LAPORAN PRAKTIKUM

(PENGOLAHAN CITRA)

(MODUL 9 dan 10)

Disusun oleh :

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FAKULTAS ILMU KOMPUTER

UNIVERSITAS KUNINGAN

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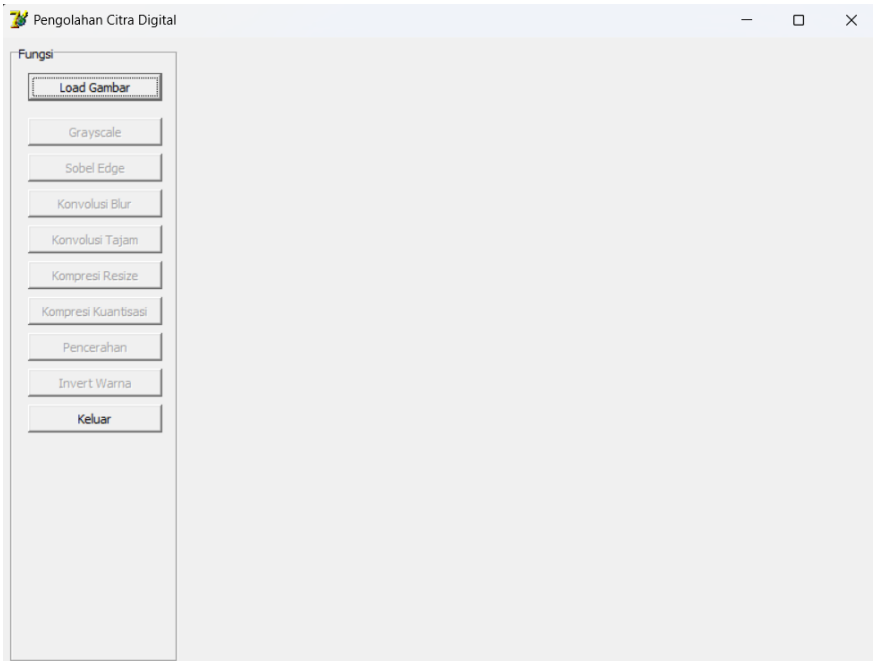
I. Tujuan Praktikum

1. Mahasiswa dapat memahami analisis citra
2. Mahasiswa mampu memahami cara pembuatan program feature extraction

II. PRAKTEK

1. Buka program Aplikasi Delphi
2. Buat Proyek Baru dan beri nama SimpanVideo.dpr
3. Tambahkan Komponen-komponen berikut ke dalam Form1



