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UTILIZATION OF COLOUR MARKERS IN INTERACTION WORKER - INFORMATIC SISTEM - ROBOT

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***Abstract* – Gesture, based interaction is particular interest because human use gestures to communicate naturally. Two-dimensional gesture can be easily defined and recognised using simple computer vision technique. Ours study analyse the possibility to command a robotic system using a limited set of gestures defined by specific human (operator) positions.**

Keywords: *computer, gestures, robot, vision system*

1. INTRODUCTION

The communication is the process of transmitting the information, of a message between transmitter and receiver, being in main a mechanism in the development of interpersonal relationships. Looked as a hand-running process, at large, the communication consist in the conduction and the shift of informations, of messages between persons, in circulations of impressions and commands, in sharing of affective states, of decisions and judgments of which value have as the ultimate aims obtaining of effects.
The idiom credit title as verbal is characterized through gestures, expressions of the face, the mimicry. When the verbal communication strike against the insurmountable limits of deficiency (man or device), it can be applied to the augmentative communication and to the alternative one. The augmentative communication is referring to any form of communication which replaces or enlarges the speech [1]. Through it is communicated to the reality the request form of the subject and the reality (interlocutor, device) answers as expectations or unpredictable, depending on the coherence of the gestual message, of the accuracy, the adequacy to object, relation or process, interactive realized in a given context [2].

2. THE GENERAL ARCHITECTURE OF THE COMMANDING SYSTEM FOR ROBOTS

The architecture of the commanding system for robots (see Fig. 1) doesn't differ very much of the one of a calculation system for the check of the processes, being formatted from the some following basic elements.

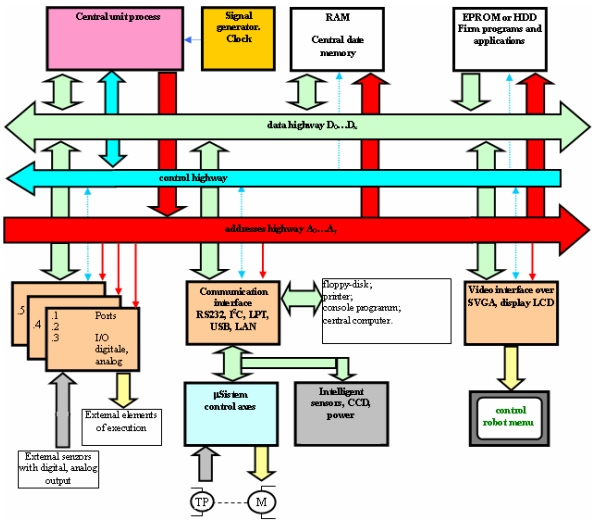


Figure 1: The general architecture of a commanding system for industrial robots.

For the facility of the dialogue worker - robot the commanding system is endowed with a terminal which depending on complexity (see Fig. 2) can cumulate one from next functions:

- terminal of manual control (teach pendant) it is used-up mostly to the robots from generation I to facilitate the worker, funded out in the workspace of the robot, the statement and the visual check of movements in the phase of learning the points of the trajectory;
- console for the scripting it is an intelligent terminal which permits the communication with the transponder master of commanding system, the treatment and the local display of information; in the

aim of simplification of the operations of implementing the applications.
Due to the possible applications in diverse involved areas of the study of human behavior (gestures, corporal expressions), currently, several researchers expand the studies of analyze for the possibility of multisensorial communication in the space of mixed reality (generalize of the augmentative reality and the virtual reality).

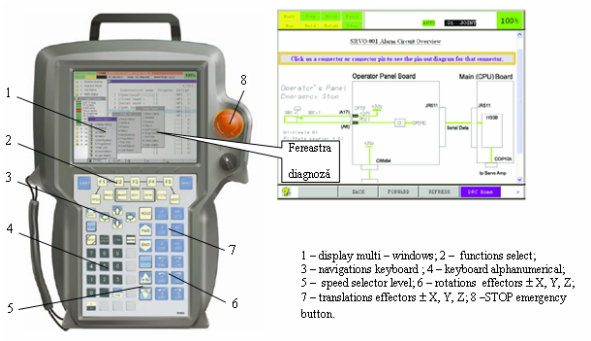


Figure 2: Console for the scripting GE Fanuc Robotics.

In this context a possible area of interest is the robotics because the digital interpretation of the human worker motions in an virtual medium can be used in the process of direct command or of learn of the robot through the natural transfer of specific motions from the human worker to the informatics system of the robot (example: the execution of operations of painting is a very difficult process which require a certain experience and understanding, so difficult to program mate from viewpoint of the trajectory and its dynamics).

