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SOME PRE-CONDITIONS OF APPLICATION OF ARTIFICIAL INTELLIGENCE

Summary. *The necessity of application of sensing systems is considered and some of their parameters are described, which are useful for robots with systems of artificial intelligence.*

Key words: *robots, artificial intelligence, analysis of the stages.*

The use of artificial intelligence systems is spreading at an increasing pace. Its operation requires a number of prerequisites. The most significant direction is an implementation of sensing systems that allow to gather the data required for an analysis and decision making.

The tools for implementing sensing systems can be classified as follows [1, p. 72–75]:

- *tactile systems* — systems that give the manipulator an ability to respond to a touch of any object;
- *power or momentary devices* — allows to analyze (estimate) efforts when working in contact with objects (measured forces and moments) in the chosen coordinate system;
- *location systems* — systems that, with the help of any emitting source determine the presence of different objects (mainly in the robot's movement direction), their location and distances to them (as well as distance change velocity);
- computer vision systems, which allow to recognize the objects and conditions (the location and nature of the object's motion), making of a decision by robot's controlling system to ensure the rational action according to the current surrounding conditions;
- other sensing systems the robot and RTK to determine the properties of the environment, process control, quality, performance, etc.

Another way of the classification is based on the action principle of concrete primary measuring transducers (sensors) [2, p.110–132]:

- inductive sensors;
- Hall sensors;
- capacitive sensors;
- ultrasonic sensors;
- near-field optical sensors;
- tactile sensors;
- discrete threshold sensors;
- analog sensors;
- internal sensors of robot's work units' condition.

To this list should be added the methods of detection of the objects in the distant field — these are location systems of various types, as well as systems of computer vision (video surveillance with the system of the analysis of the incoming frame stream).

Usually the most informative is video information (or stationary images — individual frames), so the "scene analysis" is given considerable attention [3, p. 282–313]. This raises the next question: which way of representation of the graphical information to use — voxel or pixel graphics [4, p. 38–40, 142–143].

The voxel model is a three-dimensional raster. Voxel is a volume element. By analogy with 2D raster which consists of the pixels, the voxels fill the volume in a three-dimensional raster. As you know, any pixel must have its own color. Any voxel also has its own color and, moreover, transparency. Full transparency of the voxel means the void of the corresponding part of the volume.

According to this:

- pixel — the smallest element of the two-dimensional space, divided discretely into a set of equally sized parts, characterized by the location (coordinates) and color;
- voxel — the smallest element of the three-dimensional space, divided discretely into a set of equally sized

parts, for which, in addition to the location and color, another characteristic is added — transparency.

Based on the properties of these graphic elements, one can define the scope of their application. Pixel images (for example, a photo) are obtained, it can be said, using traditional methods and such images can be obtained in simple ways.

The acquisition of voxel images requires the use of complex tools, such as tomographs that measure an object layer by layer and allow to analyze the model in a layered manner. The tomograph refers to devices operating in the near-field, in particular, it is used the same way in medicine. That's why the use of voxel graphics is unacceptable for mobile robots controlled by AI systems, since it is impossible to obtain volumetric (layered) images of the objects that are located far away from the information gathering system and raises questions about the feasibility of such actions.

Therefore, the pixel graphics are better suited for mobile robots.

Accordingly to this a number of tasks arise:

- an image acquisition during "scene" scanning;
- identification of an individual objects;
- acquiring of the position of objects depending on distance and location;
- identification of objects (comparing to available in the database);
- analysis of received objects using the decision-making system;
- generation (by the controlling system) of a sequence of commands to fulfill the chosen decision.

"Scene" scanning is carried out by location system (radio or acoustic location) or by computer vision. More likely the usage of the latter option.

Received image should be analysed by selecting separate objects which can be located on different distances from registration tools. Each of the selected objects will be further evaluated as a two-dimensional image.

Successful comparison of the stage objects requires them to be equally scaled according to distance to these objects and angular size of each of them (Fig. 1).