4. Masukan kode program dibawah ini:

Source Code 1:

```
unit Unit1;

interface

uses
  Windows, Messages, SysUtils, Variants, Classes, Graphics, Controls, Forms,
  Dialogs, Buttons, ExtCtrls, StdCtrls, ExtDlgs;

type
  TForm1 = class(TForm)
    GroupBox1: TGroupBox;
    SpeedButton1: TSpeedButton; // Grayscale
    SpeedButton2: TSpeedButton; // Sobel
    SpeedButton3: TSpeedButton; // Konvolusi
    SpeedButton4: TSpeedButton; // Konvolusi 2
    SpeedButton5: TSpeedButton; // Kompresi 1
    SpeedButton6: TSpeedButton; // Kompresi 2
    SpeedButton7: TSpeedButton; // Treatment
    SpeedButton8: TSpeedButton; // Invert
    SpeedButton9: TSpeedButton; // Exit
    BitBtn1: TBitBtn;           // Load Image
```

```
    Image1: TImage;
    OpenPictureDialog1: TOpenPictureDialog;

    procedure FormCreate(Sender: TObject);
    procedure BitBtn1Click(Sender: TObject);
    procedure SpeedButton1Click(Sender: TObject);
    procedure SpeedButton2Click(Sender: TObject);
    procedure SpeedButton3Click(Sender: TObject);
    procedure SpeedButton4Click(Sender: TObject);
    procedure SpeedButton5Click(Sender: TObject);
    procedure SpeedButton6Click(Sender: TObject);
    procedure SpeedButton7Click(Sender: TObject);
    procedure SpeedButton8Click(Sender: TObject);
    procedure SpeedButton9Click(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
  end;

var
  Form1: TForm1;
  gambar: TBitmap;

implementation

{$R *.dfm}

function Clamp(Value, MinVal, MaxVal: Integer): Integer;
begin
  if Value < MinVal then Result := MinVal
  else if Value > MaxVal then Result := MaxVal
  else Result := Value;
end;

procedure TForm1.FormCreate(Sender: TObject);
begin
  SpeedButton1.Enabled := False;
  SpeedButton2.Enabled := False;
  SpeedButton3.Enabled := False;
  SpeedButton4.Enabled := False;
  SpeedButton5.Enabled := False;
  SpeedButton6.Enabled := False;
  SpeedButton7.Enabled := False;
  SpeedButton8.Enabled := False;
end;
```

```
procedure TForm1.BitBtn1Click(Sender: TObject);
begin
  if OpenPictureDialog1.Execute then
  begin
    if Assigned(gambar) then gambar.Free;
    gambar := TBitmap.Create;
    gambar.LoadFromFile(OpenPictureDialog1.FileName);
    Image1.Picture.Bitmap := gambar;

    SpeedButton1.Enabled := True;
    SpeedButton2.Enabled := True;
    SpeedButton3.Enabled := True;
    SpeedButton4.Enabled := True;
    SpeedButton5.Enabled := True;
    SpeedButton6.Enabled := True;
    SpeedButton7.Enabled := True;
    SpeedButton8.Enabled := True;
  end;
end;

procedure TForm1.SpeedButton1Click(Sender: TObject);
var
  i, j: Integer;
  temp: PByteArray;
  gray: Byte;
begin
  if not Assigned(gambar) then Exit;
  gambar.PixelFormat := pf24bit;

  for j := 0 to gambar.Height - 1 do
  begin
    temp := gambar.ScanLine[j];
    i := 0;
    while i < 3 * gambar.Width do
    begin
      gray := Round(0.3 * temp[i + 2] + 0.59 * temp[i + 1] + 0.11 * temp[i]);
      temp[i] := gray;
      temp[i + 1] := gray;
      temp[i + 2] := gray;
      Inc(i, 3);
    end;
  end;

  Image1.Picture.Bitmap := gambar;
  gambar.SaveToFile('Grayscale.bmp');
end;
```

```
procedure TForm1.SpeedButton2Click(Sender: TObject);
const
  SobelX: array[0..2, 0..2] of Integer = ((-1, 0, 1), (-2, 0, 2), (-1, 0, 1));
  SobelY: array[0..2, 0..2] of Integer = ((-1, -2, -1), (0, 0, 0), (1, 2, 1));
var
  y, x, i, j, gx, gy, gray: Integer;
  row: array[-1..1] of PByteArray;
  hasil: TBitmap;
  line: PByteArray;
begin
  if not Assigned(gambar) then Exit;

  hasil := TBitmap.Create;
  hasil.Assign(gambar);
  hasil.PixelFormat := pf24bit;

  for y := 1 to gambar.Height - 2 do
  begin
    for i := -1 to 1 do
      row[i] := gambar.ScanLine[y + i];

    line := hasil.ScanLine[y];
    for x := 1 to gambar.Width - 2 do
    begin
      gx := 0;
      gy := 0;
      for i := -1 to 1 do
        for j := -1 to 1 do
          gx := gx + SobelX[i + 1, j + 1] * row[i]^[3 * (x + j)];
      for i := -1 to 1 do
        for j := -1 to 1 do
          gy := gy + SobelY[i + 1, j + 1] * row[i]^[3 * (x + j)];

      gray := Abs(gx) + Abs(gy);
      gray := Clamp(gray, 0, 255);

      line^[3 * x] := gray;
      line^[3 * x + 1] := gray;
      line^[3 * x + 2] := gray;
    end;
  end;

  Image1.Picture.Bitmap := hasil;
  hasil.SaveToFile('Sobel.bmp');