3. THE STUDY OF THE MARKERS FOR THE IDENTIFICATION OF POSTURE OF THE BODY IN GESTUAL INTERACTION MAN – ROBOT

For the knowledge of motions of human body is most frequently suffice to knowing the way in which are moving some characteristic points. The following motions of characteristic points is done through the utilization of distinctive elements (transmitters of information) attached on the surface of the body and of a special equipments of receptions.
Some examples of transmitters: colored markers, optical markers, electromagnetically markers. Among these I have preferred in this stage of work colored markers because they have a low cost-price, they aren't intrusive and they utilized video systems of acquisition and available programs of recognition [3].

4. ANALYSIS OF THE INFLUENCE OF GEOMETRIC FORM AND NATURE OF THE MATERIAL

In the initial phase of experimental determinations the major concern was connected with the identification of markers (see Fig. 3) which through theirs form, color, size offers as much as complete information about the posture of different parts of the body of the transmitter subject statement so that the information reception from markers can be individualized most correctly [4].
Analysis of the images captured with help of the video camera showed as after the assembling on the surface of the body, due to distance between objective of the video camera and the transmitter subject, form of the markers is a difficult parameter of monitoring. In fact, is a difference too big between the surface of the marker (the number of useful pixels to recognize correctly a geometrical form) and the surface of the human body.

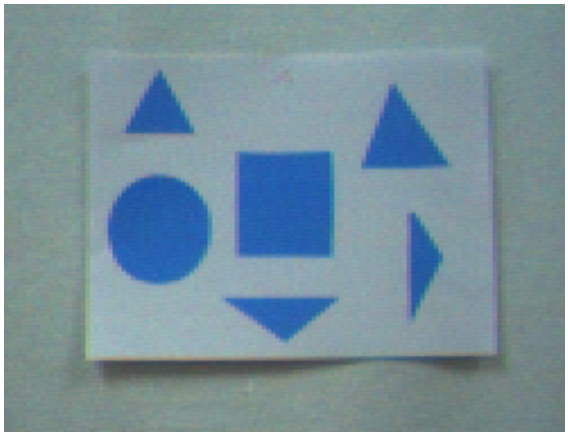


Figure 3: Several geometric forms of tested markers: image took over from 0,8 m, don't offer anymore the details of outlines.

For this reason they chose merely round form markers differentiated through color. As markers they used elements made from plasticized and matted auto-adhesive paper respective from thin textures. The markers from matted textures from this viewpoint seemed as a solution much better but along the experimental determinations it is noticed as for certain postures of arms these tending to folded relatively easy (due to motion of the folds of the clothes of which these are by-paths grasped).

5. INFLUENCE OF THE TEMPERATURE OF COLOR OF THE SOURCE OF THE LIGHT ABOUT ON MARKER'S COLOR

The man is a being dependent of the light (see Fig. 4). The visual perception is recognized as being the most important bound with environment. Near 80% from all information's arrive at the brain through eyes and,

thus, they influenced in a decisive way the human actions. The researchers were, and still are, always preoccupied of demands which must due to accomplish an installation of lighting for visual perception to be adequate.
The sensibility of human eye to luminous radiations [5, 6] alternate depending on theirs wavelength, being maximal, in the case of the diurnal sight (fotopical), to the green-yellow color ($\lambda_0 = 550$ nm).

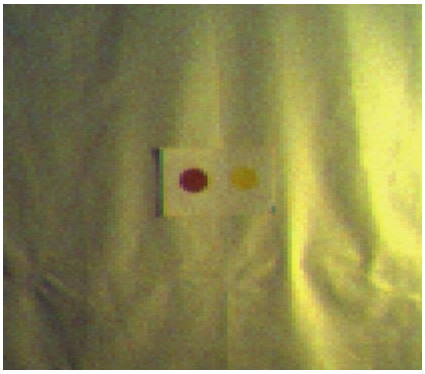


Figure 4: Images of markers in case of the utilization of a source with a halogenous lamp, to 60 lx

A temperature of high color (intense) don't involve as the object is as a matter of fact to that exact temperature. Therefore it's called the temperature of color, the temperature where an absolute black body would be wormed to generate a certain form of a spectrum beam, if it's decomposed by a prism. Indoor light has many red and normally it's up to 3200 K, the standard solar light has 5600 K, the sky light contains many blue and it has across 7000 K.

Figure 5

In the case of left called-up image it was used a source with the temperature of color going down to 3000 K, without a regular distribution, which drove to the movement toward the yellow color of general background (of white color) and to the fading of the marker of yellow color which is practically confounded with the background and shall be irretrievable by the program of recognizing the form and color.
In the case of utilization of the lamps with vapors of mercury, it was found a movement of the general background toward the green color.

