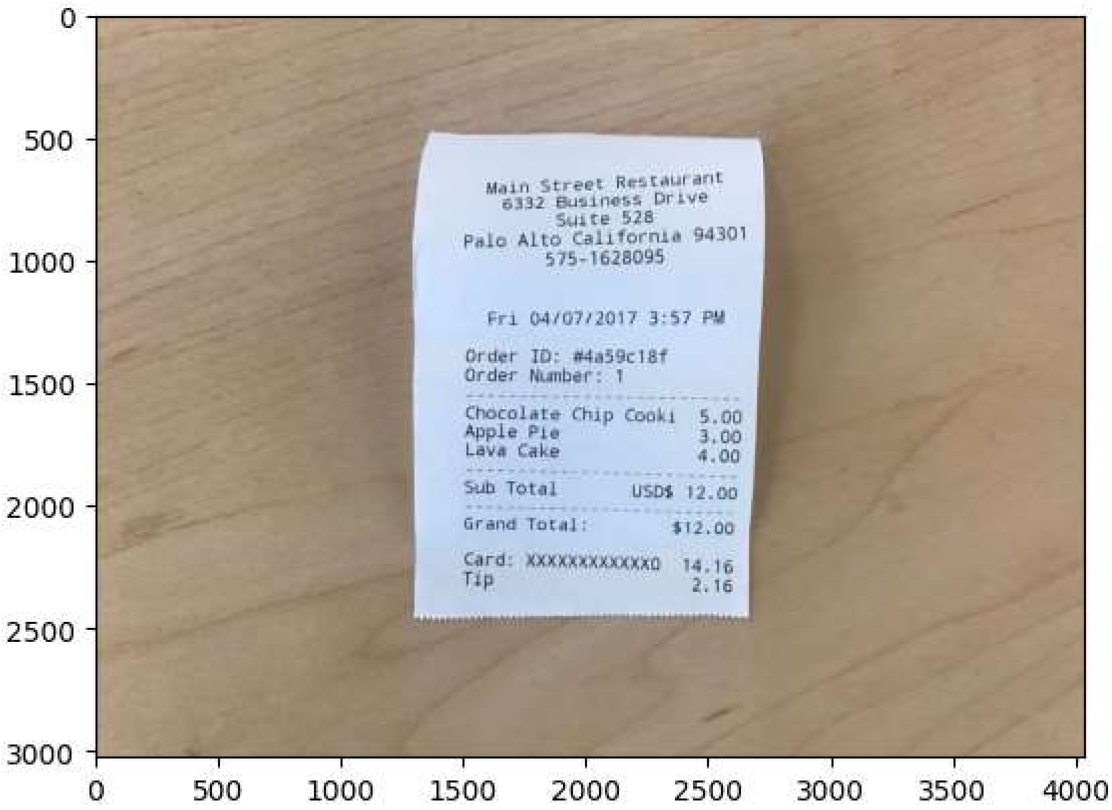
In [51]:

```
import numpy as np
import cv2
import matplotlib.pyplot as plt

from skimage.filters import threshold_local     # Local because of non-uniformity on t
from PIL import Image
```

In [52]:

```
# # Sample file out of the dataset

# Load the image
img = cv2.imread(r"C:\Users\tprat\Desktop\Project\OCR\Assignment-20230401T120858Z-001\
rgb_img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

# Display binary image
plt.imshow(rgb_img)
plt.show()


# Scale the image
scale_percent = 200
width = int(img.shape[1] * scale_percent / 100)
height = int(img.shape[0] * scale_percent / 100)
dim = (width, height)
resized = cv2.resize(img, dim, interpolation = cv2.INTER_AREA)

# Increase contrast
gray = cv2.cvtColor(resized, cv2.COLOR_BGR2GRAY)
clahe = cv2.createCLAHE(clipLimit=2.0, tileGridSize=(8,8))
contrast_img = clahe.apply(gray)

# Binarize image
threshold_value = 100
binary_img = cv2.threshold(contrast_img, threshold_value, 255, cv2.THRESH_BINARY)[1]

# # Noise removal
# kernel = np.ones((3,3),np.uint8)
# opening = cv2.morphologyEx(binary_img, cv2.MORPH_OPEN, kernel, iterations=2)
# closing = cv2.morphologyEx(opening, cv2.MORPH_CLOSE, kernel, iterations=2)

# # Skew correction
# coords = np.column_stack(np.where(closing > 0))
# angle = cv2.minAreaRect(coords)[-1]
# if angle < -45:
#     angle = -(90 + angle)
# else:
#     angle = -angle
# (h, w) = closing.shape[:2]
# center = (w // 2, h // 2)
# M = cv2.getRotationMatrix2D(center, angle, 1.0)
# rotated = cv2.warpAffine(closing, M, (w, h), flags=cv2.INTER_CUBIC, borderMode=cv2.B

# # Save skew corrected image as PNG
cv2.imwrite("Binarized.png", binary_img)

# # # Display the results

# cv2.imshow("Binarized", binary_img)
# cv2.waitKey(0)
# cv2.destroyAllWindows()
```



Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

Fri 04/07/2017 3:57 PM

Order ID: #4a59c18f
Order Number: 1

Chocolate Chip Cooki	5.00
Apple Pie	3.00
Lava Cake	4.00
Sub Total	USD$ 12.00
Grand Total:	$12.00
Card: XXXXXXXXXXXX0	14.16
Tip	2.16

Out[52]:

```
True
```

Receipt Contour Detection

to find receipt contour, standart edge detection preprocessing is applied:

In [53]:

```
def opencv_resize(image, ratio):
    width = int(image.shape[1] * ratio)
    height = int(image.shape[0] * ratio)
    dim = (width, height)
    return cv2.resize(image, dim, interpolation = cv2.INTER_AREA)
```

In [54]:

```
def plot_rgb(image):
    plt.figure(figsize=(16,10))
    return plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
```

In [55]:

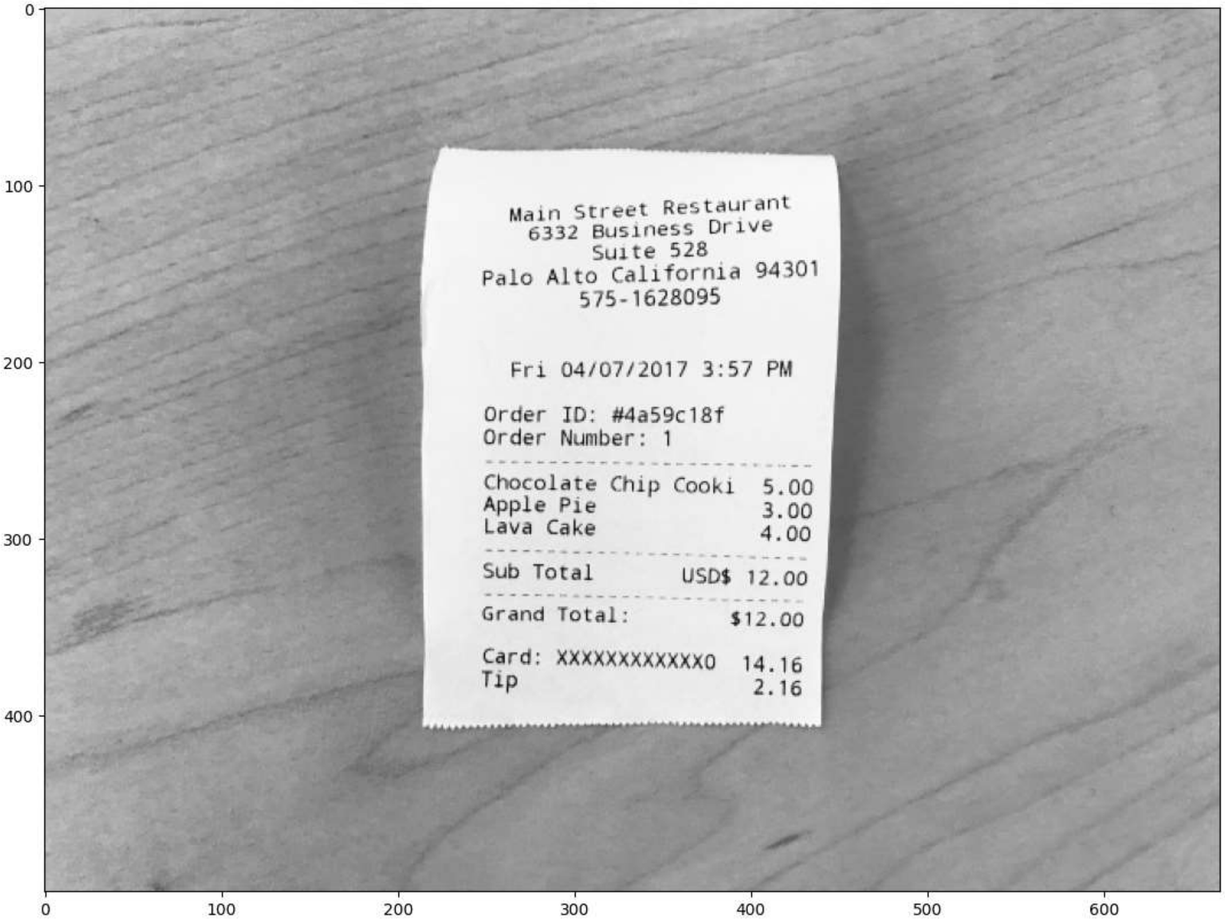
```
def plot_gray(image):
    plt.figure(figsize=(16,10))
    return plt.imshow(image, cmap='Greys_r')
```

In [56]:

```
image = img
# Downscale image as finding receipt contour is more efficient on a small image
resize_ratio = 500 / image.shape[0]
original = image.copy()
image = opencv_resize(image, resize_ratio)
```

In [57]:
```python
# Convert to grayscale for further processing
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
plot_gray(gray)
```

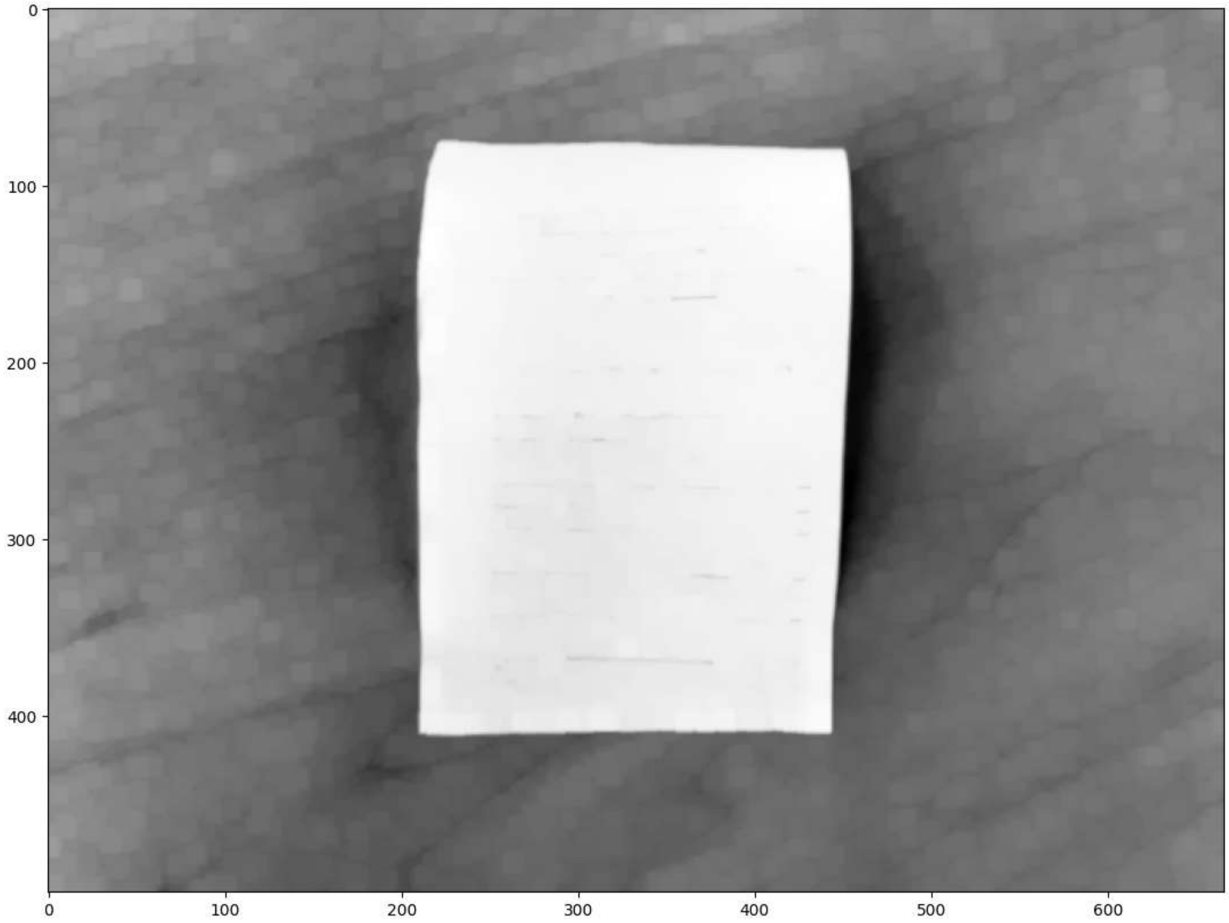
Out[57]:
```
<matplotlib.image.AxesImage at 0x2f3856b5a20>
```



```
      Main Street Restaurant
       6332 Business Drive
            Suite 528
  Palo Alto California 94301
           575-1628095

     Fri 04/07/2017 3:57 PM

  Order ID: #4a59c18f
  Order Number: 1
  ------------------------------------
  Chocolate Chip Cooki          5.00
  Apple Pie                     3.00
  Lava Cake                     4.00
  ------------------------------------
  Sub Total              USD$  12.00
  ------------------------------------
  Grand Total:                $12.00

  Card: XXXXXXXXXXXX0          14.16
  Tip                           2.16
```

