IMPLEMENTATION OF A MOVING SYSTEM IN A LABYRINTH

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Abstract: In the present paper, in didactic purpose, the implementation of a moving system in a labyrinth is proposed, which simulates the functioning and the importance of controlling a real technological process with the help of the industrial robots

Keywords: system, control programs, implementation.

1. INTRODUCTION

In an advanced industrialized society the modern technology assumes enlarged and complex automation of the productive processes, based on cybernetic control and using the artificial intelligence (Popescu, 1999).

Being known that the conventional conveyers created for a single purpose cannot efficiently solve this problem, the industrial robots are the ones to solve it. The association of the robot with a series of automate machines, having the structure of the classic machines (for instance machine-tools), has lead to automation of some activities considered until recent days, impossible to develop without direct participation of the man. In this moment, the robot represents the cross point of the top results in several domains: mechanics, automatics, computers and actuation systems (Ivanescu, 1994). This concord of these so different scientific and technological branches is explained through the special complexity of the robot, as mechanical architecture, also as control system.

Generally, the robot systems include a variable number of hierarchical levels depending on the complexity and on the „intelligence” degree of the used control system (fig. 1).

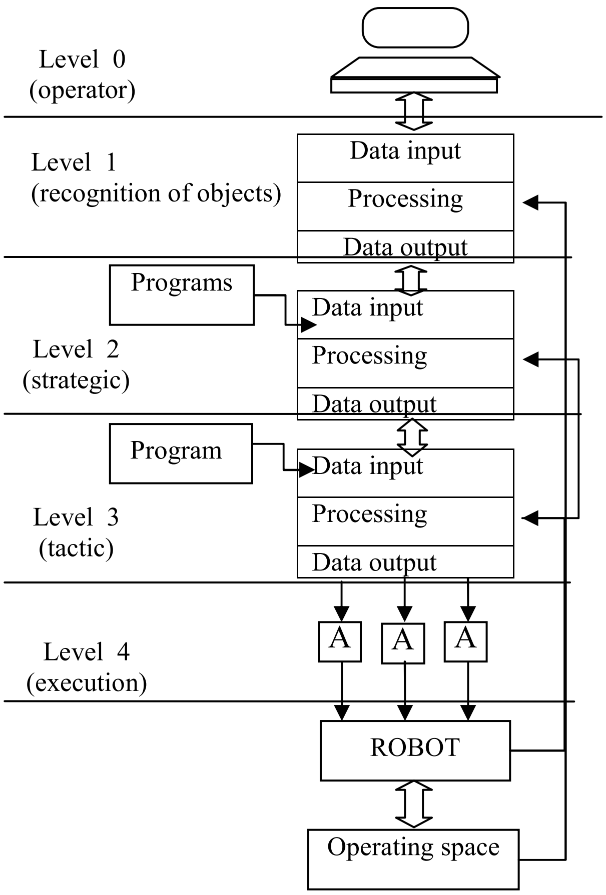

Fig. 1. Control system.

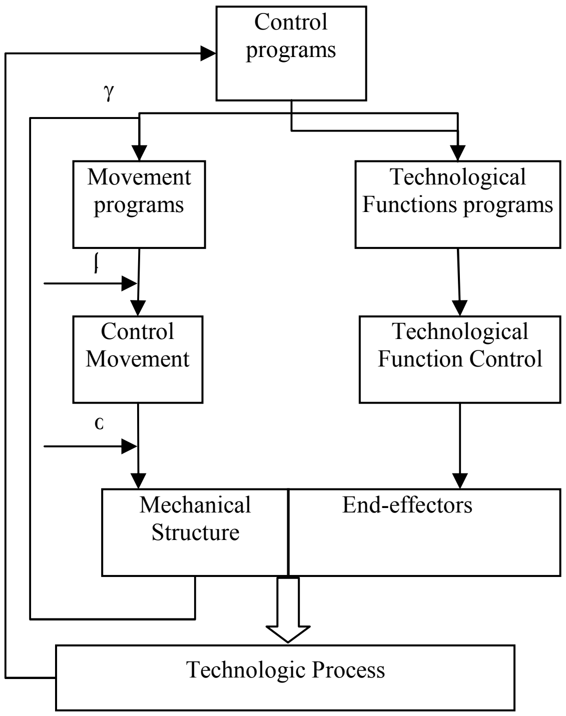

Fig. 2. Informational structure of the control system.

