NAVIGATION OF INDUSTRIAL MANIPULATOR BASED ON COMPUTER VISION

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Abstract

Paper deals with using machine vision to control pointing device. It focuses on creating control software for movement and positioning with pointing device based on machine vision. Using the account information on the identification and location of the object positioning obtained using machine vision techniques.

Key words: control, autonomy, software, machine vision, robot

INTRODUCTION

Using machine vision techniques, we can identify the object according to selected visible parameters. The unification coordinate system of scanned image and industrial robot can determine its exact position. Using the trajectory algorithm for autonomous robot move, can manipulate and perform various other operations with the objects, which would achieve goal-oriented behavior of such a system.

SYSTEM STRUCTURE

The basic structure of the system consists of a positioning device, which can be an industrial robot or manipulator who has to move objects from one (starting) position to the second (final) positions. The system is also equipped with a camera system, which consists of a webcam and recognition application. The role of recognition application is to detect the search object. Grasping objects of the manipulator is guided to the camera. The final position is determined by the recognition application according to the position of the object. The proposed system for autonomous positioning with using of machine vision lies in the fact that the whole system is controlled by one control application. It will consist of two basic parts:

a) of processes of image processing such as recognition, detection of object and the following processes associated with

b) the processes connected with the control of pointing device and his movement.

Fig. 1 Diagram of the layout of sub-tasks to create complex application for robot control using machine vision

ROBOT CONTROL SOFTWARE WITH USING MACHINE VISION

When solving autonomous positioning with using machine vision, several problems raise. One of the most common problems are high demands on computing hardware and software. In standard applications, as a mean of recording commercial cameras with sensitive optics for detailed imaging of objects are used. Their price is much higher compared with the proposed concept solution using a webcam. For the simple task of recognizing and determining the position it can meet their functional parameters. Another advantage is that it has a USB (Universal Serial Bus) interface, which is readily available and installation is simple.

In machine vision applications, problems arise in the selection of tools for image processing. Each application can be interpreted as a combination of successive elementary tasks. These elementary tasks can be solved by tools that include graphic libraries. The advantage of graphic libraries, unlike graphic programs is the ability to create own application. They contain many features and a wide range of tools for image interpretation.

The control system is a software application on the PC, which is guaranteed to meet the requirements on computing hardware and create sufficient backups for the increasing performance of tasks. The big advantage is the complexity of the management software, which covers several areas for the solution of the whole task. Processes related to image processing and evaluation, and management of industrial manipulator, therefore its movement are basic processes. Between the separate programs from which the system is composed, it is necessary to solve their compatibility. By complexity of the management
software we can avoid issues with compatibility in various subprograms.

Another problem which needs to be solved in such a role is the calibration of the camera coordinate system with robot coordinate system. Information about the exact position or distance of the object detected by image processing requires a coordinate system in which the data were obtained to be identical with the coordinate system used by the robot. Practically it is never possible to orientate the camera so that it coordinates to be identically with the coordinates of the robot. The image can be rotated, skewed perspective or affected by other disturbances. Transformation of coordinates of camera view to the coordinates of the robot is a solution for unification of coordinate system. And therefore it is necessary to propose an algorithm to determine the proper transformation coefficients. They may apply only to defined camera position and scene. For each camera moving to a new position it is necessary to change the transformation coefficients.

There are several ways and methods of motion control of robots and manipulators. Information about the coordinates of the captured object is obtained by processing the scanned image. This position represents the final position of the effector. By using methods of motion control it is necessary to propose an algorithm for autonomous generation of effector trajectory.

The first one shows normal video. The second one shows all detected objects. The third box shows the biggest object. And the fourth one just draws a sign in the biggest object location.

Also, there is added rich textbox window in which the coordinates of the largest object is shown.

To understand how the filters work I use red object. In my provided software, the user can choose his request color and size. For color detection function is use "euclidean filter" and "blobcounter" for extracting data. The first line selects the select color value. You all know color has a value 0 to 255. I specified my center color will be a red effected color because here value of red is 215, green and blue is 30, and filter. Radius = 100 means that all color value near 100 in my specified color. Now for detect objects, I use bitmap data and use lockbits method. In the window will be shown a image of the detected object in the rectangle.

At this stage, the application identifies each object according to the desired color. In real time you can change the color palette, and track objects under them. The application is written in C# where I used graphics library Aforge.net.

The software works so that the search starts at the beginning of the default color which can be changed in real time.. There are 4 views, 3 of them are Aforge video source control and another one is a picture box.

In the development environment Microsoft Visual Studio 2008 in programming language C# to develop program in training center, which will run all the processes necessary to ensure the autonomous positioning based on machine vision.

To communicate with the PC controller of Mitsubishi robot RV-2AJ can be used standard interface RS-232C or Ethernet network interface (TCP/IP), of which the advantage is connection to the control unit via the Internet and transfer of arrangements and long-distance service. In the first phase of development of applications a serial interface RS-232C was used For Compatibility of control unit with PC it was necessary to adjust individual values for baud rate, setting the bits, parity check to check accuracy of data and stop bits to end the communication.
An important step for managing the robot is necessarily a proper control of internal commands for managing and checking the control unit of robot and commands for the robot programming language. The movement of the robot is provided by sending individual commands. In the next stage of the program will be a solution of other operations as a continuous movement through a few points, for its security we need to gather information of the current state of the robot. It must be sent by request in a repeated interval. The solution of next stage is closely related with integration of computer vision tasks. On the picture 4 there is an example of application on external robot control tested by device Mitsubishi RV-2AJ. In the control window are shown functions setting values for the serial connection, boxes for entering values of coordinates, keys with the pre-defined commands to activate the robot control unit, servoturn, move the robot to the position specified by coordinates and button for opening and closing effector.

CONCLUSION

The article deals with the use of machine vision in control the pointing device. Described the structure of the system and its basic parts, such as image processing and control of the pointing device.

There is presented a proposed solution camera system, which consists of a web camera and recognition application that image processing using graphics library Aforge.net. Described is the application on external control robot, which provides movement of pointing device. Calibration of the camera coordinate system to robot coordinate system, using an algorithm for generate trajectories we can be achieved autonomous movement of pointing device. The present solution of the control system is formed from a one software application. The next step in solution this task is expected calibration of the camera coordinate system with the robot coordinate system, submission an algorithm to generate trajectories, and other tasks with which we can achieve an autonomous movement of pointing device.

References


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