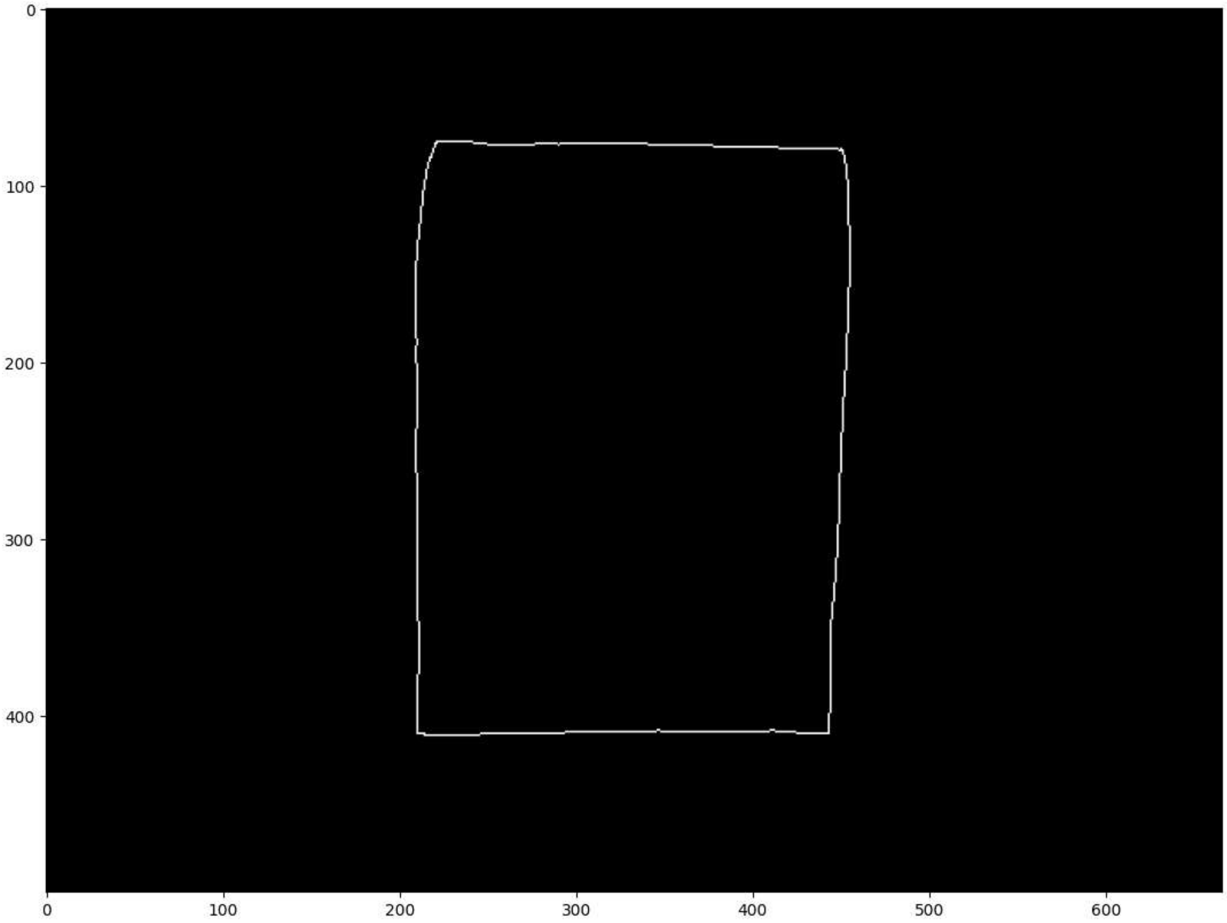
In [58]:
```python
# Get rid of noise with Gaussian Blur filter
blurred = cv2.GaussianBlur(gray, (5, 5), 0)
# plot_gray(blurred)

# Detect white regions
rectKernel = cv2.getStructuringElement(cv2.MORPH_RECT, (9, 9))
dilated = cv2.dilate(blurred, rectKernel)
plot_gray(dilated)
```