Later on the received images should be digitally represented as matrices, usually in the same dimension. Every pixel is described by a brightness and color, for example using RGB codes. Presented in a such way objects can be compared with previously added to the database with the purpose of their identification. In case of an absence of the object in database it should be inserted by operator as a new element with the addition of the corresponding comments-identifiers based on

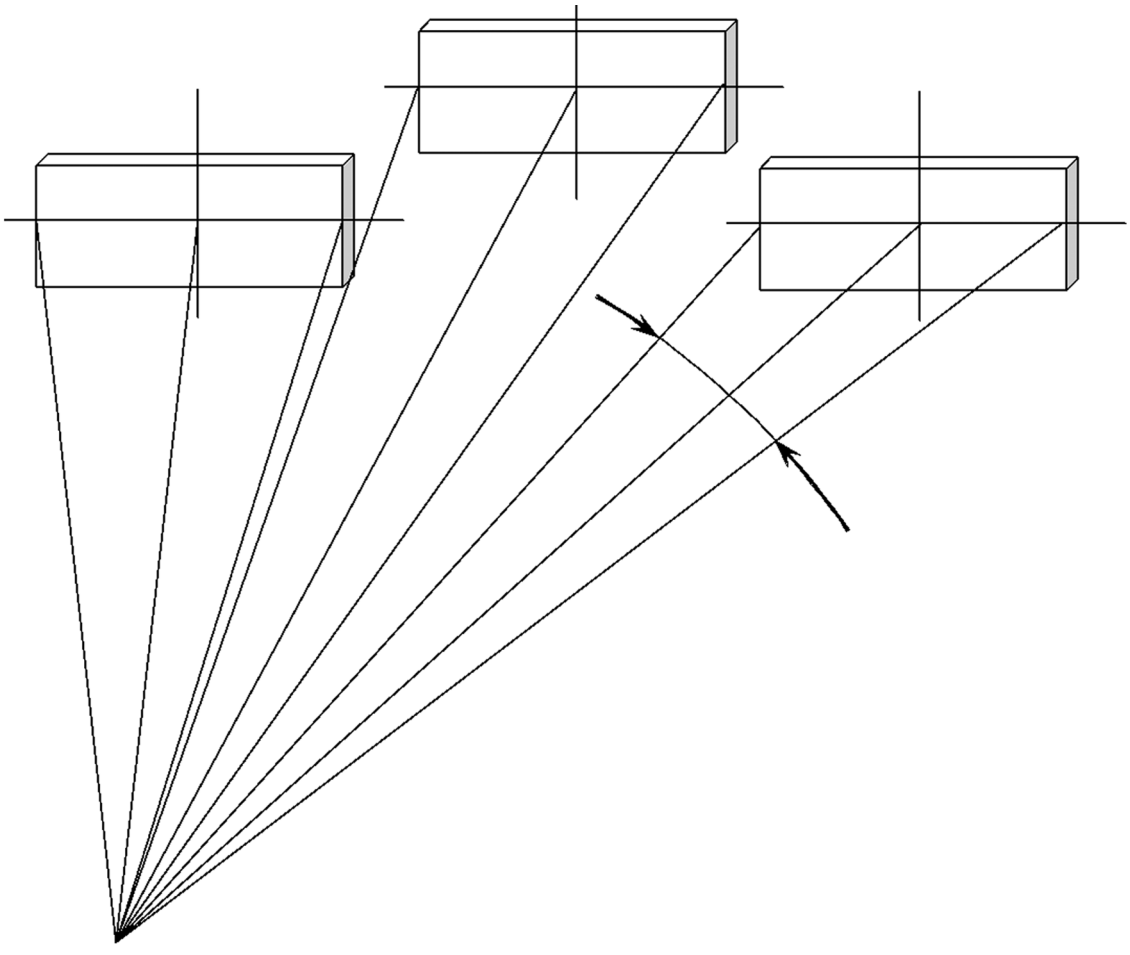

Fig. 1. Chart of down-scaling of objects of the stage

received visual information. This will allow to reuse the newly added data for characterizing the similar objects in the future.

Populating of the images database becomes the "learning" process of the robot. For the robots of the different purposes will be necessary their own specific databases. The development of the universal base in theory is possible, but will need a very large amount of information and storage space.

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