Bangladesh University of Engineering and Technology

Department Of Electrical and Electronic Engineering

Assignment Report

Course: EEE 447 (Digital Image Processing)

Submitted To.

Dr. Mohammad Ariful Haque

Professor

Department of EEE, BUET

Submitted By.

Kazi Ahmed Akbar Munim

Student ID: 1906006

Major: CSP

Date of Submission: 06-01-2024

Overview

This assignment includes three parts-

1. Image Registration

2. Information Extraction

3. MCQ Answer Sheet Evaluation

Image Registration:

In this section, an input image is aligned with a reference image. At first, key points are found in both images, and they are matched against each other to find the relation between their positions. At last, geometric transformation is done on the input image to align it with reference image.

Information Extraction:

Different types of information are extracted from input image like name, batch, mobile, test date, roll number and test id. These are obtained by performing OCR (optical character recognition) on input image. OCR is a machine learning based image processing technique which can recognize alphabets, digits, special characters etc. in a document. Here, Google's Tesseract-OCR Engine is used, which is a widely used open-source OCR Engine. To reduce the number of errors, pre-processing (grayscale, thresholding, noise removal, increase contrast) the input image and post-filtering the output is necessary.

MCQ Answer Sheet Evaluation:

In mcq answer sheet, options (circles) are detected with HoughCircles function and then marked circles are detected by counting the number of black pixel inside the circles. Later, marked options are matched against a given answer list and marks are given.

Language: Python

Library: OpenCV

Platform: Google Colab

Assignment GitHub Link:

https://github.com/AhmedMunim/Image-registration-OCR-OMR

Phase 1: Image Registration

Steps at a glance:

1.1 Read and display template and input image

1.2 Find key points in both image

1.3 Match key points in both image

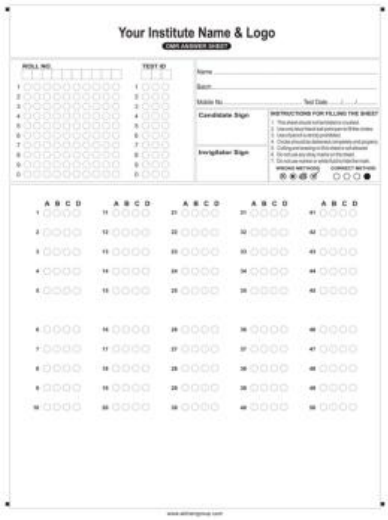
1.4 Find homography

1.5 Warp input image according to homography and display output

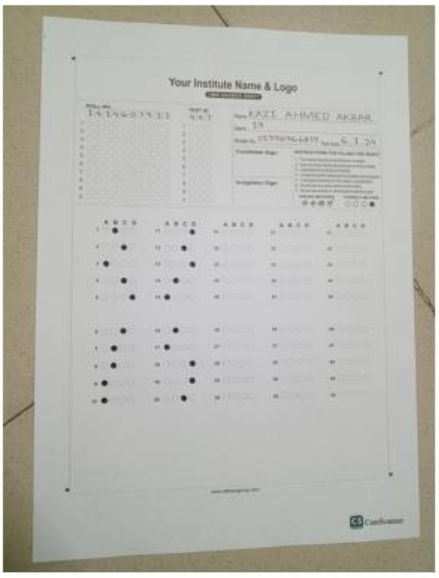
Step 1.1 : Read and display template and input image

```
# Read reference image
ref_image_path = "/content/reference_form.jpeg"
print("Reading reference image:", ref_image_path)
im1 = cv2.imread(ref_image_path)
im1 = cv2.cvtColor(im1, cv2.COLOR_BGR2RGB)

# Read image to be aligned
input_imagee_path = "/content/test15.jpg"
print("Reading image to align:", input_imagee_path)
im2 = cv2.imread(input_imagee_path)
im2 = cv2.cvtColor(im2, cv2.COLOR_BGR2RGB)

# Display Images
plt.figure(figsize=[10, 5]);
plt.subplot(121); plt.axis('off'); plt.imshow(im1); plt.title("Original
Form")
plt.subplot(122); plt.axis('off'); plt.imshow(im2); plt.title("Scanned
Form")
```

Original Form



Scanned Form



Step 1.2 : Find key points in both image

2000 key points will be created in each image.