Out[58]:
```
<matplotlib.image.AxesImage at 0x2f388c001c0>
```



In [59]:
```
edged = cv2.Canny(dilated, 100, 200, apertureSize=3)
plot_gray(edged)
```

Out[59]:
```
<matplotlib.image.AxesImage at 0x2f388c5a830>
```



In [60]:

```
# Detect all contours in Canny-edged image
contours, hierarchy = cv2.findContours(edged, cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)
image_with_contours = cv2.drawContours(image.copy(), contours, -1, (0,255,0), 3)
# plot_rgb(image_with_contours)

# Get 10 largest contours
largest_contours = sorted(contours, key = cv2.contourArea, reverse = True)[:10]
image_with_largest_contours = cv2.drawContours(image.copy(), largest_contours, -1, (0,
# plot_rgb(image_with_largest_contours)
```

In [61]:

```
# approximate the contour by a more primitive polygon shape
def approximate_contour(contour):
    peri = cv2.arcLength(contour, True)
    return cv2.approxPolyDP(contour, 0.032 * peri, True)
```

In [62]:

```
def get_receipt_contour(contours):
    # loop over the contours
    for c in contours:
        approx = approximate_contour(c)
        # if our approximated contour has four points, we can assume it is receipt's r
        if len(approx) == 4:
            return approx

    return None
```

Cropping if required and perspective restoration

`cv2.warpPerspective` to restore perspective of the receipt.

- convert contour into a rectangle-like coordinate
- use rectangle points to calculate destination points of the "scanned" view
- feed destination points into `cv2.getPerspectiveTransform` to calculate transformation matrix
- and finally use `cv2.warpPerspective` to restore the perspective!

In [63]:

```
def contour_to_rect(contour):
    pts = contour.reshape(4, 2)
    rect = np.zeros((4, 2), dtype = "float32")
    # top-left point has the smallest sum
    # bottom-right has the largest sum
    s = pts.sum(axis = 1)
    rect[0] = pts[np.argmin(s)]
    rect[2] = pts[np.argmax(s)]
    # compute the difference between the points:
    # the top-right will have the minumum difference
    # the bottom-left will have the maximum difference
    diff = np.diff(pts, axis = 1)
    rect[1] = pts[np.argmin(diff)]
    rect[3] = pts[np.argmax(diff)]
    return rect / resize_ratio
```

In [64]:

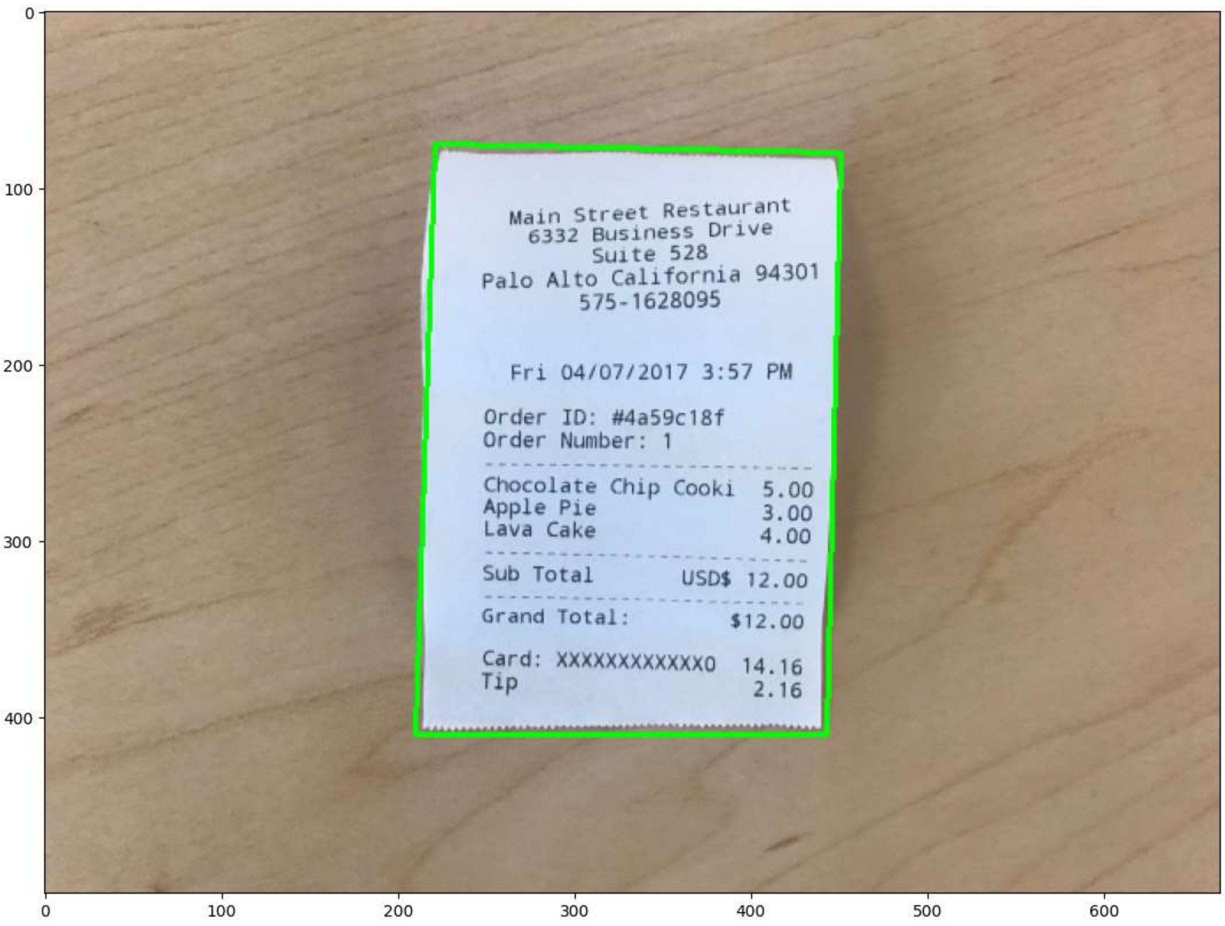
```
def wrap_perspective(img, rect):
    # unpack rectangle points: top left, top right, bottom right, bottom left
    (tl, tr, br, bl) = rect
    # compute the width of the new image
    widthA = np.sqrt(((br[0] - bl[0]) ** 2) + ((br[1] - bl[1]) ** 2))
    widthB = np.sqrt(((tr[0] - tl[0]) ** 2) + ((tr[1] - tl[1]) ** 2))
    # compute the height of the new image
    heightA = np.sqrt(((tr[0] - br[0]) ** 2) + ((tr[1] - br[1]) ** 2))
    heightB = np.sqrt(((tl[0] - bl[0]) ** 2) + ((tl[1] - bl[1]) ** 2))
    # take the maximum of the width and height values to reach
    # our final dimensions
    maxWidth = max(int(widthA), int(widthB))
    maxHeight = max(int(heightA), int(heightB))
    # destination points which will be used to map the screen to a "scanned" view
    dst = np.array([
        [0, 0],
        [maxWidth - 1, 0],
        [maxWidth - 1, maxHeight - 1],
        [0, maxHeight - 1]], dtype = "float32")
    # calculate the perspective transform matrix
    M = cv2.getPerspectiveTransform(rect, dst)
    # warp the perspective to grab the screen
    return cv2.warpPerspective(img, M, (maxWidth, maxHeight))
```

