Development control systems takeover: subject robotic arm on the example anthropomorhic robot AR-601

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Abstract. It is proposed the formation software architecture of complex motion for robotic systems in the form of sets of behavior - patterns - similar to the motor reflexes of living organisms. To form patterns of behavior of the robot teh authors used a methodology of structural analysis of complex systems IDEF0, then developed types of elementary algorithms (patterns) that make up the dynamics of the anthropomorphic robot jump. The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

Management of live organisms based on the use of unconditioned and conditioned reflexes. Unconditioned reflexes are the body's reaction to the "typical" boring, to which the body responds to "standard" way. Unconditioned reflexes inherent in organism from birth and are constant for the entire lifetime. Conditioned reflexes are acquired as a result of training, are not innate, can be changed during the life [1].

An important role for the organism have the unconditional or somatic motor reflexes ensuring unconscious body's response to external disturbances is the basis for its motion, the protective reactions of defense. In this paper, we propose to use a reflex mechanisms for the development of control algorithms anthropomorphic robot. Use reflexes, similar to the motor reflex of humans and animals, will reduce the development time control algorithms for robot and make the robot more dynamic and resilient. Furthermore, it will implement parallelized solver algorithms to accelerate the formation of the robot control actions.

Name these reflexive mechanisms applied to traffic control robot behavior- patterns. For each of these patterns, you can define a set of measurable parameters of the robot current state, targets, characterized by a set of parameters of the state of governance and performance criteria.

The movement of the robot is regarded as a set of a large number of patterns, which are analogues of conditioned and unconditioned reflexes of a living organism. To determine the structure of this set will use the methodology of structural analysis SADT, have developed a certain

methodology IDEF0 (Icam DEFinition). IDEF0 is a technology description of the whole system as a set of interrelated activities or functions [2].

In accordance with this methodology, any meaningful control of the robot can be considered as a series of nested SADT-diagrams, starting and finishing from the contextual diagrams describing the basic patterns of the robot behavior.

Form the patterns of the robot behavior used for walking on a flat surface, in accordance with the methodology IDEF0. Uses traditional circuit formation step anthropomorphic robot [3, 4].

1. At the top level description or consider contextual diagram step. The diagram in block form A0.

2. One of the basic functions is to manage the balance step to ensure the position of the robot body close to vertical. By analogy with human behavior control is carried out or stops, or hand movements or inclinations of the body. Since step precedes the state, then the diagram level 1 (Fig. 1) to ensure the balance indicated by block A1.

3. Step is carried out by transferring the non-reference legs to some preselected point on the surface - block A2 (Fig. 1).

4. After transfer of non-reference legs have to move it a foothold, as indicated on the diagram level 1 unit A3 (Fig. 1).

5. Next, the procedure is repeated non-reference transfer feet, which is not reflected in the charts.

6. The block for a balance A1 undergoes further decomposition is depicted in figure 2-level sequence of blocks A11, A12, A13 (Figure 2). It is at this level of decomposition pattern appears A13-stabilization.

Pattern A13-stabilization is a kind of unconditional reflex is not necessary to further decompose.

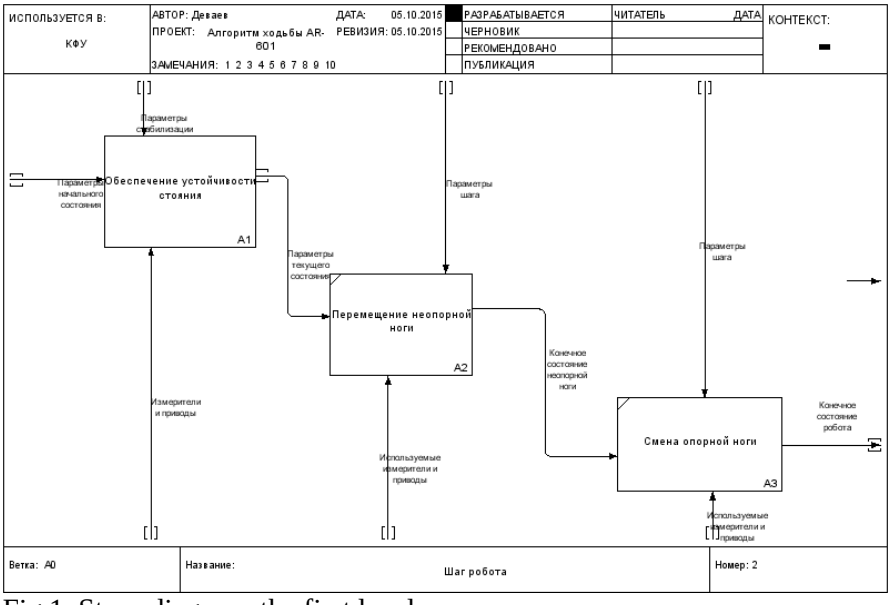

Fig.1. Steps diagram, the first level.