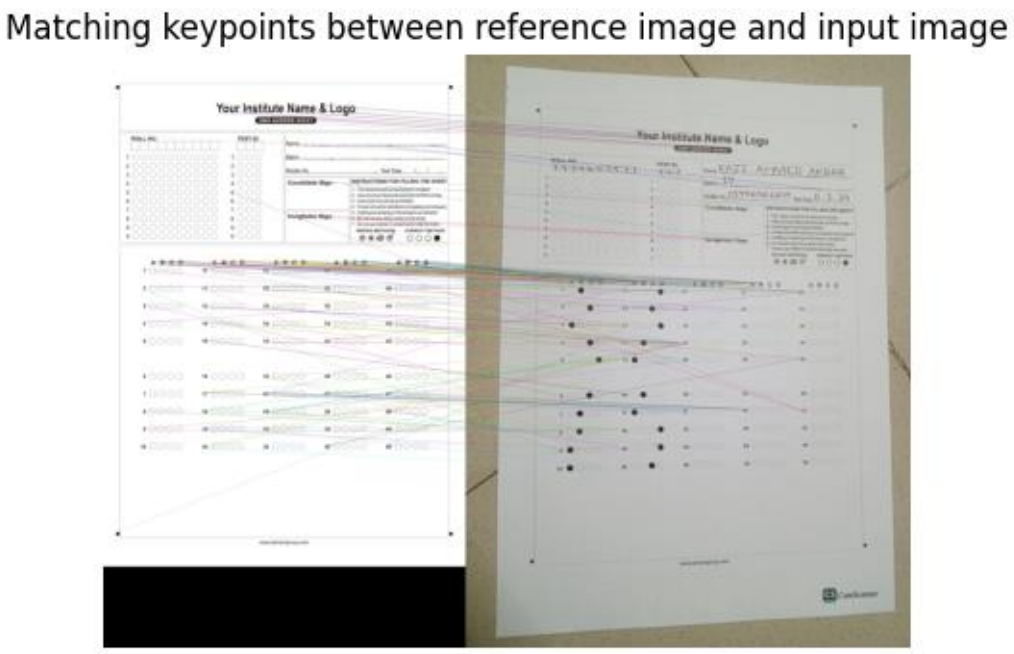
```
# Convert images to grayscale
im1_gray = cv2.cvtColor(im1, cv2.COLOR_RGB2GRAY)
im2_gray = cv2.cvtColor(im2, cv2.COLOR_RGB2GRAY)

# Detect ORB features and compute descriptors.
MAX_NUM_FEATURES = 2000
orb = cv2.ORB_create(MAX_NUM_FEATURES)
keypoints1, descriptors1 = orb.detectAndCompute(im1_gray, None)
keypoints2, descriptors2 = orb.detectAndCompute(im2_gray, None)

# Display
im1_display = cv2.drawKeypoints(im1, keypoints1, outImage=np.array([]),
                                color=(255, 0, 0),
flags=cv2.DRAW_MATCHES_FLAGS_DRAW_RICH_KEYPOINTS)

im2_display = cv2.drawKeypoints(im2, keypoints2, outImage=np.array([]),
                                color=(255, 0, 0),
flags=cv2.DRAW_MATCHES_FLAGS_DRAW_RICH_KEYPOINTS)

# Display Step 2 result
plt.figure(figsize=[20,10])
plt.subplot(121); plt.axis('off'); plt.imshow(im1_display);
plt.title("Original Form");
plt.subplot(122); plt.axis('off'); plt.imshow(im2_display);
plt.title("Scanned Form");
```

Original Form

Scanned Form

Step 1.3 : Match key points in both image

```
# Match features.
matcher =
cv2.DescriptorMatcher_create(cv2.DESCRIPTOR_MATCHER_BRUTEFORCE_HAMMING)

# Converting to list for sorting as tuples are immutable objects.
matches = list(matcher.match(descriptors1, descriptors2, None))

# Sort matches by score
matches.sort(key=lambda x: x.distance, reverse=False)

# Remove not so good matches
numGoodMatches = int(len(matches) * 0.1)
matches = matches[:numGoodMatches]

# Draw top matches
im_matches = cv2.drawMatches(im1, keypoints1, im2, keypoints2, matches,
None)

# Display Step 3 result
plt.figure(figsize=[8, 4])
plt.imshow(im_matches);plt.axis("off");plt.title("Matching keypoints
between reference image and input image")
```