The tasks in front of a control system cause a two-classes dividing of the working informations, meaning informations that ensure the desired movement conditions and, on the other hand, informations that cover the technological function imposed to the robot.

2. CONTROL OF THE MOVING SYSTEM IN A LABYRINTH

2.1 The shape and the dimensions of the labyrinth

The moving operation is executed by a metallic ball that must follow, based on control received from the computer, a certain route (in this case it is established) in the labyrinth (Popescu, 2004). With a program and a graphic interface that runs in Labwindows environment gets executed the displacement control for the metallic ball in a labyrinth, shaped and sized as shown in fig. 3.

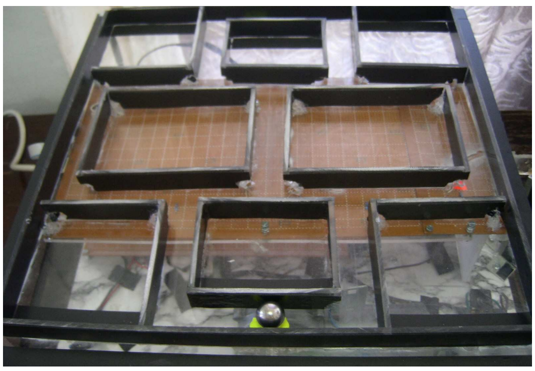

Fig. 3. The shape of the labyrinth .

2.2 Fundamental components of the mechanical structure

The main components of the mechanical structure are: the end-effector (gripper), the arm and the base of the robot. The end-effector element assures the direct contact between the robot and the object actuated upon. The arm of the robot is used for correct positioning of the end-effector (Popescu and Petrisor, 2006). All these elements and subassemblies are mounted on a special frame that forms the base of the robot. This can be fixed or mobile.

2.3 Programming the industrial robots in LabWindows/CVI developing environment

The LabWindows/CVI environment is an environment for developing applications by using the ANSI C programming language. As the name says, it is designed for virtual instrumentation, it is ideal for industrial automations, measurements; it offers the possibility to aquire data from the process. The debug offers the possibility to import the libraries from Borland C++ Builder 4.0 and Visual C++ 6.0. This generates the code of the designed interface, it attaches events, etc.

2.4 Control movement

No matter the kind of motion, touching a current point in the operating space, with some restrictions on speed, acceleration and other elements of the motion represents a permanent requirement. For determining the robots control lows, movement under the influence of the disturbances represent a unanimously accepted modality of study. The disturbances may be provoked either by external factors generated by the environment where the robot works, or by internal factors provoked by some internal physical items. The labyrinth contains a START point placed in the upper side of the motor M1 and a FINISH point placed on the left side of the motor M2 (fig. 4). During executing the RUN instruction, the metallic ball starts moving on a pre-established way. This is actuated by the two d.c. motors. Using two limiter switches a minimum point (motor down) and a maxim point (motor up) were established.

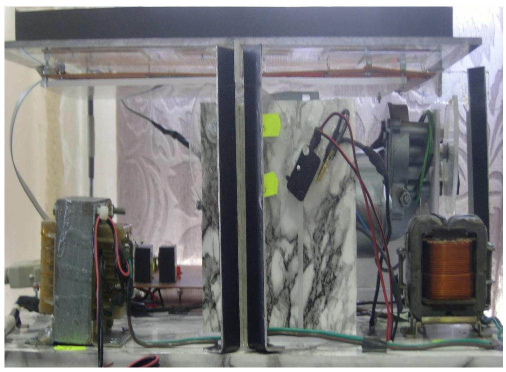

Fig. 4. Explanatory concerning the position of the receptive and transmitter sensors in the labyrinth.