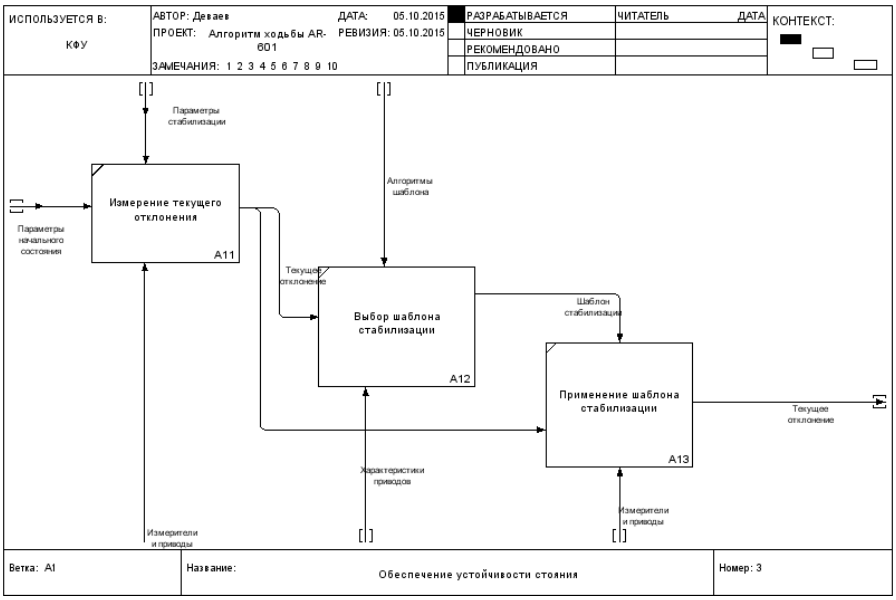

Fig. 2. Steps diagram, a second level.

Thus, this paper proposes and illustrates the application of the structural analysis method of complex processes control movement of robot based on the methodology IDEF-0 to highlight the elementary behavior patterns that are later implemented in software.

An example of the stabilization implementation of the template is given in [5], which shows the stabilization of the anthropomorphic robot AR-601 in the longitudinal plane mode state by controlling the drive stops and the measurement deviation from the vertical by a strain gauge force-torque sensors foot.(See Fig. 3) Also, an algorithm is implemented hopping robot in the following patterns.

1. The pattern squats. It is performed by the instructions from outside the robot. The depth squats determined allowable acceleration, which can then straightens his legs.

2. The pattern of leg extensions. It is activated once the pattern completes squats. Straightening the legs is performed so that the gap of the robot from the floor surface took place at a predetermined speed. The magnitude and direction of the speed determined in the future trajectory of the robot jump.

3. The pattern of balancing during the flight. Performs small hand movements, stabilizing the movement along the calculated trajectory.

4. The pattern of the landing (squat). It is activated when the robot touches the floor. Measured overload and done squat to ensure permissible overload. The pattern in passive mode when the magnitude of the overload becomes close to the acceleration of free fall.

5. Pattern straightening the legs. Activated at the close of the previous pattern.

6. The pattern of static stability. It is active when is a load of the feet of the robot. During the flight, it is deactivated. This pattern provides stability by turning the robot drives the ankle and is designed to prevent the fall during the remaining patterns.

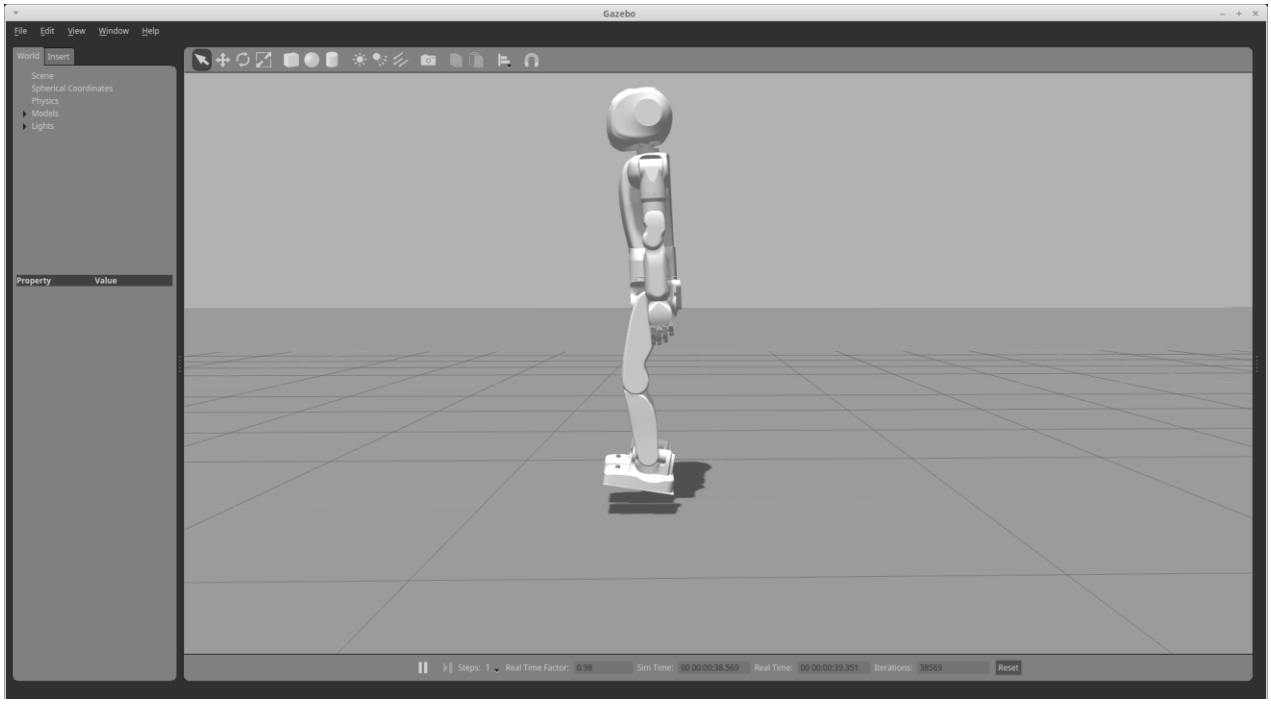

Fig. 3. Robot jump pattern.

References.

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