  hasil.Free;
end;
```

```
procedure TForm1.SpeedButton3Click(Sender: TObject);
const
  Kernel: array[0..2, 0..2] of Integer = (
    (1, 1, 1),
    (1, 1, 1),
    (1, 1, 1)
  );
var
  x, y, i, j, r, g, b: Integer;
  row: array[-1..1] of PByteArray;
  hasil: TBitmap;
  line: PByteArray;
begin
  hasil := TBitmap.Create;
  hasil.Assign(gambar);
  hasil.PixelFormat := pf24bit;

  for y := 1 to gambar.Height - 2 do
  begin
    for i := -1 to 1 do
      row[i] := gambar.ScanLine[y + i];

    line := hasil.ScanLine[y];

    for x := 1 to gambar.Width - 2 do
    begin
      r := 0; g := 0; b := 0;
      for i := -1 to 1 do
        for j := -1 to 1 do
        begin
          r := r + row[i]^[3 * (x + j) + 2] * Kernel[i + 1][j + 1];
          g := g + row[i]^[3 * (x + j) + 1] * Kernel[i + 1][j + 1];
          b := b + row[i]^[3 * (x + j) + 0] * Kernel[i + 1][j + 1];
        end;
      r := r div 9;
      g := g div 9;
      b := b div 9;

      line^[3 * x + 2] := r;
      line^[3 * x + 1] := g;
      line^[3 * x + 0] := b;
    end;
  end;

  Image1.Picture.Bitmap := hasil;
  hasil.SaveToFile('Konvolusi_Blur.bmp');
  hasil.Free;
```

```
end;

procedure TForm1.SpeedButton4Click(Sender: TObject);
const
  Kernel: array[0..2, 0..2] of Integer = (
    (0, -1, 0),
    (-1, 5, -1),
    (0, -1, 0)
  );
var
  x, y, i, j, r, g, b: Integer;
  row: array[-1..1] of PByteArray;
  hasil: TBitmap;
  line: PByteArray;
begin
  hasil := TBitmap.Create;
  hasil.Assign(gambar);
  hasil.PixelFormat := pf24bit;

  for y := 1 to gambar.Height - 2 do
  begin
    for i := -1 to 1 do
      row[i] := gambar.ScanLine[y + i];

    line := hasil.ScanLine[y];

    for x := 1 to gambar.Width - 2 do
    begin
      r := 0; g := 0; b := 0;
      for i := -1 to 1 do
        for j := -1 to 1 do
        begin
          r := r + row[i]^[3 * (x + j) + 2] * Kernel[i + 1][j + 1];
          g := g + row[i]^[3 * (x + j) + 1] * Kernel[i + 1][j + 1];
          b := b + row[i]^[3 * (x + j) + 0] * Kernel[i + 1][j + 1];
        end;
      r := Clamp(r, 0, 255);
      g := Clamp(g, 0, 255);
      b := Clamp(b, 0, 255);

      line^[3 * x + 2] := r;
      line^[3 * x + 1] := g;
      line^[3 * x + 0] := b;
    end;
  end;

  Image1.Picture.Bitmap := hasil;
```

```
  hasil.SaveToFile('Konvolusi_Sharpen.bmp');
  hasil.Free;
end;

procedure TForm1.SpeedButton5Click(Sender: TObject);
var
  kecil: TBitmap;
begin
  kecil := TBitmap.Create;
  kecil.Width := gambar.Width div 2;
  kecil.Height := gambar.Height div 2;
  kecil.PixelFormat := pf24bit;

  kecil.Canvas.StretchDraw(Rect(0, 0, kecil.Width, kecil.Height), gambar);

  Image1.Picture.Bitmap := kecil;
  kecil.SaveToFile('Kompresi_Resize.bmp');
  kecil.Free;
end;

procedure TForm1.SpeedButton6Click(Sender: TObject);
var
  i, j: Integer;
  p: PByteArray;
begin
  for j := 0 to gambar.Height - 1 do
  begin
    p := gambar.ScanLine[j];
    for i := 0 to gambar.Width - 1 do
    begin
      p[i * 3] := (p[i * 3] div 64) * 64;
      p[i * 3 + 1] := (p[i * 3 + 1] div 64) * 64;
      p[i * 3 + 2] := (p[i * 3 + 2] div 64) * 64;
    end;
  end;

  Image1.Picture.Bitmap := gambar;
  gambar.SaveToFile('Kompresi_Kuantisasi.bmp');
end;

procedure TForm1.SpeedButton7Click(Sender: TObject);
var
  i, j: Integer;
  p: PByteArray;
  bright: Integer;
begin
  bright := 40;
```

```
  for j := 0 to gambar.Height - 1 do
  begin
    p := gambar.ScanLine[j];
    for i := 0 to gambar.Width - 1 do
    begin
      p[i * 3] := Clamp(p[i * 3] + bright, 0, 255);
      p[i * 3 + 1] := Clamp(p[i * 3 + 1] + bright, 0, 255);
      p[i * 3 + 2] := Clamp(p[i * 3 + 2] + bright, 0, 255);
    end;
  end;

  Image1.Picture.Bitmap := gambar;
  gambar.SaveToFile('Treatment_Pencerahan.bmp');
end;

procedure TForm1.SpeedButton8Click(Sender: TObject);
var
  i, j: Integer;
  p: PByteArray;
begin
  for j := 0 to gambar.Height - 1 do
  begin
    p := gambar.ScanLine[j];
    for i := 0 to gambar.Width - 1 do
    begin
      p[i * 3] := 255 - p[i * 3];
      p[i * 3 + 1] := 255 - p[i * 3 + 1];
      p[i * 3 + 2] := 255 - p[i * 3 + 2];
    end;
  end;

  Image1.Picture.Bitmap := gambar;
  gambar.SaveToFile('Invert.bmp');
end;

procedure TForm1.SpeedButton9Click(Sender: TObject);
begin
  Close;
end;

end.
```