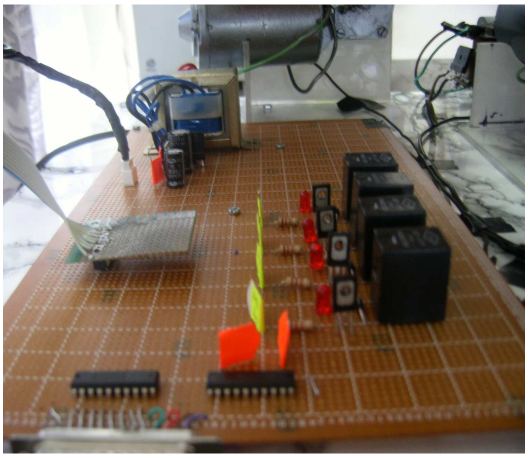

Fig. 5. Motors control.

Moving up and down is performed by two motors and on each motor's axle there's a cam built in such way in order to accomplish this function. The motors are controlled through four relays, two for each motor, these being used for changing the rotation sense of the motor's axle (rotor) (fig. 5).

Depending on the received control, the relays actuate the motors that move the labyrinth up or down in order to optimize the displacement of the ball. When the LE pin of the 74HCT573 circuit is HIGH then the data from the Dy inputs get into the latches. When the LE pin is LOW then the latches store the information that had been present at the inputs. When the OE pin is LOW then the content of the two latches is available on the output. When the OE pin is set to HIGH then the contents gets to the high impedance state.

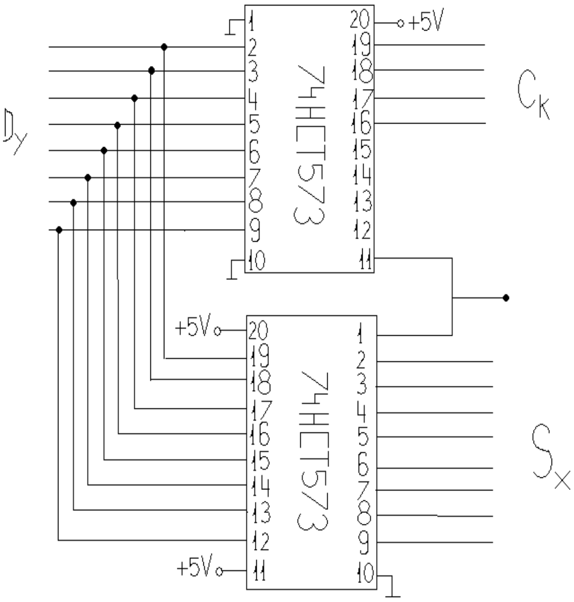

Fig. 6. Explanatory on connecting the pins to the Sx sensors on the Dy input data and on the control of the Ck motors.

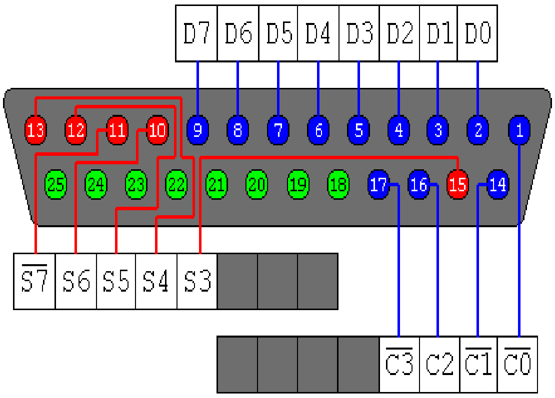

Fig. 7. Placement of the pins in the parallel port.

Inputs operating on the OE pin does not affect the state of the latch. Coupling the pins to the Sx sensors, to the Dy input data and to the control of the Ck motors is shown in fig. 6, in which: for the first circuit 74HCT573, the state "1" corresponds to the loading data function, and the state "0" corresponds to data memorizing; for the second circuit 74HCT573, the state "1" corresponds to the high impedance state and the state "0" is assigned for functioning (transmitting the controls).

The communication with the electronic card is realized on parallel port so that for each motor corresponds two pins, as it follows [4]: the pins 6 and 7 correspond to motor M1, and the pins 8 and 9 correspond to motor M2 (fig. 7).