Now we can make use of helper methods defined to get a perspective version of the receipt:

In [65]:
```
def bw_scanner(image):
    # gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    T = threshold_local(image, 21, offset = 5, method = "gaussian")
    return (image > T).astype("uint8") * 255
```

In [66]:
```
def bw_scanner_box(image):
    gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
    T = threshold_local(gray, 21, offset = 5, method = "gaussian")
    return (gray > T).astype("uint8") * 255
```

In [67]:
```
if get_receipt_contour(largest_contours) is not None:
    receipt_contour = get_receipt_contour(largest_contours)
    image_with_receipt_contour = cv2.drawContours(image.copy(), [receipt_contour], -1,
    plot_rgb(image_with_receipt_contour)
    scanned = wrap_perspective(original.copy(), contour_to_rect(receipt_contour))
    plt.figure(figsize=(16,10))
    plt.imshow(scanned)
    result = bw_scanner_box(scanned)
    plot_gray(result)
else:
    scanned = binary_img.copy()
    # plt.imshow(scanned)
    result = bw_scanner(scanned)
    plot_gray(result)
```



Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

Fri 04/07/2017 3:57 PM

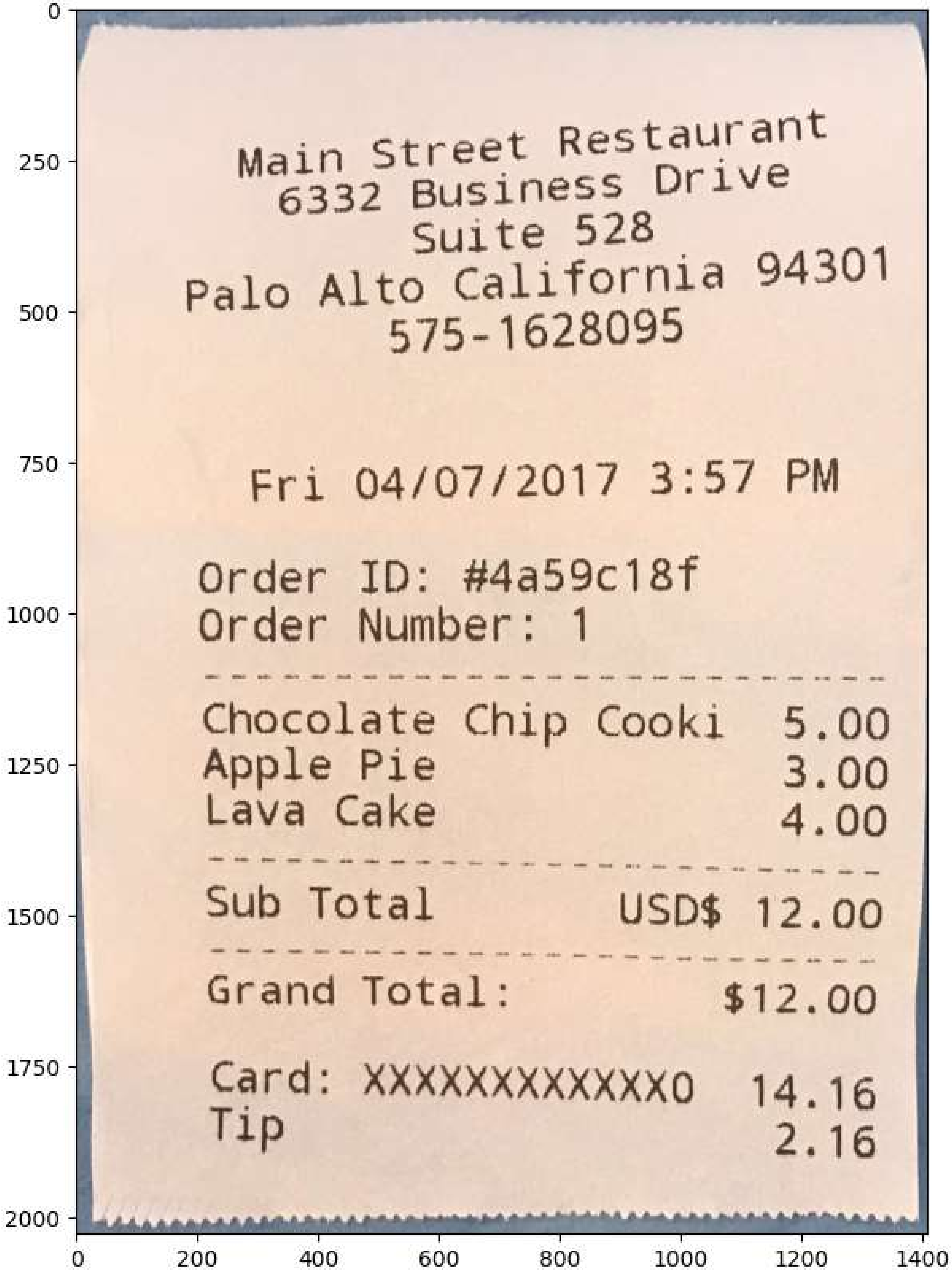
Order ID: #4a59c18f
Order Number: 1

Chocolate Chip Cooki 5.00
Apple Pie 3.00
Lava Cake 4.00

Sub Total USD$ 12.00

Grand Total: $12.00

Card: XXXXXXXXXXXX0 14.16
Tip 2.16



0
250
500
750
1000
1250
1500
1750
2000
0
200
400
600
800
1000
1200
1400

Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

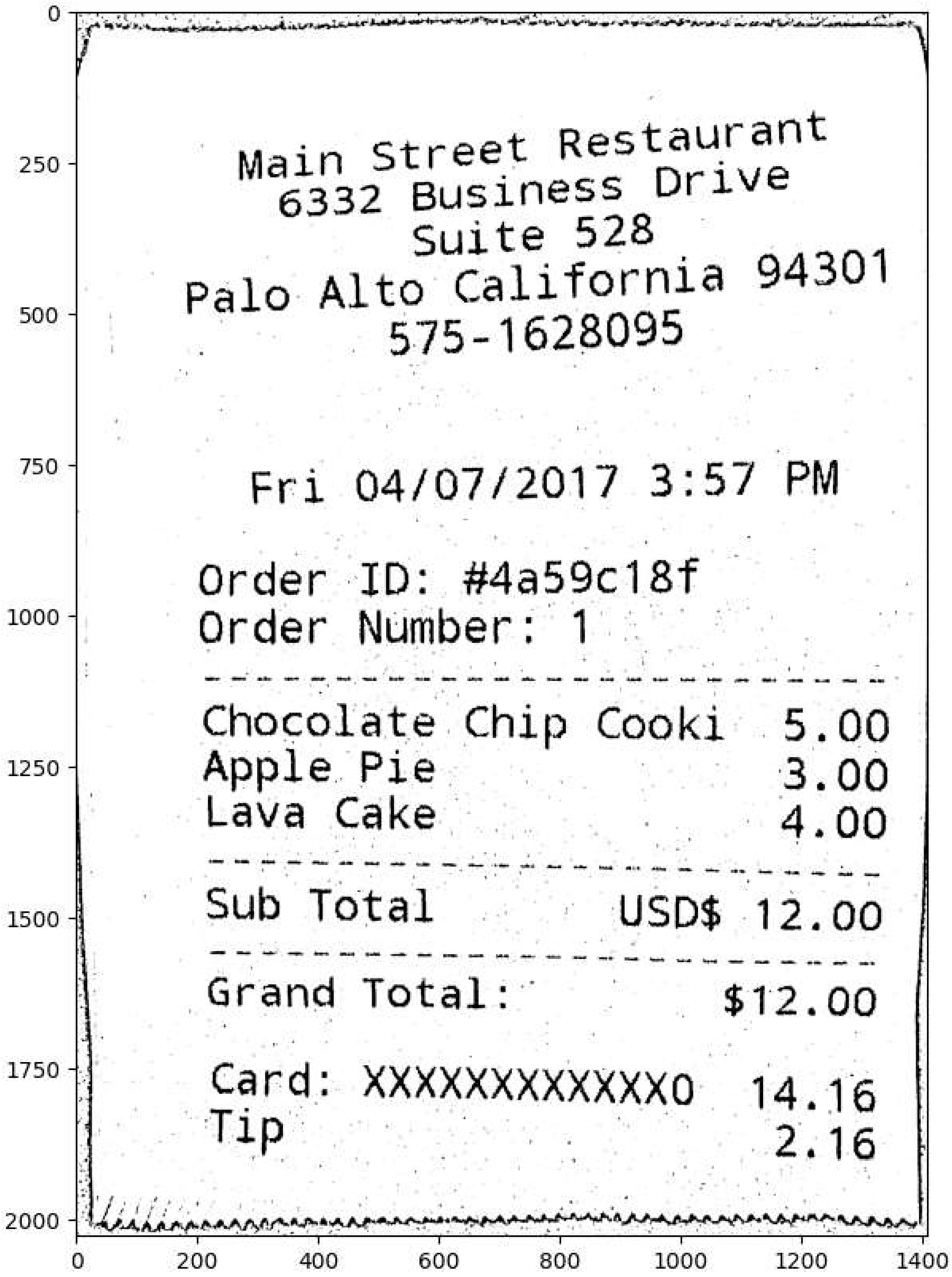
Fri 04/07/2017 3:57 PM

Order ID: #4a59c18f
Order Number: 1

Chocolate Chip Cooki	5.00
Apple Pie	3.00
Lava Cake	4.00

Sub Total	USD$ 12.00

Grand Total:	$12.00
Card: XXXXXXXXXXXX0	14.16
Tip	2.16



Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

Fri 04/07/2017 3:57 PM

Order ID: #4a59c18f
Order Number: 1

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Lava Cake	4.00

Sub Total USD$ 12.00

Grand Total: $12.00

Card: XXXXXXXXXXXX0 14.16
Tip 2.16

0
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1000
1250
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0
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400
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800
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1200
1400

Now the final part - obtain black and white scanner effect with the color transformation:

In [68]:
```
output = Image.fromarray(result)
output.save('result.png')
```

We are done with the first part of the *Receipt OCR with OpenCV* series!

Let's recap:

- At first, we have applied OpenCV preprocessing to get rid of noise and detect contours
- Next, we used heuristics and contour approximation methods to find contour of the receipt
- Finally, we used perspective transformation to obtain top-down view of the receipt

The transformed image is ready for Optical Character Recognition (OCR) which is covered in the next notebook of the series.

