ROBOT CONTROL WITH CAMERA EYE

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Abstract

Visual robots are very popular in this moment, because of the technological innovations in the image sensors. There are many propositions of using image sensors to control the movements and reactions of a mobile robot. Such robots can see the space around, analyze the situations and make decisions for the right direction of movement. The visual robots equipped with image sensors became autonomous and are used in many practical cases as surveillance, services, toys etc. There are some other cases when it is necessary a person to control a visual robot. In such cases the possibilities are to make this control with some buttons or keyboard and transmit the control signals with wires or wireless to robot. The goal of this article is to control the robot from the human eyes movements, which are followed with a camera eye. It is chosen for experiments Lego Robot, equipped with a camera eye.

1. Introduction

The visual information can give to the robots very useful information for the real and current situation in the observation space, were the robot is placed and make the decisions for his movements [1]. This information can be processed and then send to the robot moving system to guaranty the right control the robot movements in the observed space [2]. This general goal can be divided to some problems, which can be solved first separate and then arranged in a sequence for right execution. The first problem is to input the visual information in robot system using a visual sensor. The second operation is to process this information for finding the eye as an object in the image information. Then it must to find the eye iris and to calculate camera eye co-ordinates. The next step is to transform the camera eye co-ordinates in the robot co-ordinate system. Finally it is necessary to interpret the robot co-ordinates as the specific robot commands for choosing right direction of robot movements. It is possible and necessary to add a communication system to link the mobile robot system with computer for distance control of the mobile robot. All of the mentioned steps are the goal and the parts of this article and are presented more clearly in the Figure 1 as the blocks of an algorithm.

2. Matlab program for visual information processing

2.1. Find and tracking the eye iris

Matlab simulation is made to examine the eye finding, iris of eye fixing, calculating the iris co-ordinates and eye movement track.
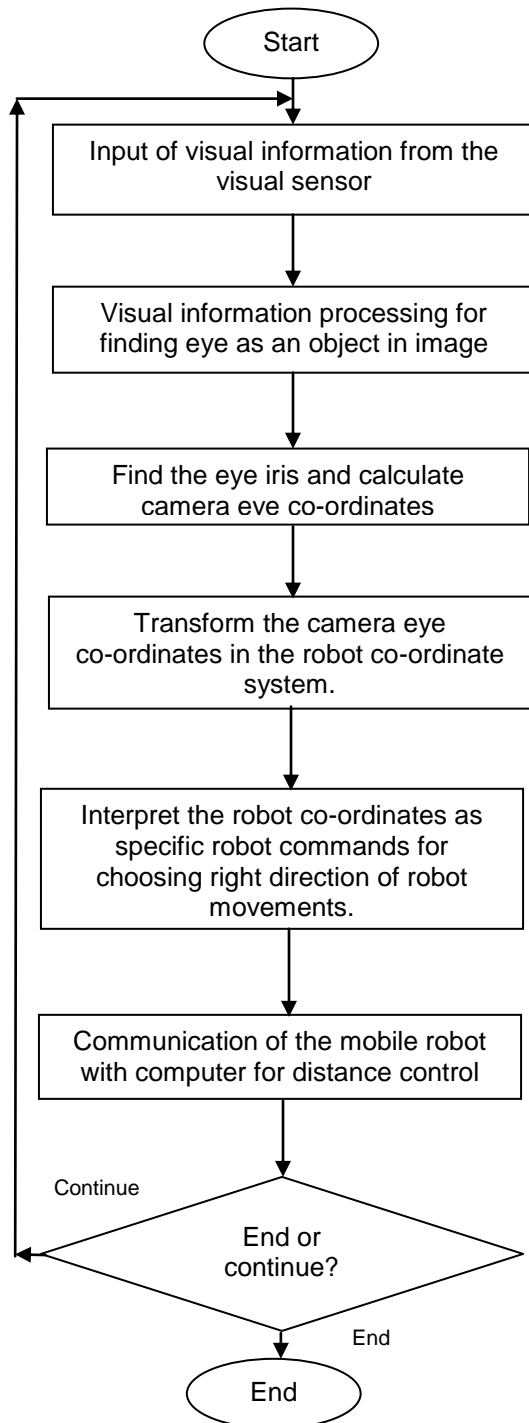

Figure 1. General view of algorithm

The image is input in real time or is stored and load in Matlab program as file in AVI format to use as test of visual information for human eye movements. The general view of the input image is shown in Figure 2.

