borders and the level of detail maps [17].
– The presence of distortion. Nearby objects output spaces can go ahead to distant points on the map. In particular, objectively existing clusters can be torn on fragments. And Vice versa, distant ones objects can by accident get on the map map nearby, especially if they were the same far from everyone clusters. Distortions unavoidable consequences design multidimensional selections on plane. Distribution points on the map allows you to judge just about local structure multidimensional ones data, and then not always [18].
– Dependency from initialization. Initial weight distribution significantly affects on the learning process and it can affect you not just on the Internet location clusters, but even on their own quantities [19].
Toils Kohonen was purchased wide application in issues speech recognition images, optimization and management [9].
Under recurrent neural networks are defined as neural networks, that they have one or several reverse orders connections. Above has already been addressed one of the ways the construction of such networks – single layer ASN Hopfield networks (see Fig. 1). Other important class recurrent ones (dynamic) neural networks that have received wide application in management tasks, – recurrent neural networks based on a multi-layer perceptron or neural networks ad networks with temporary ads with delays [20].
Structure generalized recurrent neural network the network that has d of elements delays for input signal u(k) and q elements delays for output signal to(k), shown at Figure 1. Value u(k) and in(k) at every moment times here are scalar values, that is considered one-dimensional the case.

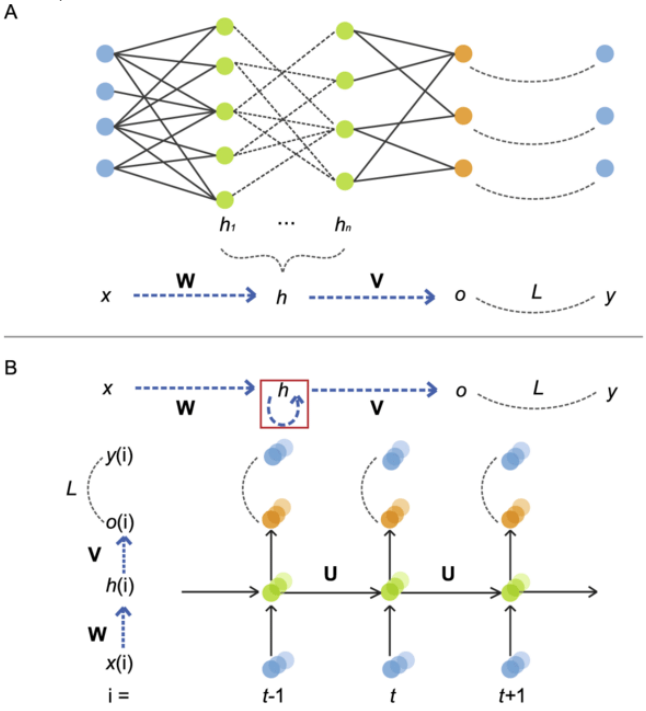

Figure 1: Structure recurrent neural network ad networks

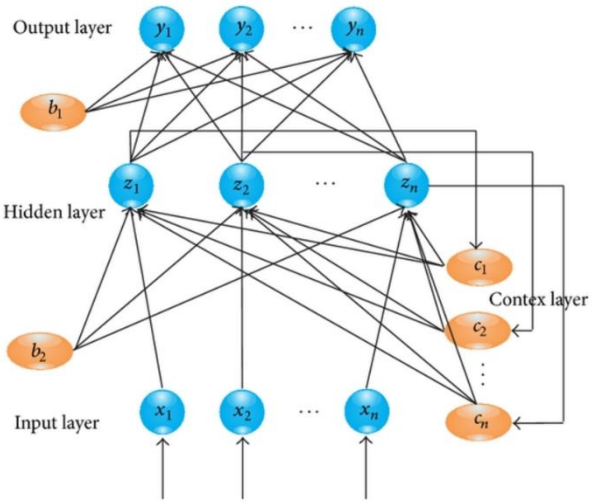

Figure 2: Recurrent Elman network

Figure 1 shows us structure of recurrent neural network. Figure 2 shows us recurrent Elman network, which are the best to solve our problem.
Here X(k) - vector of variables States of neural networks, that is neuron outputs hidden layer (dimension n) at time k; I – the identity matrix dimensions nhn. Thus, hidden layer of neural networks consist of with n neurons, on the whose inputs served component value the input vector $u_1(k)$, $u_2(k)$, ... , $u_l(k)$, and also detained per clock cycle output values these neurons $x_1(k)$, $x_2(k)$, ... , $x_l(k)$ [21].
Recurrent ones ad networks received wide application when making a decision identification tasks, forecasting and management nonlinear dynamic ones objects. In quality of functions activations neurons at the same time their construction usually used sigmoid function or hyperbolic the tangent. Most common algorithms training – reverse algorithm distribution and its modifications [9].
Comparing neural networks algorithms with algorithms, based on an indistinct map logic, you can see that each of these it doesn't matter its advantages and disadvantages. Neural networks easy to learn using examples, removing when basic knowledge from " raw " data, however, this process it is often lengthy and inclined to "hang" in local settings minimums error functions. In addition, knowledge, received in the result training neural networks that are "smeared" in all neurons as values weight coefficients (that is, trained the network is always " black box for user) [22].