In [69]:

```
import numpy as np
import cv2
import matplotlib.pyplot as plt
import pytesseract
import re

from pytesseract import Output
```

Defining helper methods:

In [70]:

```
def plot_gray(image):
    plt.figure(figsize=(16,10))
    return plt.imshow(image, cmap='Greys_r')
def plot_rgb(image):
    plt.figure(figsize=(16,10))
    return plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
```

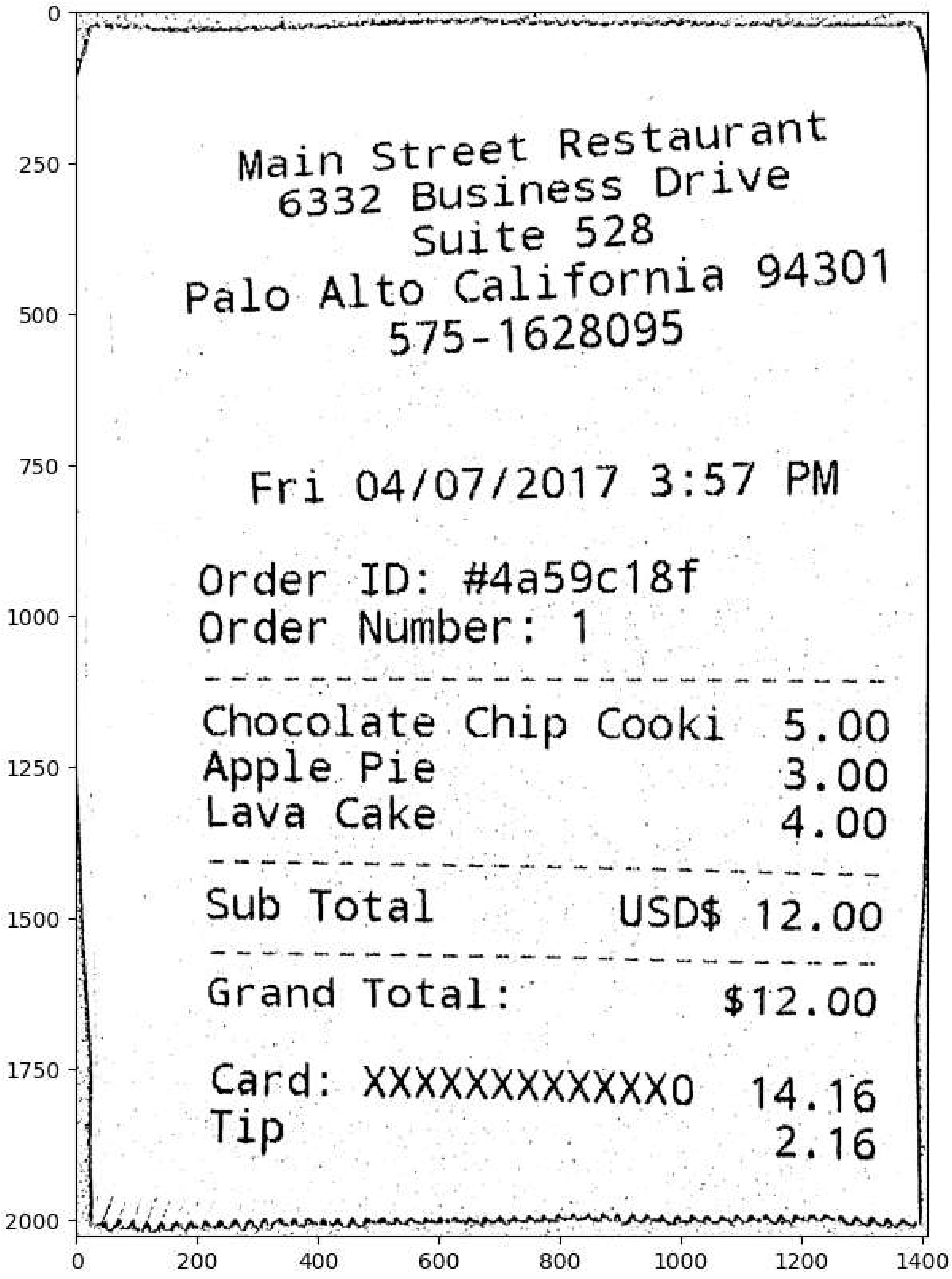
We will use a scanned version of the receipt, which result.png

In [71]:

```
file_name = r"C:\Users\tprat\Desktop\Project\OCR\result.png"
image = cv2.imread(file_name, cv2.IMREAD_GRAYSCALE)
plot_gray(image)
```

Out[71]:

```
<matplotlib.image.AxesImage at 0x2f39192b820>
```


0
250
500
750
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1250
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0
200
400
600
800
1000
1200
1400

Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

Fri 04/07/2017 3:57 PM

Order ID: #4a59c18f
Order Number: 1

Chocolate Chip Cooki 5.00
Apple Pie 3.00
Lava Cake 4.00

Sub Total USD$ 12.00

Grand Total: $12.00

Card: XXXXXXXXXXXX0 14.16
Tip 2.16

In [72]:

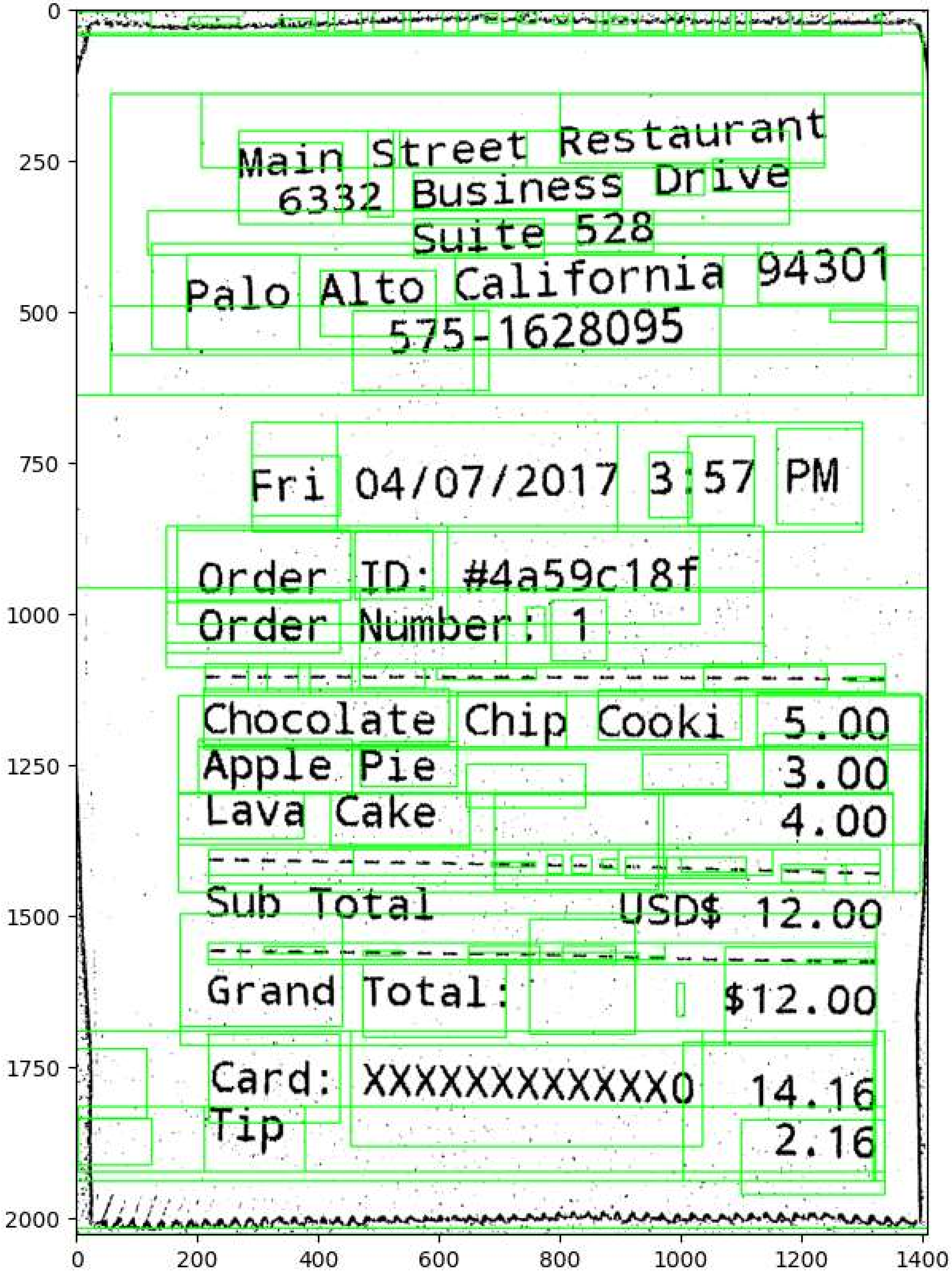
```
# Text box detection
pytesseract.pytesseract.tesseract_cmd = r'C:/Program Files/Tesseract-OCR/tesseract.exe

d = pytesseract.image_to_data(image, output_type=Output.DICT)
n_boxes = len(d['level'])
boxes = cv2.cvtColor(image.copy(), cv2.COLOR_BGR2RGB)
for i in range(n_boxes):
    (x, y, w, h) = (d['left'][i], d['top'][i], d['width'][i], d['height'][i])
    boxes = cv2.rectangle(boxes, (x, y), (x + w, y + h), (0, 255, 0), 2)

plot_rgb(boxes)
```

Out[72]:

```
<matplotlib.image.AxesImage at 0x2f3872924d0>
```


0
250
500
750
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1250
1500
1750
2000
0
200
400
600
800
1000
1200
1400

Main Street Restaurant
6332 Business Drive
Suite 528
Palo Alto California 94301
575-1628095

Fri 04/07/2017 3:57 PM

Order ID: #4a59c18f
Order Number: 1

Chocolate Chip Cooki	5.00
Apple Pie	3.00
Lava Cake	4.00
Sub Total	USD$ 12.00
Grand Total:	$12.00
Card: XXXXXXXXXXXX0	14.16
Tip	2.16

In [73]:

```
# Text recognition
extracted_text = pytesseract.image_to_string(image)
print(extracted_text)
```

```
Lge iets: dake soe Lees Reali net be 8 Cat Te A Moca ag Fh rata NS Wd ASS cai eternal
ei a

| treet Restaurant
main > Business Dr ive
: ! Suite 528 © |
, Palo Alto California 94301
: —575- “1628095” re

Fri. 04/07/2017 3: 57 PM

“order. Ip: #4a59C18F
Order. Number + 1

eel dee eae oe ee ne as

Chocolate Chip Cooki. 5.00.
Apple. Pie. hee oS 3.00
-Lava Cake Hs 4300

a ae ae ae
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Te ee

me nae

Cai ie oe naa
ee eee
me

Bane Total: oe : $12.00

| card: OEHEORAKKD A446
fo TARE “B16
```

Extract info on Invoice No. and grand total

In [74]:

```python
def find_amounts(text):
    decimal_numbers = re.findall(r'(\d+\s*\.\s*\d{2})\b', text)
    print(decimal_numbers)
    decimal_numbers = [float(re.sub(r'\s+', '', num)) for num in decimal_numbers]
    unique = list(dict.fromkeys(decimal_numbers))
    return unique
```

In [75]:

```python
def find_invoice_no(text):
    patterns = [
        r'Invoice Number\s*(\d+)',
        r'Invoice No :\s*(\d+)',
        r'Invoice No\s+(\d+)',
        r'Invoice Number\s+(\d+)',
        r'Bill No\. :\s*(\d+)',
        r'Qrder No:\s*([A-Za-z0-9]+)',
        r'B1ll Ho\.:([\w\-\/]+)'

    ]
    for pattern in patterns:
        match = re.search(pattern, text)
        if match:
            return match.group(1)

    return None
```

In [76]:

```
amounts = find_amounts(extracted_text)
print(f'All amounts ending with .00 are : {amounts}')
# Grand total is the largest one

print(f"Grand total is the largest one : {max(amounts)}")
```

```
['5.00', '3.00', '12.00']
All amounts ending with .00 are : [5.0, 3.0, 12.0]
Grand total is the largest one : 12.0
```

In [77]:

```
# Invoice no. will be after "Invoice No :"  , also you can add all the possibility of
invoice_no = find_invoice_no(extracted_text)
print(f'Invoice/Bill Number : {invoice_no}')   # perfect solution to this will be NER
```

```
Invoice/Bill Number : None
```