SECTION 7. Mechanics and machine construction.

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PROGRAMMING A ROBOTIC MACHINE

The purpose of this article is to study some algorithms for analysis of the images obtained machine tool with CNC.
Keywords: machine, algorithms, management.

The basis of any machine with CNC is the coordinate table provides the move tool or component, or both) in three planes - right-left, front-back and up - down [1-2]. Consider a CNC machine programming, in case when the coordinates and the position of parts dynamically changes.

In programming tasks include the following questions:
- problem detection details,
- determination of the exact coordinates of the details,
- determination of the angle of rotation of details,
- develop a program controlling a mouse,
- execution move the object using the mouse.

Camera DVC-329M was installed at a distance $1m$ from the surface of the base, as the parts were used the same hexagons with an edge $2,5\ sm$, brightly painted in red, yellow and blue colors.

Objects we assume fixed and having the same size and a different color. At the first stage will search for objects of the same color Fig.1. Located above the white base of the video camera, connect it to the computer, put on the basis of multi-colored objects. Develop an algorithm for image filtering and screening of extra noise.

code: Delphi

```
procedure TForm1.Button1Click(Sender: TObject);
var
i:integer;          //i- coordinate of the pixel horizontal
j,q,w:integer;      //j- coordinate of the pixel vertical
y,cb,cr:real;       // Variables number of differences
pg,sa,ii,jj,k:integer;
r1,g1,b1:real;
r2,g2,b2:Byte;
```

```
FirstColor,SecondColor:Integer;
Color:TColor;
ChangeDetect:byte;    yy:real;
bit,bit2:tbitmap;
begin

pg:=20;

image2.Canvas.Brush.Color:=clwhite;
image2.Canvas.FillRect(rect(0,0,image1.Width,image1.Height));
bit:=Tbitmap.Create;

Bit.Height:=image1.Height;
Bit.Width:=image1.Width;
bit.LoadFromFile(fname);
   j:=10;
  for i := 1 to 3000 do
  for j := 1 to 3000 do
b[i,j]:=0;

  for i := 1 to bit.Width do
begin
  for j := 1 to bit.Height do
   begin
     // Get the color of the current pixel first image
     FirstColor:=bit.Canvas.Pixels[i,j];
         // Get the RGB components
     r1:=GetRValue(FirstColor);
     g1:=GetGValue(FirstColor);
     b1:=GetBValue(FirstColor);

// Filtering

if (r1-g1>pg) and (r1-b1>pg) then  begin
image2.Canvas.Pixels[i,j]:=clred;   b[i,j]:=1;end;

if (r1-b1>pg) and (g1-b1>pg) then  begin
image2.Canvas.Pixels[i,j]:=clyellow;    b[i,j]:=2;end;

if (b1-r1>pg) and (g1-r1>pg) then     begin
image2.Canvas.Pixels[i,j]:=clblue;     b[i,j]:=3;end;

  end;
```

```
     end;
```