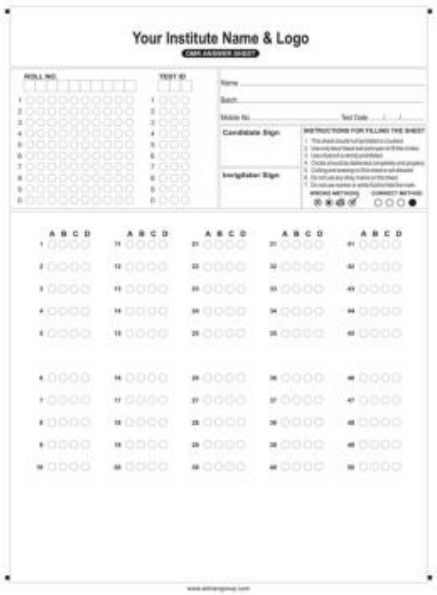
Step 1.4 : Find Homography

```
# Extract location of good matches
points1 = np.zeros((len(matches), 2), dtype=np.float32)
points2 = np.zeros((len(matches), 2), dtype=np.float32)

for i, match in enumerate(matches):
    points1[i, :] = keypoints1[match.queryIdx].pt
    points2[i, :] = keypoints2[match.trainIdx].pt

# Find homography
h, mask = cv2.findHomography(points2, points1, cv2.RANSAC)
```

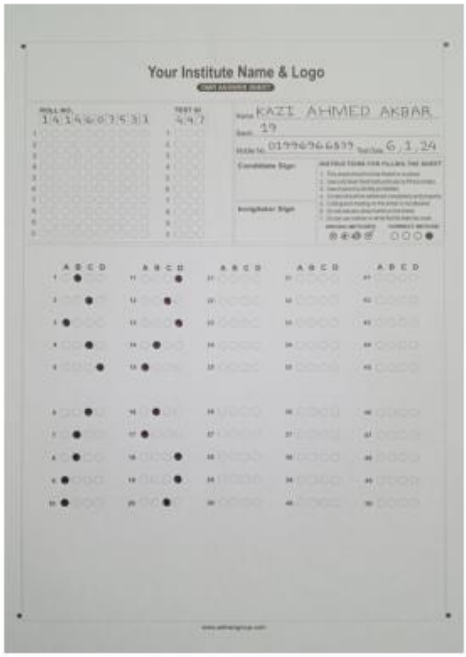
Step 1.5 : Warp input image according to homography and display output

```
# Use homography to warp image
height, width, channels = im1.shape
im2_reg = cv2.warpPerspective(im2, h, (width, height))
reg_image_path = "/content/registered_form.jpg"
cv2.imwrite(reg_image_path, im2_reg)

# Display results
plt.figure(figsize=[10, 5])
plt.subplot(121);plt.imshow(im1);    plt.axis("off");plt.title("Origina
l Form")
plt.subplot(122);plt.imshow(im2_reg);plt.axis("off");plt.title("Scanned
Form")
```

