Fake currency recognition using edge detection

Team: Heptacone

Submitted to: Dr. Samah El-Tantawy

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Abstract

Edge detection is a fundamental tool in image processing, machine vision, and computer vision, it is used-to be specific-in feature detection and feature extraction. In our project, we are keen on showing the benefits of applying edge detection techniques on different applications. We will discuss fake currency as our application. We will discuss how linear algebra takes part in it. We will also display some algorithms used in it and how some parameters affect it.

Introduction

- Counterfeit currency detection is a significant problem in the financial industry.
- Edge detection is a powerful image processing technique that can extract unique features for currency recognition.
- Our project investigates the use of edge detection for the recognition of fake currency notes as we aim to demonstrate the potential of edge detection and what are the possible encounters that this technique will face.

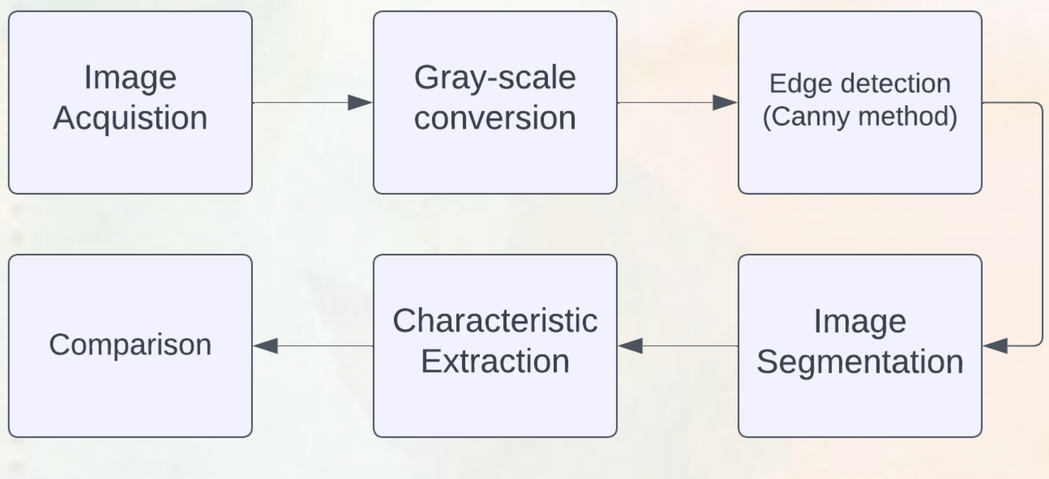
Literature Review

Many research papers have explored its potential by comparing different methods and technologies such as:

1. **A study and comparison about different edge detection techniques**
2. **Fingerprint recognition**
3. **Automated new license plate recognition in Egypt**
4. **Overview of Edge Detection Algorithms Based on Deep Learning**

Solution Methodology

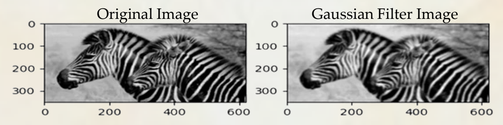
These following steps will be applied as our methodology:



Canny edge detection

The following are the steps to apply the Canny edge detection:

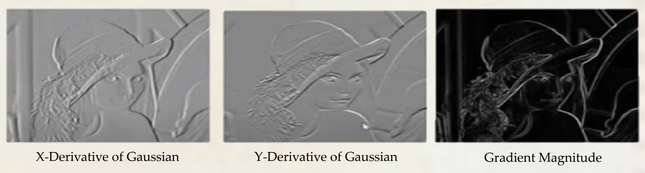
- Noise Reduction (Image smoothening):
  - $G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$



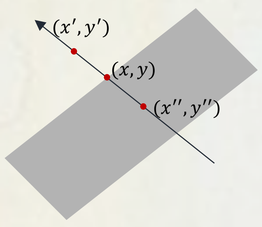
- Finding Intensity Gradient:

(S_x, S_y): Gradient Vector

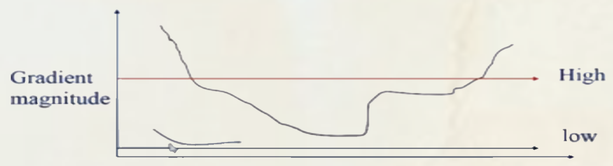
- Magnitude = $\sqrt{({S_x}^2 + {S_y}^2)}$
- Direction $(\theta) = tan^{-1}\frac{S_y}{S_x}$



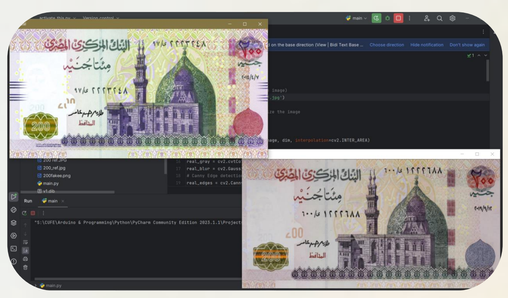
- Non-maximum Suppression:
  - $M(x,y) = \begin{cases} |\nabla S|(x,y) & if\ |\nabla S|(x,y) > |\Delta S|(x',y') \\ & ,|\Delta S|(x,y) > |\Delta S|(x'',y'') \\ 0 & otherwise \end{cases}$