Figure 2. General view of input image

For the simulation, the automatic eye find is substituted with a simplified manual specifying of the place of the eye, shown in Figure 3 and marked with crosses. The result of eye separating is shown in Figure 4. Then it is find the iris of the eye, determining their co-ordinates as a centre of gravity X_g, Y_g, thinking iris as a simple circle. In the calculation are used the common equation for the centre of gravity for the objects in an image:

$$X_g = \frac{\sum_{i=1}^{n} a_i * x_i}{\sum_{i=1}^{n} a_i} \quad (1)$$

$$Y_g = \frac{\sum_{i=1}^{n} a_i * y_i}{\sum_{i=1}^{n} a_i}, \quad (2)$$

Where

X_g, Y_g are the co-ordinates of the eye iris;

$x_i, y_i -$ the current co-ordinates of image points;

$a_i -$ the values of current image point brightness.

Figure 3. Manual eye specifying

Figure 4. Result of eye separating

The result of iris eye fixing is shown in Figure 5 as crossing point of two lines.
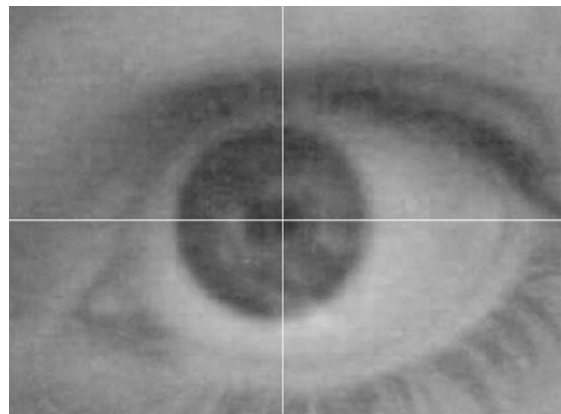

Figure 5. Result of eye iris co-ordinates calculation

The result of iris of eye fixing and find their co-ordinates is using for eye movements movement tracking with a suitable Matlab program. For a presentation of the eye movements tracking, in the Figure 6 is shown an appropriate trajectory for some little eye movement, dominantly in horizontal direction. This simulate the eye observation of some objects of interest in the space of human, to turn the attention of the visual moving robot in this direction.
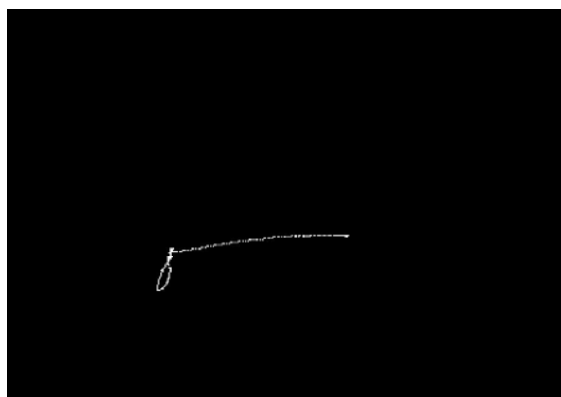