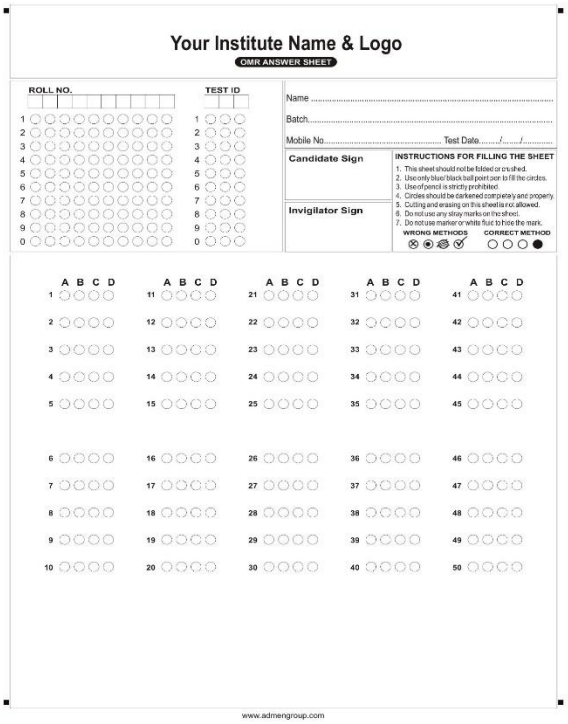
Original Form



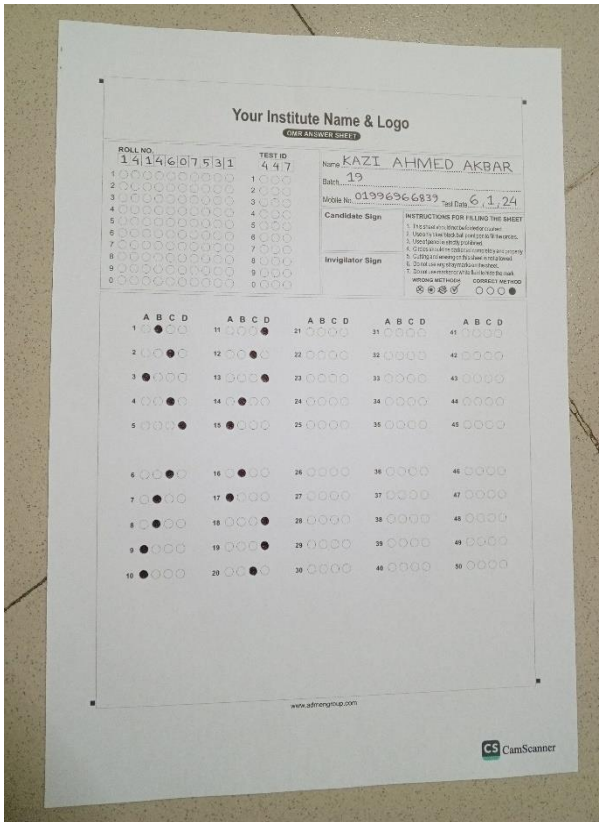
Scanned Form

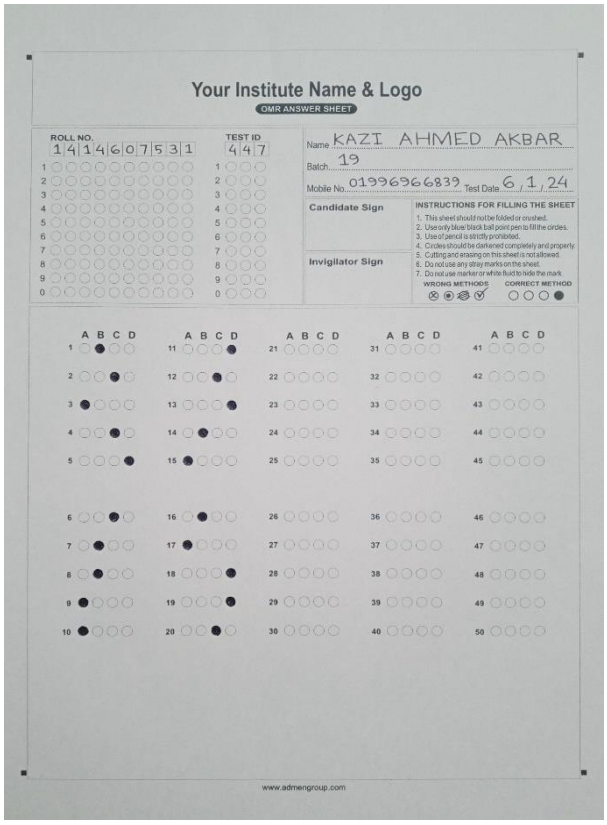


Reference Image:

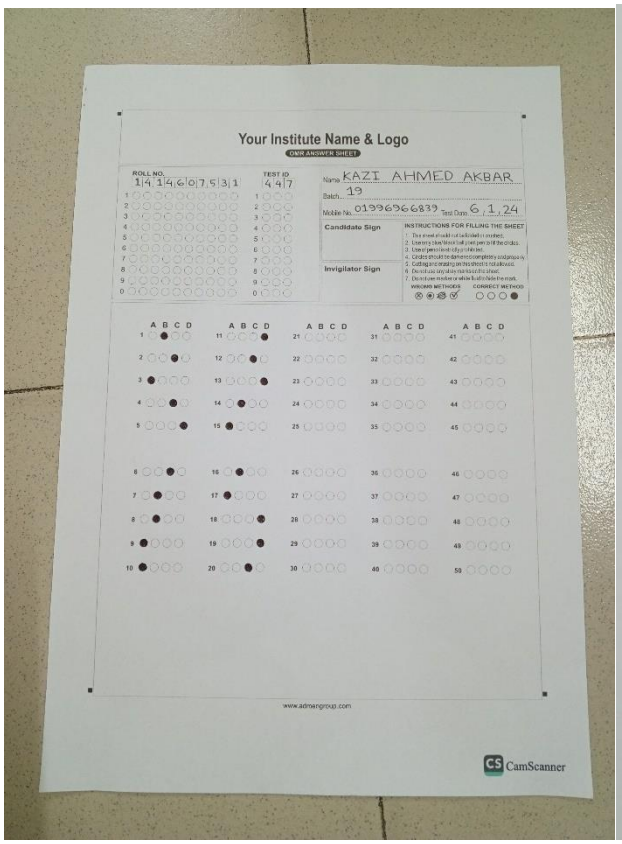


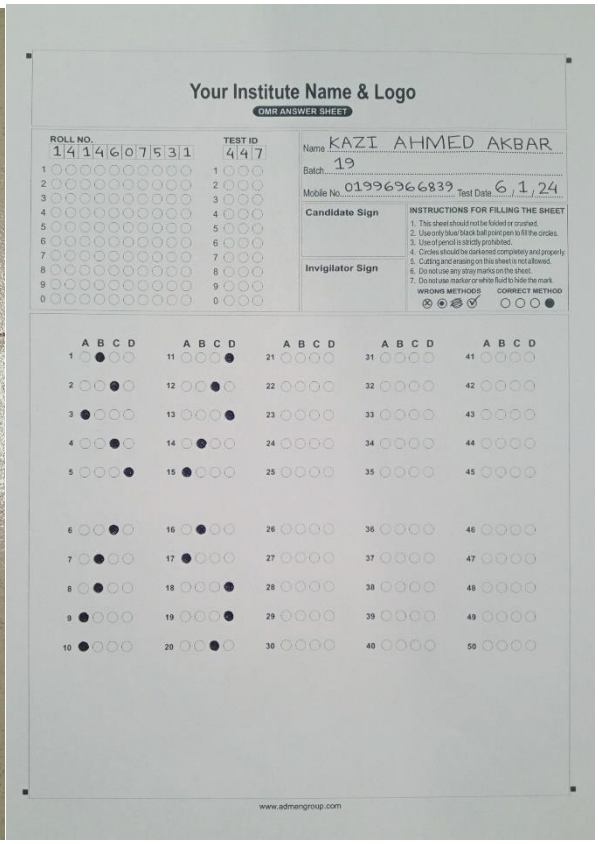
Input Image and Registered Image (1)



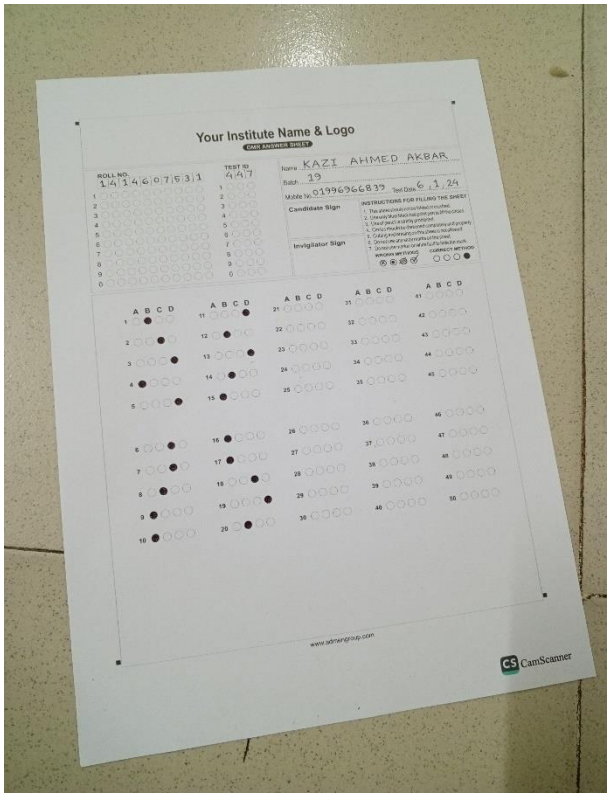


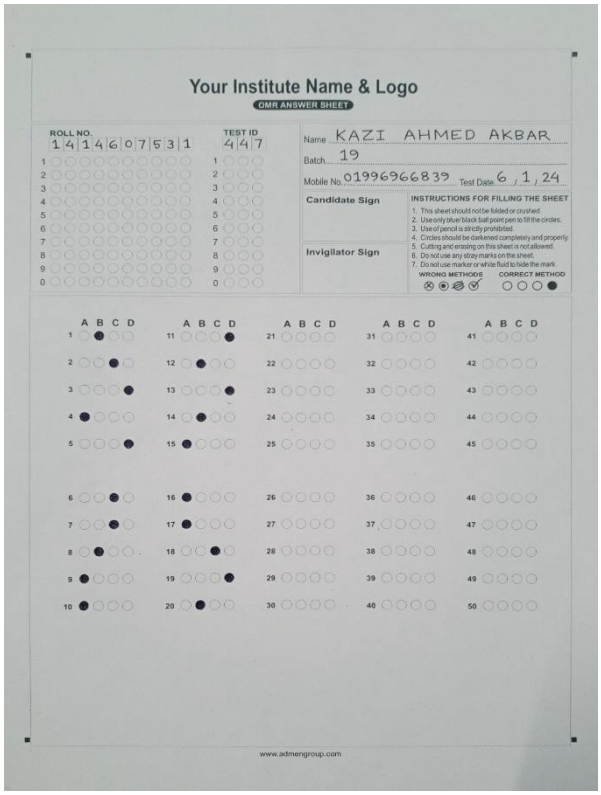
Input Image and Registered Image (2)