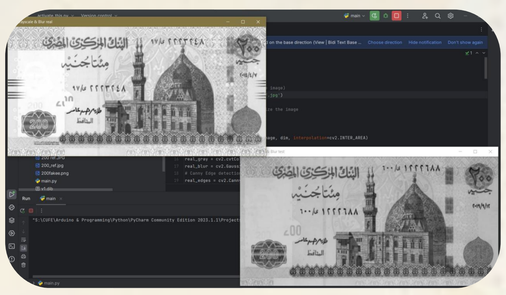
- Hysteresis Threshold:



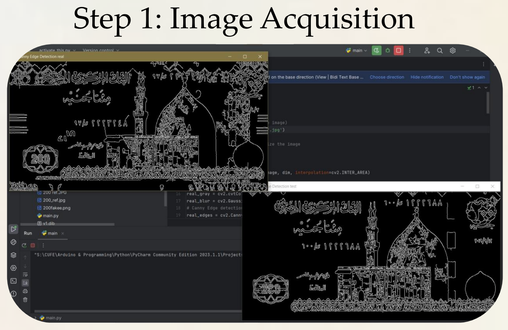
Analysis & Results



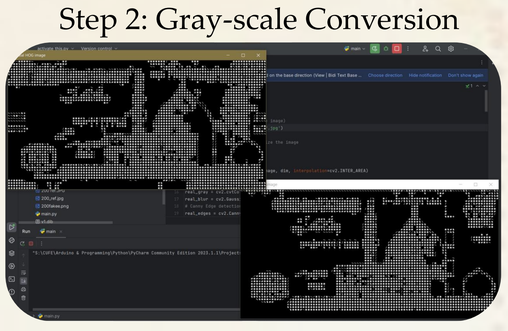
Step 1: Image Acquisition



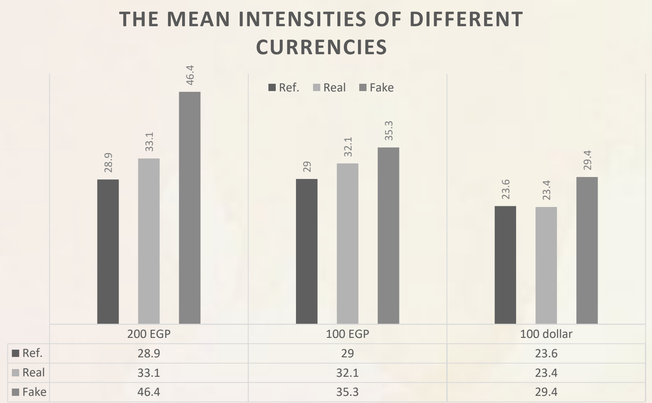
Step 2: Gray-scale Conversion



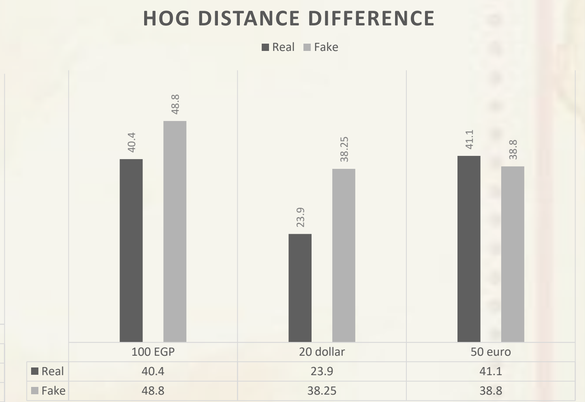
Step 3: Edge Detection



Step 4: Characteristic Extraction (HOG feature)



	200 EGP	100 EGP	100 dollar
Ref.	28.9	29	23.6
Real	33.1	32.1	23.4
Fake	46.4	35.3	29.4



	100 EGP	20 dollar	50 euro
Real	40.4	23.9	41.1
Fake	48.8	38.25	38.8

The Graphs showed how the effect of each parameter and the dataset affect the results of the test. The results was as expected for the dataset and has proven the impact of the image's quality at the results i.e., 50 Euro sample, as we tested low quality images.

Conclusion & Future Work

- Edge detection using canny can successfully be used for fake currency recognition.
- Limitations such as low-quality input images can cause detection technology to fail, so it is necessary to check specific image specifications to ensure program success.
- As a future work, we can use machine learning to enhance feature extraction by training it on a large dataset of real & fake currencies.

Done By:
Michael Hany
Yousef Elbably
Moayad Ahmed
Moamen Wael
Habiba Hatem
Shahd Attia
Sohila Ahmed

References & Our Python code