Research Paper

Engineering

Module And Algorithm For Recognizing Small Objects by Using The Matlab Programming Language

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ABSTRACT

This paper presents an example of a recognition Matlab application and a proper device that allows us to detect small objects, to determine the shape and the dimensional characteristics of these objects.The goal is to transfer these results to a controlling unit where they can be used for the process of robotized manipulation. For the recognition operation the system uses the 2D Video acquisition mode.

KEYWORDS : image acquisition, image processing, object recognition, 2D video

INTRODUCTION

Choosing the type of sensor to be embedded robot control to achieve depends on the desired application. It is generally accepted that anyway to artificial is the most powerful and yet the most flexible type environment perception that has led to considerable developments and research in the field, to artificial being a top area of robotics. Enlightenment is an important objective for acquiring visual information. Its purpose is to provide adequate separation between background and object (eg a piece on a conveyor belt), helping to identify the defining characteristics of the object. If passive systems like video cameras, lighting object can be very critical, ambient lighting ordinary - either artificial or natural - is inappropriate, it may be lower or producing shadows or glows as misleading. Active video sensors, as the direct object produce its own light (optical or ultrasound) and therefore this type of sensors are not dependent on artificial lighting systems.

C.C.D. sensor operation (Charged Coupled Device) is a technique to turn bright information. This technology involves a series of discrete elements of sensors image. Each image is called PIXEL Elementary. Miniaturization and robustness of the captors are two advantages that lends itself well to applications of robotics. These devices C.C.D. They consist of two electronic entities; First conversion to light energy into electricity, the second constituting elementary circuits to access information.

2D sensors currently showing considerable interest in robotics for the effective and practical, but orders slow feedback. They are actually a practice thought, preferring 2D to 3D video systems in terms of their simplicity and easier operation.

The 3D image may be obtained using data from a 2D sensor and the touch sensor. It is the focus of research in 3D thanks to robot operations to achieve faster, more accurate and flexible robot.

2D video sensors are based on an array of optical transmitters and special design of artificial light. Unis 2D smart sensors also have limited computing power, but allowing them a certain image processing. It can be used both to facilitate the data processing in the main control computer, and to interact with the lighting system; for example to control the light level and provide the best quality.

Most optical arrays of transducers which are able in some way to provide an output image to grayscale. The only exception to this is the room that DRAM, based on a memory device to produce a binary image output. It is pointed out that a grayscale image can be produced with a laser, but for getting bigger by overlapping multiple binary images obtained with different exposure times.

Lighting conditions and / or limitations that require computing power to interpret binary encoder output. This is the case of lighting, which allows images to opaque objects only two distinct levels of grayscale.

Another example is the use of microcomputers for controlling the robot and image processing. These devices can actually manipulate images easily grayscale due to the large amount of memory required for

the output transducer. For example a 256x256 image with 8-bit grayscale (256 colors) would actually require 65,536 bytes.

In the handling of various objects it is necessary to recognize objects. It is necessary to create a system allowing the robot to recognize objects recognized in order to select the object manipulation. There are all sorts of applications that enable object recognition, one of these applications using MATLAB software. These applications give 2D images that fulfill the function of the robot.

THE HARD AND SOFTWARE RESOURCES

For acquiring and processing the images, the system must fulfill some of the following conditions:

• regarding the hardware the system contains an image acquiring device, a plate (with special features) for supporting the objects, a modulated metallic structure witch holds the assembly together, light spots and a computer.
• From the software site of view the processing algorithm is written in the Matlab M-File language using the resources of the Matlab Image Acquisition and Image Processing Toolboxes.

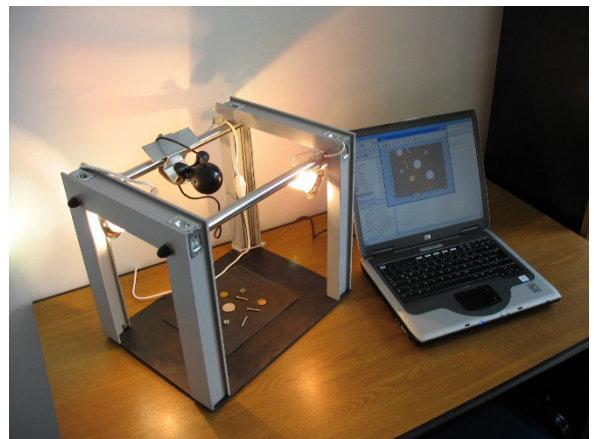The acquisition and processing devices are presented in figure 1.

Figure 1: the acquisition and processing devices used for the recognition

In this case the acquisition is achieved by a Logitech 8.4.1Q video camera with a maximum resolution of 640x480 pixels. The camera can acquire images in color, gray and also infrared mode. For best quality images, some conditions, like the angle of incidence and the length between the camera and the objects, must agree with specifications. For example, the optimum angle of incidence is set at 90° and, any deviation from this angle concludes in an error in the processing data. In some cases, this error can be minimized by using some specific algorithms but this action will affect the processing time. Also it is high-

ly important to effectively use an **illuminating device**, because any shadows on the plate will be detected as an object and the operation will be corrupted. It is recommended that the illumination should be made from all directions, but this is hardly accomplishable in practice, so a compromise must be made. For this application two **spotlights** are available. Positioning the spotlights and setting up the frequency and intensity must be made by experimental means. Higher intensity means that the acquisition device could be blinded; lower intensity has as a result recognition errors.