Input Image and Registered Image (3)





Phase 2: Information Extraction

Steps at a glance

2.1 Selecting different ROI (region of interest)

2.2 Defining necessary functions

2.3 Image Pre-processing (Grayscale)

2.4 Image Pre-processing (Threshold)

2.5 Image Pre-processing (Noise Removal)

2.6 Image Pre-processing (Increase contrast)

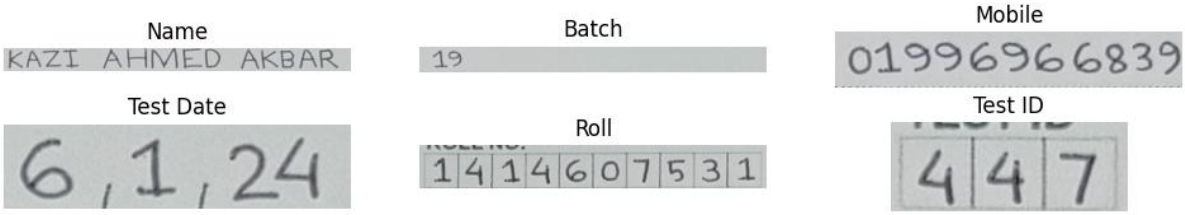
2.7 OCR

Step 2.1 : Selecting Different ROIs

I have defined some area in the registered image where OCR will be performed. These values are obtained by studying the reference image. This step is necessary since performing OCR on the whole document will give undesired output.

```
import matplotlib.image as mpimg

def define_and_save_roi(image_path, x, y, width, height, output_path):
    # Read the image
    img = cv2.imread(image_path)

    # Extract the region of interest (ROI) based on the specified
coordinates and dimensions
    roi = img[y:y+height, x:x+width]

    # Save the defined area to the specified output directory
    cv2.imwrite(output_path, roi)

# Provide the path to your image file, the coordinates of the upper-
left corner pixel,
# width, height, and the output directory
image_path = "/content/registered_form.jpg"

# Name field
name_path = "/content/name.jpg"
define_and_save_roi(image_path, 1350, 550, 995, 65, name_path)
name_roi = mpimg.imread(name_path)
```

```
# Batch field
batch_path = "/content/batch.jpg"
define_and_save_roi(image_path, 1344, 630, 1006, 77, batch_path)
batch_roi = mpimg.imread(batch_path)

# Mobile field
mobile_path = "/content/mobile.jpg"
define_and_save_roi(image_path, 1410, 730, 475, 75, mobile_path)
mobile_roi = mpimg.imread(mobile_path)

# Test Date field
test_date_path = "/content/test_date.jpg"
define_and_save_roi(image_path, 2048, 725, 308, 75, test_date_path)
test_date_roi = mpimg.imread(test_date_path)

# Roll field
roll_path = "/content/roll.jpg"
define_and_save_roi(image_path, 180, 580, 620, 75, roll_path)
roll_roi = mpimg.imread(roll_path)

# Test ID field
test_id_path = "/content/test_id.jpg"
define_and_save_roi(image_path, 906, 580, 200, 75, test_id_path)
test_id_roi = mpimg.imread(test_id_path)

# Display different roi
plt.figure(figsize=[12,2])
plt.subplot(231);plt.imshow(name_roi);    plt.axis("off");plt.title("Na
me")
plt.subplot(232);plt.imshow(batch_roi);plt.axis("off");plt.title("Batch
")
plt.subplot(233);plt.imshow(mobile_roi);    plt.axis("off");plt.title("
Mobile")
plt.subplot(234);plt.imshow(test_date_roi);    plt.axis("off");plt.titl
e("Test Date")
plt.subplot(235);plt.imshow(roll_roi);    plt.axis("off");plt.title("Ro
ll")
plt.subplot(236);plt.imshow(test_id_roi);    plt.axis("off");plt.title(
"Test ID")
```



Step 2.2 : Defining necessary functions

Grayscale: Converts color (BGR) image to grayscale image.

Binary: Performs a threshold operation to produce a binary image.

Noise Removal: Removes undesired noise.

Thick Font: Increase contrast.