Fuzzy data algorithms, on the contrary, they are clear and convenient for explanation received from using them conclusions. However formalization process knowledge in the form of products to the end is not automated and bound with a certain arbitrariness. From here arises the natural interest in application hybrid cars technologies in the form of fuzzy data neural networks (Fuzzy Neural Networks), where the outputs are they are made on the based on the device fuzzy logic, and the relevant ones accessory functions fuzzy sets they are being adjusted with the use of algorithms training neural networks.
Fuzzy data neural networks (hybrid) the network is bright representative new branch computing intelligence – soft computing. The term " soft calculations» (Soft Computing) it

was the first time introduced in 1994 year JI. Ass. According to JI. Buttocks, soft calculations – it's an Association methodologies calculations that they are based on fuzzy logic, neural networks, genetic resources algorithms and probabilistic ones calculations [23]. Later in the day conglomerate were enabled reasoning based on the readings (Evidential Reasoning), web of trust (Belief Networks), chaotic systems and sections of the theory training. In comparison with traditional, "hard" calculations, soft computing more adaptable to the comprehensive inaccuracies the real one the world. Governing bodies principle soft computing there is " tolerance inaccuracies, uncertainties and partial truths to achieve this facilities manipulations, robustness, low cost solution and better agreement with reality." [24]

In soft computing what matters is that their components methodologies add-ons each other and provide synergetic approach effect, and not compete together. Thus, sharing information listed higher technologies allows you to in many cases get more information high quality execution task than application their separate that lets you talk about the keyword role of soft ones calculations in the creating and development intellectual control systems and acceptance solutions [25].

Consider as an example one of the most popular common ones architecture fuzzy neural networks ad networks-adaptive neural network, based on the fuzzy system output (ANFIS, Adaptive Neuro-Fuzzy Inference System). This architecture neural networks it was the first time suggested price in 1992, the city of Jian.

When available educational program selections $\{(X^1, d^1), \dots, (X^R, d^R)\}$. Let's count italso, what do we know rule system, recorded relatively linguistic features variables x_1, x_2, x_3 and in:

IF $x_1 = L_1$ And $x_2 = L_2$ And $x_3 = L_3$, THEN $b = b_1$; (1)

IF $x_1 = N_1$ And $x_2 = N_2$ And $x_3 = L3$, THEN $b = b_2$; (2)

IF $x_1 = N_1$ And $x_2 = N_2$ And $x_3 = N_3$, THEN $b = b_3$; (3)

where L_1, L_2, L_3, N_1, N_2, N_3 – fuzzy sets for input data variables x_1 h_2, x_3, set using appropriate accessory functions. in_1, V_2, V_3 – real numbers calculated values accordingly to the mechanism fuzzy Takagi-Sugeno bridge how:

$y_i = c_{i1} x_1 + c_{i2} x_2 + c_{i3} x_3$, $(i = 1, 2, 3)$, (4)

where $With_{ij}$, (i, j = 1, 2, 3) – some constant.