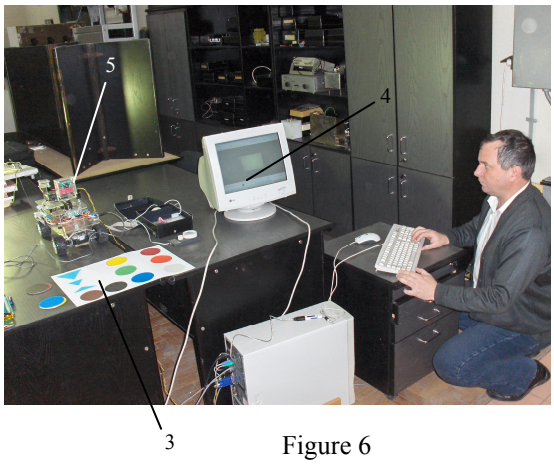


Figure 6

Figure 5 and 6: Stand utilized for the verification of compatibility between the colors of markers and the influences of the sources of light:
1- stand with sources of light; 2 - luxmetre; 3 – markers for tests; 4 – system for acquisition and analysis of image; 5 – digital color video camera.

Through this demarche it has been pursued the determination of the correct methods of choosing markers postures and color so that the cases of uncertainty to be minimal. Results (see Table 1) of the level of similitude between colors are on a scale from 0 to 1 (corresponding to the similitude of the colors).

Color of the marker	Red	Orange	Yellow	Brown	Green	Blue	White
Red							
Orange							
Yellow							
Brown							
Green							
Blue							
White							

Table 1: The level of similitude of markers colors tested on white backgrounds.

For the experimental determinations it was used a specialized software CMUcam2GUI Java, a digital color video camera CMU cam2 v1.0c6 with a maximal resolution of 356 x 292 and the possibility of remaking of the image: pursuing predefined color, filtering image, differentiating image, histograms for image etc. It is certain that maximal tolerance presents the blue and the green colors which can be used-up most dense in any points of the body, while the colors with minimal tolerances orange and brown can be utilized cautiously knowing in the first rank that them possible attachments with another's markers against their color can make that it don't exist a tolerance.
Thus of attachments, as a result (see Fig. 7) of changing posture of the body, can drive to the distortion of the signification of the commander gesture and, in the best case, the command isn't recognized

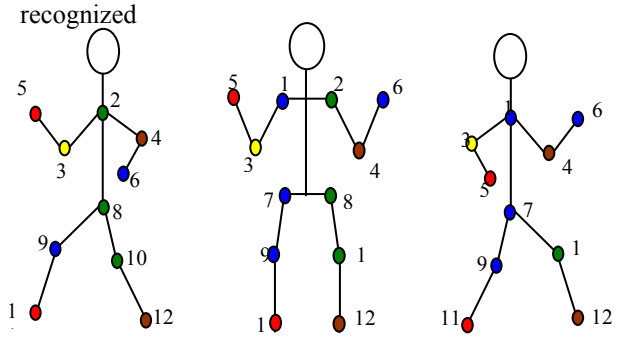
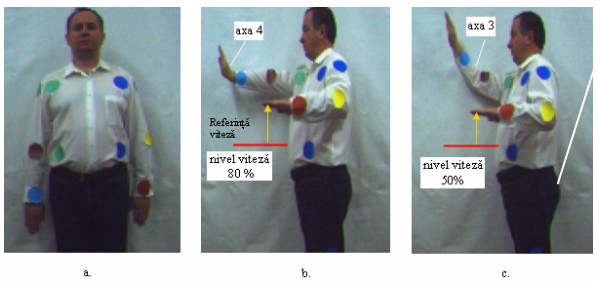


Figure 7: Choosing posture and color of markers for correct recognition of the commands.

For the starting, the stopping of the axes of robot as well as for adjustment of the speed of movement on trajectory is proposed the utilization of a system of measure for the distance $d_{viteză}$ among the slap of the left hand of the worker and a plan of reference.



a. b. c.

Figure 8: The gestual command of the robot.
a. in initial posture;
b. the command of turning upside, the axis 4, with the speed 80%;
c. the command of turning upside, the axis 4.

For measuring this distance were proposed two solutions which efficiency has to test on next future stages:
1. measure with a video system, and the determination through calculation of posture of the slap in report with an established locator mark in phase of calibration of the system of acquisition [7, 8];
2. measure with a digital sensor of distance (example a sonar with resolution of 1 mm it will permit the prescription of the speed with a resolution of 1 for a run of the slap of 100 mm.
Is presented some examples (see Fig. 8) of gestual commands, acquisitioned with the system presented, what are shall utilized for commanding of an industrial robot:

6. CONCLUSIONS

The digital interpretation of a human worker motions in a virtual environment can be used in the process of direct command or of learning of the robot through the natural transfer of specific motions from the human worker to the informatics' system of the robot. Therefore it is necessary that choosing the markers of color to be done directing to the material nature from which these are made, the level of similitude for colors, the temperature of color of the sources of the lighting used, the relative posture of markers for all used gestual commands.

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