Digit Recognition: Performs OCR and everything except digits are filtered out.

Text Recognition: Performs OCR and everything except English letters are filtered out.

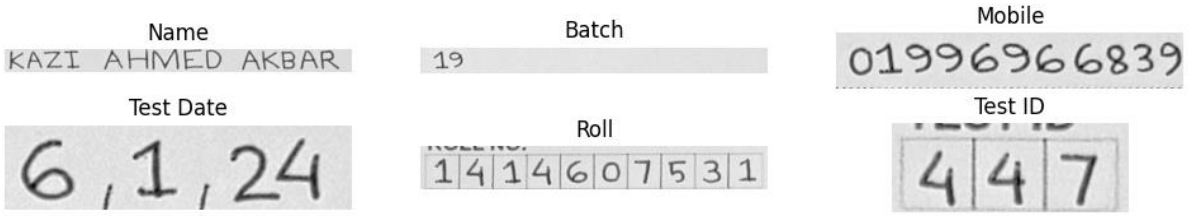
```
def grayscale(image):
    return cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

def binary(image):
    thresh, image_bw = cv2.threshold(image, 127, 255,
cv2.THRESH_BINARY)
    return(image_bw)

def noise_removal(image):
    import numpy as np
    kernel = np.ones((2,2), np.uint8)
    image = cv2.dilate(image, kernel, iterations=1)
    kernel = np.ones((1,1), np.uint8)
    image = cv2.erode(image, kernel, iterations=1)
    image = cv2.morphologyEx(image, cv2.MORPH_CLOSE, kernel)
    image = cv2.medianBlur(image, 3)
    return (image)

def thick_font(image):
    import numpy as np
    image = cv2.bitwise_not(image)
    kernel = np.ones((2,2),np.uint8)
    image = cv2.dilate(image, kernel, iterations=1)
    image = cv2.bitwise_not(image)
    return (image)

def digit_recognition(img):
    import string

    # Find contours in the thresholded image
    contours, _ = cv2.findContours(img, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)

    # Sort contours from left to right
    contours = sorted(contours, key=lambda x: cv2.boundingRect(x)[0])
```

```
    recognized_text = ""
    allowed_characters = string.digits

    for contour in contours:
            # Get bounding box coordinates and dimensions
            x, y, w, h = cv2.boundingRect(contour)
            min_contour_width = 0
            min_contour_height = 40

            # Check if the contour meets the minimum width and height
criteria
            if w >= min_contour_width and h >= min_contour_height:
                # Extract the digit using the bounding box
                digit_roi = img[y:y+h, x:x+w]

                # Perform OCR using pytesseract
                digit_text = pytesseract.image_to_string(digit_roi,
config='--psm 10 --oem 3')

                # Clean up OCR result (keep only digits)
                digit_text = ''.join(filter(lambda char: char in
allowed_characters, digit_text))

                # Append recognized digit to the result
                recognized_text += digit_text.strip()

    return recognized_text

def text_recognition(img):
    import string

    # Find contours in the thresholded image
    contours, _ = cv2.findContours(img, cv2.RETR_EXTERNAL,
cv2.CHAIN_APPROX_SIMPLE)

    # Sort contours from left to right
    contours = sorted(contours, key=lambda x: cv2.boundingRect(x)[0])

    recognized_text = ""
    allowed_characters = string.ascii_letters + ".- ()"

    for contour in contours:
            # Get bounding box coordinates and dimensions
            x, y, w, h = cv2.boundingRect(contour)
            min_contour_width = 0
            min_contour_height = 40
```

```
            # Check if the contour meets the minimum width and height
criteria
            if w >= min_contour_width and h >= min_contour_height:
                # Extract the digit using the bounding box
                digit_roi = img[y:y+h, x:x+w]

                # Perform OCR using pytesseract
                digit_text = pytesseract.image_to_string(digit_roi,
config='--psm 10 --oem 3')

                # Clean up OCR result (keep only digits)
                digit_text = ''.join(filter(lambda char: char in
allowed_characters, digit_text))

                # Append recognized digit to the result
                recognized_text += digit_text.strip()

    return recognized_text
```