Structure hybrid neural network the network that has architecture ANFIS, shown at Fig. 1.8. Miscellaneous layers of this neural network networks perform such functions.

Layer 1 provides calculations function values accessories under specific conditions (fixed) values inputs. In the quality of activation functions neurons of this layers can accepted triangular, sigmoid or radial basic functions.

Layer 2 calculates the level activity, that is the steps truths left side for each rule, replacing logical connection "And" the work:

$\beta_1 = \mu_{L1}(x_1)\, \mu_{L1}(x_2)\, \mu_{L3}(x_3)$; (5)

$\beta_3 = \mu_{H1}(x_1)\, \mu_{H1}(x_2)\, \mu_{H3}(x_3)$; (6)

$\beta_3 = \mu_{H1}(x_1)\, \mu_{H1}(x_2)\, \mu_{H3}(x_3)$. (7)

Everything the neurons of this the layers are labeled the letter "T". This means that they can use for modeling operations "And" custom T – the norm, for example, T = min.

Neurons layer 3 (indicated by with the letter N) implement rationing values activity levels each rule:

Shar 4 generates the value weighted components output (V_{and}):

$\bar{y}_i = w_i y_i = \text{wi}(\text{ci1}\, x_1 + c_{i2} x_2 + c_{i3} x_3)$, $(i = 1, 2, 3)$. (8)

The only one linear neuron layer 5 implements operation defazzification:

$y = \bar{y}_1 + \bar{y}_2 + \bar{y}_3 = w_1 y_1 + w_2 y_2 + w_3 y_3$. (9)

Training the network is reduced to such a place settings parameters accessory functions, which provides the following information minimum value error value training.

On the base of the system under consideration above the network ANFIS can be implemented, also others mechanisms fuzzy output, for example, output mechanism according [26].

Obvious advantage architectures ANFIS-its full version "transparency", since the outputs neurons of each the layers have a clear and clear interpretation, what allows you to correct it chain of logical links considerations using product systems, boosting process quality training neural networks [27].

They exist and other architectures fuzzy neural networks: NNFLC (Neural Network Fuzzy Logic Controller) – fuzzy the controller is on based on a neural network networks, NNDFR (Neural Network Driven Fuzzy Reasoning) - neural network for fuzzy reasoning, GARIC (Generalized Approximate Reasoning based on Intelligent C ontrol) - generic close friend output based on an intellectual level management, FUN (Fuzzy Net) – fuzzy network, intended use to manage it movements mobile number work.

3. CONCLUSION

Neural networks start play a prominent role when creating automatic control systems management (ACS) complex dynamic ones objects. K such objects belong to modern ones aircraft, power and energy systems installations, mobile robots and others. For them characteristic features absence accurate mathematical models models or their excessive difficulty, high dimension state spaces and accepted ones management solutions, hierarchical structure, diversity criteria quality, high noise level and external ones excitements.

Classic ones management methods they work well when fully used deterministic the control object and deterministic external the environment. For systems with incomplete information and high complexity the control object optimal there are fuzzy and neural networks ACS, moreover in the most complex cases appropriate it turns out application neural networks control systems.

Difficulties, emerging issues during construction ACS complex dynamic ones objects. conditionally shared into three main categories:

- computational complexity;
- availability non-linearities;
- uncertainty.

How they show you numerous studies, neural networks they manage successfully with all three of them by categories the mentioned difficulties. First parallel the nature of these networks provides calculations with high speeds. Networks containing non-linear functions components, they may be used for approximation nonlinear systems displays with any

the desired degree accuracy. And the fact that settings neural networks can adapt real time based input/output data indicates that they can be used part of an intellectual management systems providing high quality functioning these systems are used in conditions of a significant transaction uncertainties (insufficiency) information about the map item management and external.

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