```
In [ ]: import cv2 as cv
        import pandas as pd
        import numpy as np
        from matplotlib import pyplot as plt
```

```
In [ ]: class ContagemMoedas:
            def __init__(self, image_path):
                    self.img = cv.imread(image_path)
                    self.moedas = 0
                    self.total_value = 0.00
                    self.diameters = []

            def __get_background_color(self):
                region = (0, 10, 0, 10)
                roi = self.img[region[0]:region[1], region[2]:region[3]]
                self.bg_color = np.median(roi, axis=(0, 1)).astype(np.uint8)

            def __pre_process(self):
                self.__get_background_color()
                mask = cv.inRange(self.img, self.bg_color, self.bg_color)
                self.inverted = cv.bitwise_not(mask)
                kernel = np.ones((5, 5), np.uint8)
                erosion = cv.erode(self.inverted, kernel, iterations=1)
                self.img_pre_processed = erosion

            def __detecta_moedas(self):
                edges = cv.Canny(self.img_pre_processed, 100, 200)
                self.contours, _ = cv.findContours(edges, cv.RETR_EXTERNAL, cv.CH

            def __processa_img(self):
                self.__detecta_moedas()
                for contour in self.contours:
                    area = cv.contourArea(contour)
                    approx = cv.approxPolyDP(contour, 0.02 * cv.arcLength(contour

                    if len(approx) >= 8 and area > 100:
                        (x, y, w, h) = cv.boundingRect(approx)
                        diameter = max(w, h)
                        self.diameters.append(diameter)
                        cv.drawContours(self.img, [contour], -1, (0, 255, 0), 2)

            def _moedas_real(self, diameter):
                normalized = diameter / self.max_diameter
                diameters = {
                    (0.72, 0.76): 0.10, # 10 centavos
                    (0.78, 0.83): 0.05, # 5 centavos
                    (0.84, 0.87): 0.50, # 50 centavos
                    (0.90, 0.93): 0.25, # 25 centavos
                    (0.98, 1.10): 1.00, # 1 real
                }

                for start, end in diameters:
                    if start <= normalized <= end:
                        return diameters[(start, end)]

                return 0.00  # Não identificado

            def _moedas_euro(self, diameter):
```

```python
        normalized = diameter / self.max_diameter
        diameters = {
            (0.61, 0.65): 0.01, # 1 cents
            (0.71, 0.74): 0.02, # 2 cents
            (0.76, 0.78): 0.05, # 5 cents
            (0.80, 0.83): 0.10, # 10 cents
            (0.84, 0.87): 0.20, # 20 cents
            (0.88, 0.90): 0.50, # 50 cents
            (0.92, 0.94): 1.00, # 1 euro
            (0.98, 1.10): 2.00, # 2 euros
        }

        for start, end in diameters:
            if start <= normalized <= end:
                return diameters[(start, end)]

        return 0.00  # Não identificado

    def __conta_moedas(self, moeda):
        self.max_diameter = max(self.diameters)
        for diameter in self.diameters:
            if moeda == 'real':
                self.total_value += self._moedas_real(diameter)
            elif moeda == 'euro':
                self.total_value += self._moedas_euro(diameter)
            self.moedas += 1

    def __waitUntilX(self, window):
        while True:
            k = cv.waitKey(100) & 0xFF
            if k == 27:
                break
            elif k == 113:
                break

        cv.destroyAllWindows()

    def show_image(self):
        window = cv.imshow('Moedas', self.img)
        self.__waitUntilX(window)

    def show_image_pre_processed(self):
        window = cv.imshow('Moedas', self.img_pre_processed)
        self.__waitUntilX(window)

    def get_total_value(self):
        return self.total_value

    def get_moedas(self):
        return self.moedas

    def get_diameters(self):
        return self.diameters

    def get_image(self):
        return self.img

    def get_image_pre_processed(self):
        return self.img_pre_processed
    def run(self, moeda='real'):
        self.__pre_process()
        self.__processa_img()
        self.__conta_moedas(moeda)
```

In [ ]:

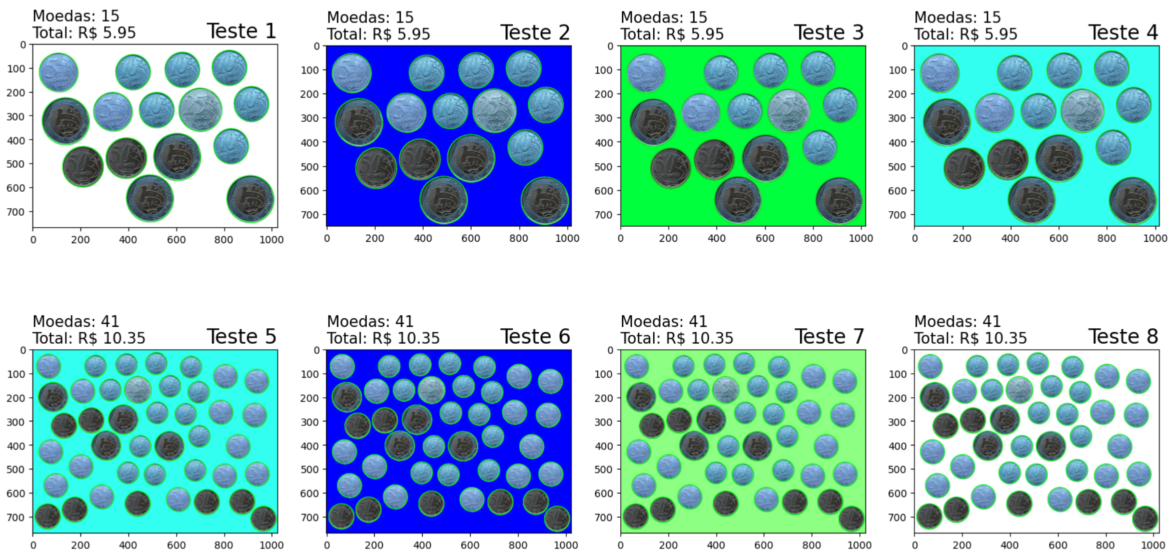
```
nTests_real = 8
df_tests = pd.DataFrame(columns=['image', 'moedas', 'total'])
contaMoedas = []

for i in range(0, nTests_real):
    image_path = f'imgs/teste{i+1}.png'
    contaMoedas.append(ContagemMoedas(image_path))
    df_tests.loc[i, ['image']] = image_path

for i in range(0, nTests_real):
    contaMoedas[i].run()
    df_tests.loc[i, ['moedas']] = contaMoedas[i].get_moedas()
    df_tests.loc[i, ['total']] = contaMoedas[i].get_total_value()

contaMoedas.append(ContagemMoedas('imgs/teste1_euro.png'))
contaMoedas[-1].run(moeda='euro')
df_tests.loc[nTests_real, ['image']] = 'imgs/teste1_euro.png'
df_tests.loc[nTests_real, ['moedas']] = contaMoedas[-1].get_moedas()
df_tests.loc[nTests_real, ['total']] = contaMoedas[-1].get_total_value()

df_tests
```

Out[ ]:

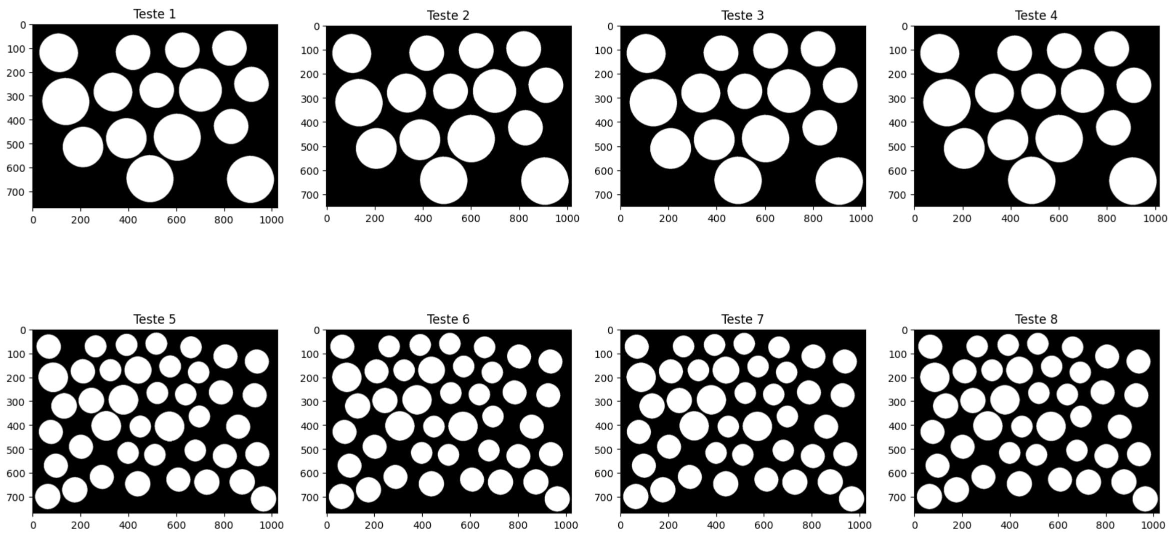
	image	moedas	total
0	imgs/teste1.png	15	5.95
1	imgs/teste2.png	15	5.95
2	imgs/teste3.png	15	5.95
3	imgs/teste4.png	15	5.95
4	imgs/teste5.png	41	10.35
5	imgs/teste6.png	41	10.35
6	imgs/teste7.png	41	10.35
7	imgs/teste8.png	41	10.35
8	imgs/teste1_euro.png	8	3.88

In [ ]:

```
plt.figure(figsize=(20,10))

for i in range(0, nTests_real):
    plt.subplot(2, 4, i+1)
    plt.title(f'Teste {i+1}', loc='right', fontsize=20)
    plt.text(0, -25,
        f'Moedas: {contaMoedas[i].get_moedas()}\nTotal: R$ {contaMoedas[i
        fontsize=15)
    plt.imshow(contaMoedas[i].get_image(), cmap='gray')

plt.savefig('export/testes_reais.png', bbox_inches='tight')
```

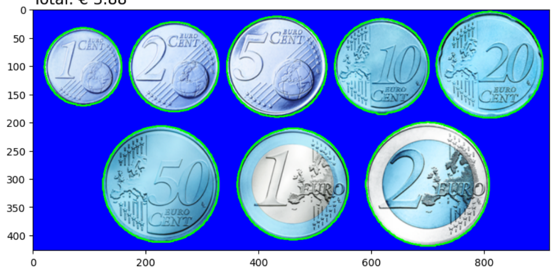


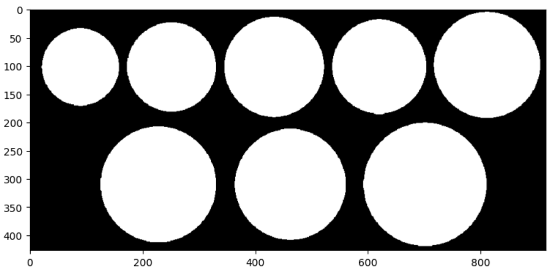
In [ ]:
```python
plt.figure(figsize=(20,10))

for i in range(0, nTests_real):
    plt.subplot(2, 4, i+1)
    plt.title(f'Teste {i+1}')
    plt.imshow(contaMoedas[i].get_image_pre_processed(), cmap='gray')

plt.savefig('export/testes_processed_imgs.png', bbox_inches='tight')
```



In [ ]:
```python
plt.figure(figsize=(20,10))
plt.subplot(1,2,1)
plt.text(0, -10,
    f'Moedas: {contaMoedas[-1].get_moedas()}\nTotal: \u20ac {contaMoedas[
    fontsize=15)
plt.imshow(contaMoedas[-1].get_image(), cmap='gray')
plt.subplot(1,2,2)
plt.imshow(contaMoedas[-1].get_image_pre_processed(), cmap='gray')

plt.savefig('export/teste_euro.png', bbox_inches='tight')
```

```
Moedas: 8
Total: € 3.88
```





```
In [ ]:
```