The plate that supports the objects, also serves as a **background** and therefore it must own some special characteristics. The optimum choice is to have a background with a black color shade. It must be made out of a gut material witch means that the light is absorbed and not reflected.

THE ALGORITHM
The algorithm used for this process is made according to the steps shown below:

Step 1: Acquiring the Image
Step 1.1: Identifying Available Devices;
Step 1.2: Identify installed image acquisition devices. Determine device information and capabilities;
Step 1.3: Accessing Devices and Video Sources;
Step 1.4: Access image acquisition devices. Select and access the current video source;
Step 1.5: Access and configure a video input object's properties. Access property help and   information;
Step 1.6: Managing Image Acquisition Objects;
Step 2: Processing the Image
Step 2.1: Read image;
Step 2.2: Threshold the image;
Step 2.3: Remove the noise and working with the image properties;
Step 2.4: Image transformation: RGB GrayscaleBinary Image;
Step 2.5: Find the boundaries;
Step 2.6: Determine which objects are round;
Step 2.7: Identifying the nuts;
Step 2.8: Determine the geometrical dimensions and the position for the selected nuts;
Step 2.9: Saving the results in workspace for an eventual transfer to de C&C system;
Below there are presented and commented some of the programs most essential lines (these sub functions are the base for the ulterior data processing):

```
function recognition;
% identify the device;
imaqInfo = imaqhwinfo
imaqInfo.InstalledAdaptors
winvideoInfo = imaqhwinfo('winvideo')
winvideoInfo.DeviceInfo
device1 = winvideoInfo.DeviceInfo(1)
% snapshot;
% access the camera.
vidobj = videoinput('winvideo', 1,'RGB24_640x480' )
preview(vidobj);
snapshot = getsnapshot(vidobj);
image(snapshot)
imwrite(snapshot,'calc_raze.bmp');
bw = imfill(bw,'holes');
imshow(bw)
[B,L] = bwboundaries(bw,'noholes');
…………………………………………
% obtain the area calculation corresponding to label 'k'
 area1 = stats(k).Area;
% compute the roundness metric
metric = 4*pi*area1/perimeter^2;
% display the results
```

As shown, the program displays the boundaries of all objects, the center for the round objects and the roundness coefficient, the diameter for the nuts and the position of the center of the nuts and the type of the nut (metric standard).
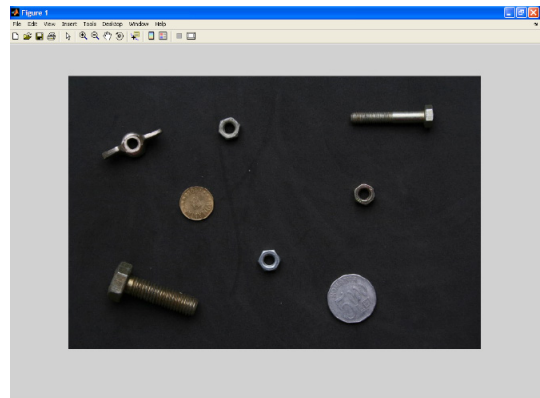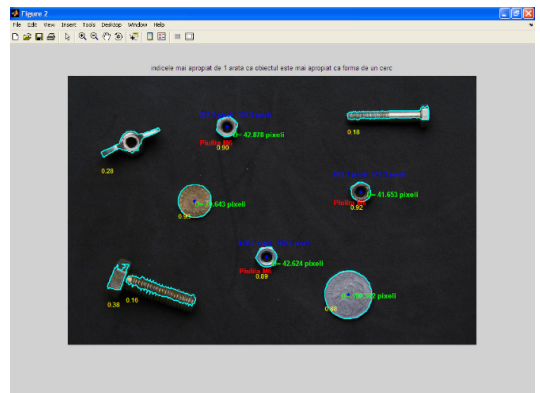

Figure 2. a: the initial image

Figure 2. b: the processed image

There are also some difficulties to obtain maximum performance from the recognition device. For example if the nuts are placed on an upright position, the objects boundaries will not be relevant. A reliable solution would be to implement some controlled vibrations into the "holding plate" so that the objects would fall.

CONCLUSIONS
In the example video system has learned of three items based on characteristics: number of holes, objects the size and shape characteristics. Subsequently video system whenever it is presented a picture showing one of the objects, they will be able to recognize his presence in the field of view. This is accomplished by comparing the image with the object characteristics stored in memory, that recognizing it, the system will search the object in memory with similar characteristics.

In practice a certain tolerance must be accepted in comparison algorithm because video sensory system is not perfect and there will always produce the same output for the object, so that a perfect match will be hardly possible. A tolerance too high could lead to the recognition of two similar objects as the same object.

The module proposed in this example has a configuration witch can be easily adapted for a robotized cell where you need fast processing time and exact dimensional recognition. Also by inserting another camera into the system the 2D Vision System can be easily transformed into a 3D recognition device.

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