Source Code 2:

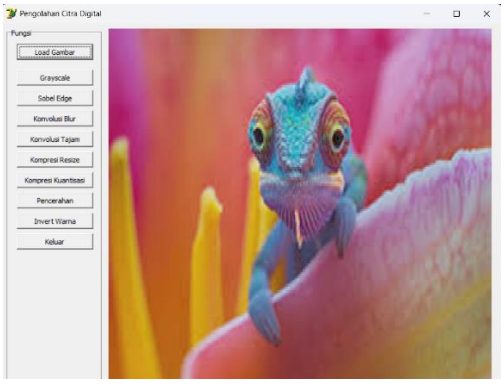
```
object Form1: TForm1
  Left = 200
  Top = 100
  Width = 800
  Height = 600
  Caption = 'Pengolahan Citra Digital'
  Color = clBtnFace
  Font.Charset = DEFAULT_CHARSET
  Font.Color = clWindowText
  Font.Height = -11
  Font.Name = 'Tahoma'
  Font.Style = []
  OldCreateOrder = False
  OnCreate = FormCreate
  PixelsPerInch = 96
  TextHeight = 13
  object GroupBox1: TGroupBox
    Left = 8
    Top = 8
    Width = 150
    Height = 550
    Caption = 'Fungsi'
    TabOrder = 0
    object BitBtn1: TBitBtn
      Left = 16
      Top = 24
      Width = 120
      Height = 25
      Caption = 'Load Gambar'
      TabOrder = 0
      OnClick = BitBtn1Click
    end
    object SpeedButton1: TSpeedButton
      Left = 16
      Top = 64
      Width = 120
      Height = 25
      Caption = 'Grayscale'
      OnClick = SpeedButton1Click
    end
    object SpeedButton2: TSpeedButton
      Left = 16
      Top = 96
      Width = 120
      Height = 25
      Caption = 'Sobel Edge'
```

```
  OnClick = SpeedButton2Click
end
object SpeedButton3: TSpeedButton
  Left = 16
  Top = 128
  Width = 120
  Height = 25
  Caption = 'Konvolusi Blur'
  OnClick = SpeedButton3Click
end
object SpeedButton4: TSpeedButton
  Left = 16
  Top = 160
  Width = 120
  Height = 25
  Caption = 'Konvolusi Tajam'
  OnClick = SpeedButton4Click
end
object SpeedButton5: TSpeedButton
  Left = 16
  Top = 192
  Width = 120
  Height = 25
  Caption = 'Kompresi Resize'
  OnClick = SpeedButton5Click
end
object SpeedButton6: TSpeedButton
  Left = 16
  Top = 224
  Width = 120
  Height = 25
  Caption = 'Kompresi Kuantisasi'
  OnClick = SpeedButton6Click
end
object SpeedButton7: TSpeedButton
  Left = 16
  Top = 256
  Width = 120
  Height = 25
  Caption = 'Pencerahan'
  OnClick = SpeedButton7Click
end
object SpeedButton8: TSpeedButton
  Left = 16
  Top = 288
  Width = 120
  Height = 25
```

```
    Caption = 'Invert Warna'
    OnClick = SpeedButton8Click
   end
   object SpeedButton9: TSpeedButton
    Left = 16
    Top = 320
    Width = 120
    Height = 25
    Caption = 'Keluar'
    OnClick = SpeedButton9Click
   end
  end
  object Image1: TImage
   Left = 168
   Top = 8
   Width = 600
   Height = 550
   Stretch = True
  end
  object OpenPictureDialog1: TOpenPictureDialog
   Filter = 'Bitmap (*.bmp)|*.bmp|JPEG (*.jpg)|*.jpg;*.jpeg|PNG (*.png)|*.png|All
Files (*.*)|*.*'
   Left = 600
   Top = 560
  end
end
```