Develop algorithm of definition of coordinates of each of the found object. To do this, we need to separate the background from the objects Fig.2 and sort the found objects on color with regard to the possible error in color.

```
type gg=array[1..10000] of record color:tcolor;
                                  xy:tpoint;
                                  pro:integer; end;
var
  Form1: TForm1;
a,b:array[0..4000,0..4000]of integer;
int:array[1..3,1..3] of real;
                 fname:string;
box:gg;
………………………………………………..
k:=1;
for I := 1 to 64 do
for j := 1 to 48 do
begin
sa:=0;
box[k].xy.X:=i;
box[k].xy.y:=j;
for Ii := 1 to 40 do
for jj := 1 to 40 do
begin
if b[i*30+ii,j*30+jj]>0 then sa:=sa+1;
end;

case b[i*30+20,j*30+20] of
1:box[k].color:='red';
2:box[k].color:='yellow';
3:box[k].color:='blue';

end;
box[k].pro:=sa;
  k:=k+1;
end;

k:=0;
memo1.Clear;
for I := 1 to 3072 do
if box[i].pro>730 then
```
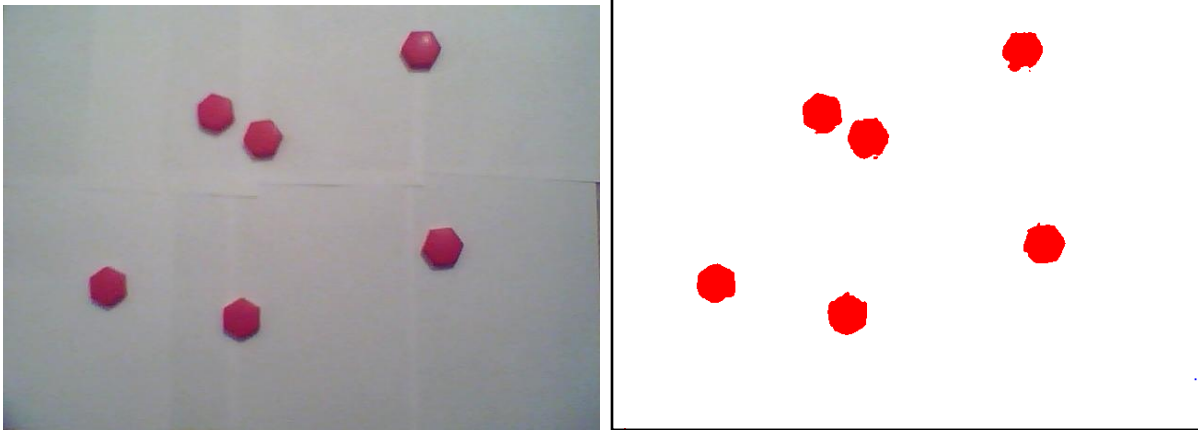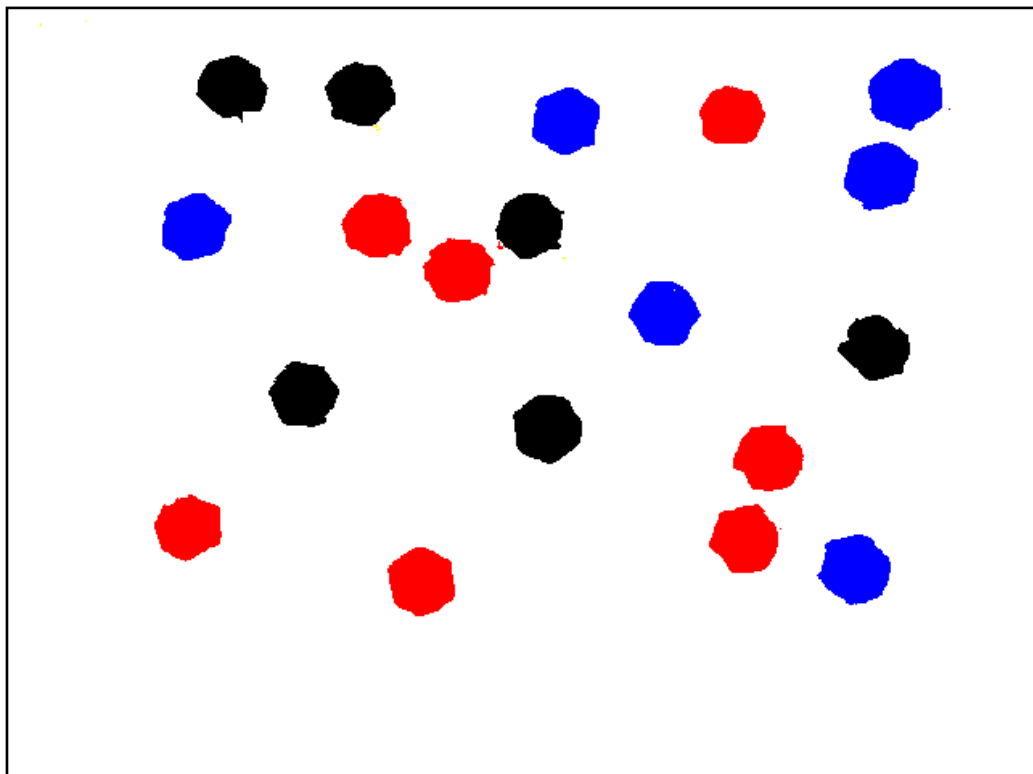
```
begin
k:=k+1;
memo1.Lines.Add(inttostr(k)+') '+inttostr(box[i].pro)+' '+
inttostr(box[i].xy.X*30)+' '+inttostr(box[i].xy.y*30)+' '+(box[i].color));
end;
```


Figure 1 - Monochrome parts on the basis of (left - camera image, right - after filtration and screening background).

Define the coordinates of the red parts of the upper left corner, the details are depicted in figure 1.

1) 1332 90 300 red
2) 1255 210 120 red
3) 1171 240 330 red
4) 853 270 150 red
5) 952 420 60 red
6) 1025 450 270 red

Figure 2 - Selection of colorful parts (top - camera image, bottom - after filtration and screening background).

And then the coordinates for the colored parts shown in Fig.2.

1) 1128 90 120 blue
2) 1209 90 300 red
3) 1223 120 30 yellow
4) 739 150 210 yellow
5) 945 210 30 yellow
6) 1185 210 120 red
7) 1124 240 330 red
8) 868 270 150 red
9) 1117 300 120 yellow
10) 913 300 240 yellow
11) 945 330 60 blue
12) 865 330 240 yellow
13) 977 390 180 blue
14) 1022 450 270 red
15) 768 450 300 red
16) 920 510 90 blue
17) 841 510 180 yellow
18) 1297 510 330 blue
19) 1379 540 30 blue

The algorithms allow to find approximate coordinates of the parts and their color. In the future it is necessary to develop an algorithm clarify the coordinates of the center of details for more precise positioning of the mouse.

Reference

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