In order to start the application, a graphic interface is needed so to actuate the start control of the operation of movement the ball in the labyrinth. The graphic interface has two sets of controls (fig. 8):

a) an automatic one – this works by executing a un click on the RUN instruction from the control bar. This set of controls has two buttons: the button START used for starting the automatic application and the button STOP used for stopping it.

b) a manual one – the manual controls work identical as the automatic ones but these are given manually from the five buttons. These instructions work as described here: the button M1 UP gives the command to the motor to move up the labyrinth; the button M1 DOWN gives the command to the motor to move down the labyrinth; the buttons M2 UP and M2 DOWN work by the same principle

The last button, TEST 0, is used for stopping the motors. Also it can be observed a simulation of the moving process which the ball executes, under the action of the two motors, when the application is started.

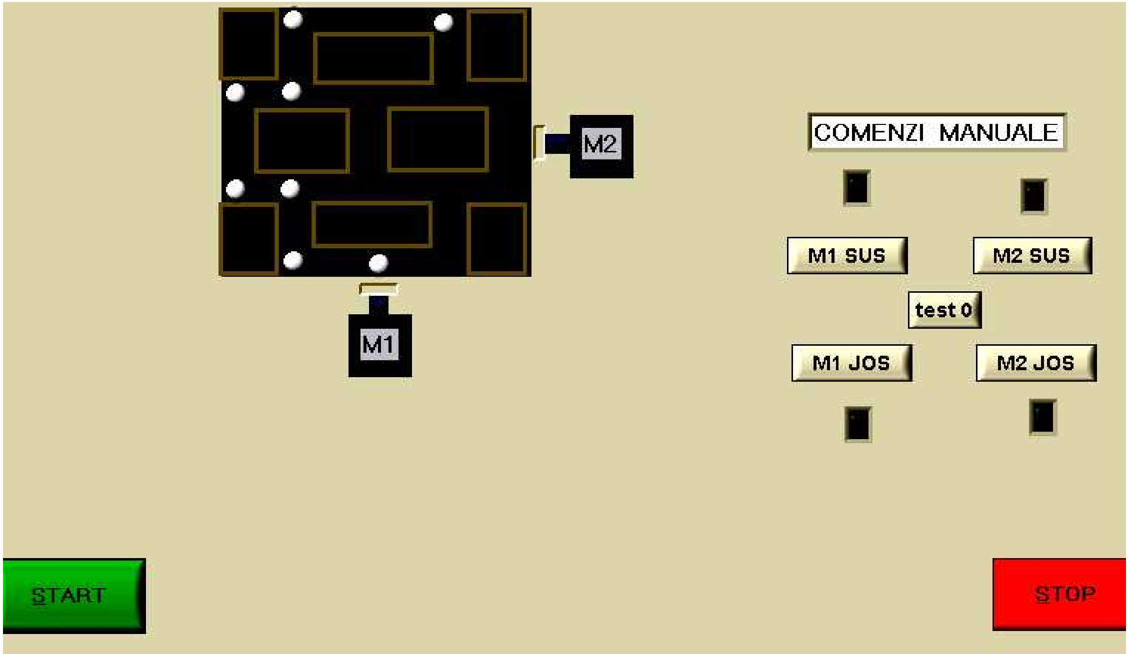

Fig. 8. Graphical interface.

CONCLUSIONS

The simple model, used in these numerical simulations, roughly explores the potential of SMA spring based hopping robot. A more complex model can expose all the advantages of using SMA spring in construction of hopping robot. Real problems for this type of robot consist in energizing sources for heating SMA spring and, if is the case, in rapid cooling of the spring. In future authors will explore the potential of more complex SMA spring based hopping robot and will implement an experimental robotic structure, in order to validate the numerical simulations.

REFERENCES

Popescu, M.C. (1994). *Inteligență artificială*. Tipografia Universității C. Brâncuşi.

Ivanescu, M. (1994). *Roboți industriali.*. Ed.Universitaria, Craiova.

Popescu, M.C. (2004). *Utilisation des ordinateurs.* Editura Universitaria, Craiova.

Popescu, M.C. (2005). *Telecomunicații.* Editura Universitaria, Craiova.

Popescu, M.C. Petrisor A..(2006). Thermocuples-Comparative Study. *Buletinul Institutului Politenic din Iaşi*, **Vol LII(LVI),** pp. 1069-1074.

Popescu, M.C. Petrisor A..(2006). 2D Optimal Control Algorithms Implementation. *WSEAS Transactions on System and Control*, Issue 1, Volume 1, pg. 94-99.

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www.alliancevision.com

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