III. Hasil Output :

1. Normal



2. Grayscale

Tujuan:
Deteksi tepi (edge detection), khususnya gradien perubahan intensitas pixel.
Cara kerja:
Menggunakan dua kernel konvolusi:

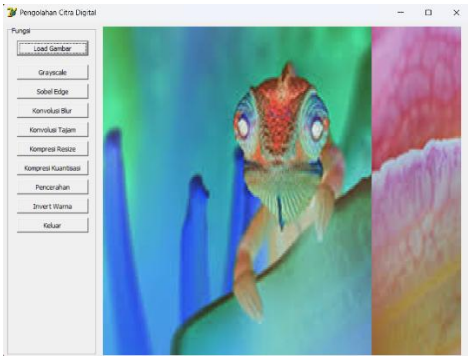
a. SobelX: mendeteksi tepi vertical
b. SobelY: mendeteksi tepi horizontal

Nilai akhir adalah penjumlahan absolut dari kedua gradien:
|Gx| + |Gy|

Manfaat:

- Menyoroti batas objek
- Penting dalam segmentasi dan pelacakan bentuk

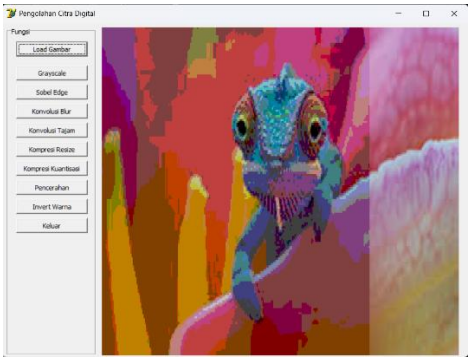
3. Invert



Tujuan:
Membalikkan warna gambar (efek negatif).
Cara kerja:
Setiap kanal warna dikurangi dari 255:
p[i] := 255 - p[i]
Manfaat:

- Digunakan untuk efek visual
- Kadang berguna untuk menyoroti fitur tersembunyi dalam gambar

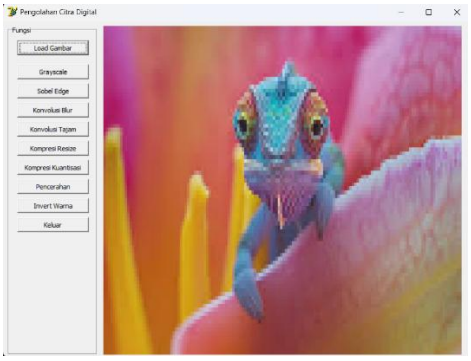
4. Kompresi Kuantisasi



Tujuan:
Mengurangi jumlah warna (depth) dalam gambar.
Cara kerja:
Membulatkan setiap kanal RGB ke kelipatan 64:
p[i] := (p[i] div 64) * 64
Manfaat:

- Menghemat penyimpanan
- Digunakan dalam teknik kompresi lossy seperti JPEG

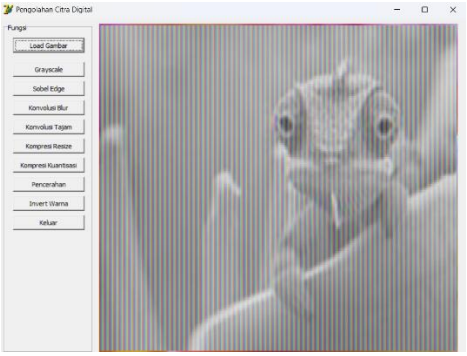
5. Kompresi Resize



Tujuan:
Mengurangi dimensi gambar (width dan height) untuk kompresi data visual.
Cara kerja:
Menggunakan StretchDraw untuk memperkecil ukuran gambar menjadi separuhnya.
Manfaat:

- Mengurangi ukuran file gambar
- Cocok untuk preview, thumbnails, atau pengiriman cepat

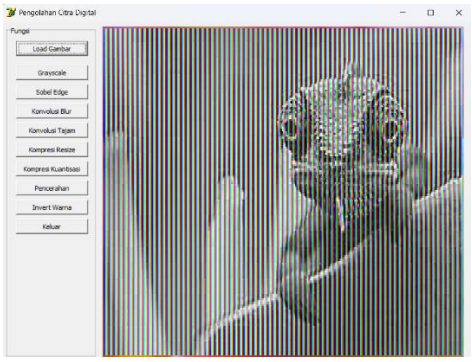
6. Konvolusi Blur



Tujuan:
Melakukan perataan (smoothing) atau mengaburkan gambar (blur).
Cara kerja:
Kernel 3x3 dengan nilai seragam (semua 1) menghasilkan efek blur ringan:
rata-rata = jumlah 9 pixel sekitarnya / 9
Manfaat:

- Mengurangi noise
- Membantu persiapan sebelum segmentasi atau deteksi tepi

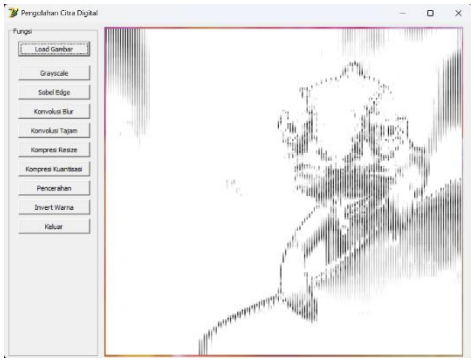
7. Konvolusi Sharpen



Tujuan:
Menajamkan gambar dengan memperkuat kontras tepi.
Cara kerja:
Kernel penajaman:
diff
Copy code
 0 -1   0
-1   5 -1
 0 -1   0
Menekankan pixel tengah dan mengurangi pengaruh tetangga.
Manfaat:

- Menonjolkan fitur penting dalam citra
- Berguna untuk visualisasi atau pre-processing analisis

8. Sobel



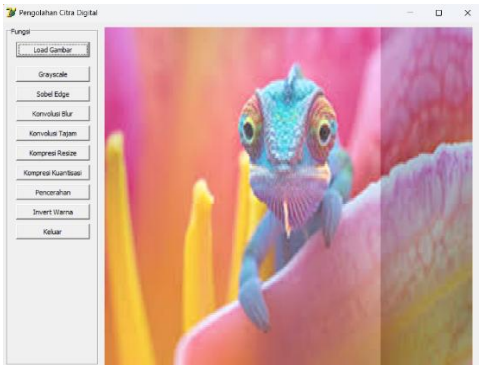
Tujuan:
Deteksi tepi (edge detection), khususnya gradien perubahan intensitas pixel.
Cara kerja:
Menggunakan dua kernel konvolusi:

- SobelX: mendeteksi tepi vertical
- SobelY: mendeteksi tepi horizontal
  Nilai akhir adalah penjumlahan absolut dari kedua gradien:
  |Gx| + |Gy|

Manfaat:

- Menyoroti batas objek
- Penting dalam segmentasi dan pelacakan bentuk

9. Treatment



Tujuan:
Meningkatkan kecerahan gambar.
Cara kerja:
Menambahkan nilai konstan (misal 40) ke setiap kanal warna, dengan Clamp() agar tetap dalam batas 0–255.
Manfaat:

- Membantu visibilitas objek dalam gambar gelap
- Persiapan sebelum proses lain seperti OCR