Figure 6. The trajectory of some little eye movements tracking

The information for eye iris movements as co-ordinates is transformed as robot co-ordinates and then as control commands to direct the robot movements in accordance to the human eye movements. A part of the program making this is shown in Figure 7.
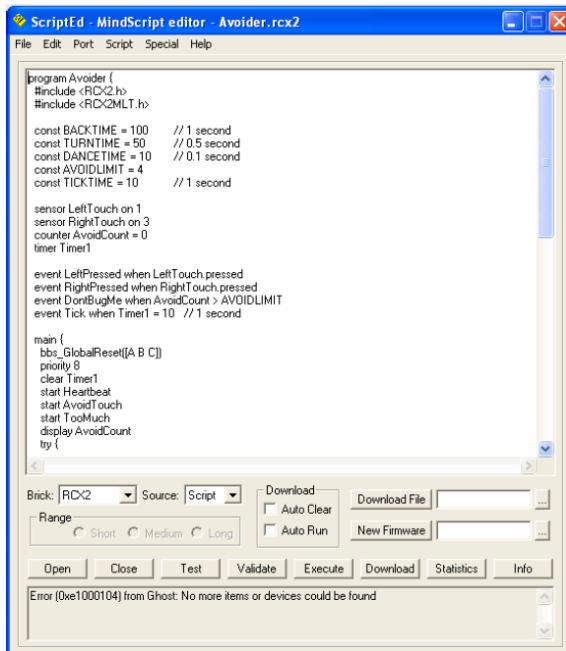
Figure 7. Robot control program

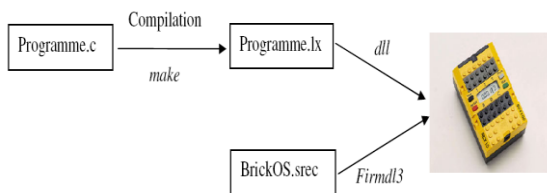The steps of preparing and execution of the robot program are shown in Figure 8.

Figure 8. The steps of robot program preparation

Finally the working block algorithm of robot control with camera eye and the general view of the experimental visual robot system is presented in Figure 9 and Figure 10, respectively.
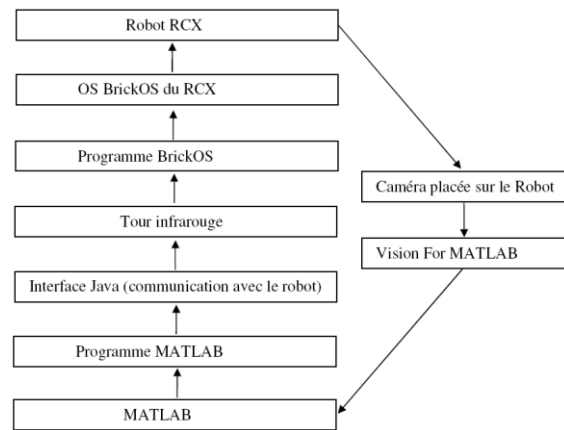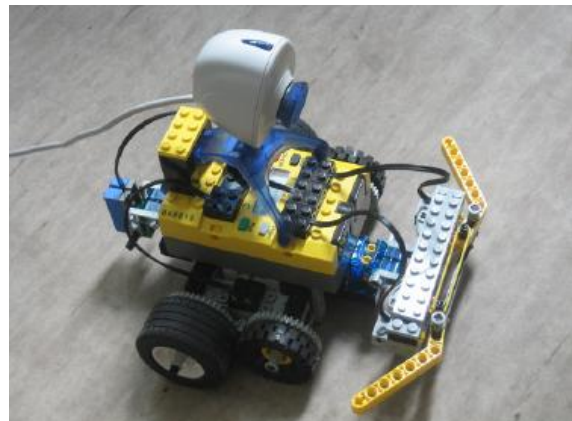

Figure 9. Workink algorithm of the robot program

Figure 10. The general view of the robot system

3. Conclusion

A camera eye robot control system is proposed and present with some experimental results of its practical working. It is necessary to say, that this is only a little step for some more deeply following investigations in this direction.

References

[1]. M. Fujita,"Digital creatures for future entertainment robotics", IEEE Int. Conf. on Robotics ,2000.

[2]. S. Mann," Wearcam" in IEEE Int. Symp. of Wearable Computing, 1998.