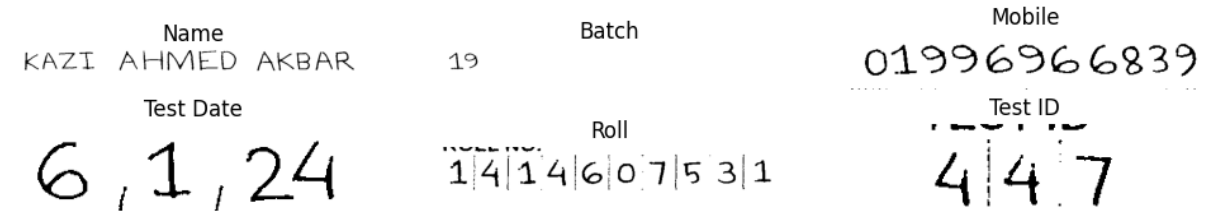
Step 2.3 : Image Pre-processing (Grayscale)

```
name_gray = grayscale(name_roi)
batch_gray = grayscale(batch_roi)
mobile_gray = grayscale(mobile_roi)
test_date_gray = grayscale(test_date_roi)
roll_gray = grayscale(roll_roi)
test_id_gray = grayscale(test_id_roi)

# Display different roi
plt.figure(figsize=[12,2])
plt.subplot(231);plt.imshow(name_gray, cmap =
'gray');    plt.axis("off");plt.title("Name")
plt.subplot(232);plt.imshow(batch_gray, cmap =
'gray');plt.axis("off");plt.title("Batch")
plt.subplot(233);plt.imshow(mobile_gray, cmap =
'gray');    plt.axis("off");plt.title("Mobile")
plt.subplot(234);plt.imshow(test_date_gray, cmap =
'gray');    plt.axis("off");plt.title("Test Date")
plt.subplot(235);plt.imshow(roll_gray, cmap =
'gray');    plt.axis("off");plt.title("Roll")
plt.subplot(236);plt.imshow(test_id_gray, cmap =
'gray');    plt.axis("off");plt.title("Test ID")
```



Step 2.4 : Image Pre-Processing (Threshold)

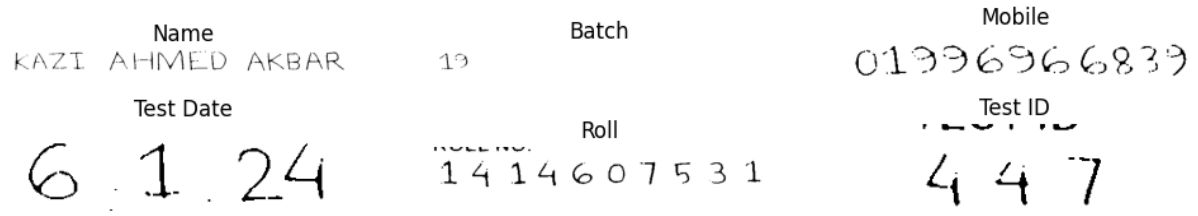
```
name_bw = binary(name_gray)
batch_bw = binary(batch_gray)
mobile_bw = binary(mobile_gray)
test_date_bw = binary(test_date_gray)
roll_bw = binary(roll_gray)
test_id_bw = binary(test_id_gray)

# Display different roi
plt.figure(figsize=[12,2])
plt.subplot(231);plt.imshow(name_bw, cmap =
'gray');    plt.axis("off");plt.title("Name")
plt.subplot(232);plt.imshow(batch_bw, cmap =
'gray');plt.axis("off");plt.title("Batch")
plt.subplot(233);plt.imshow(mobile_bw, cmap =
'gray');    plt.axis("off");plt.title("Mobile")
plt.subplot(234);plt.imshow(test_date_bw, cmap =
'gray');    plt.axis("off");plt.title("Test Date")
plt.subplot(235);plt.imshow(roll_bw, cmap =
'gray');    plt.axis("off");plt.title("Roll")
plt.subplot(236);plt.imshow(test_id_bw, cmap =
'gray');    plt.axis("off");plt.title("Test ID")
```



Step 2.5 : Image Pre-procesing (Noise Removal)

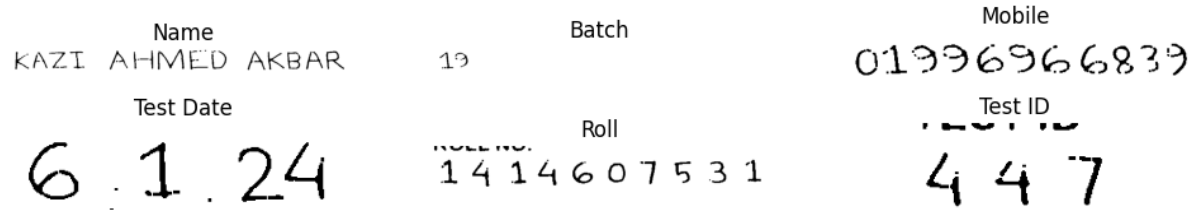
```
name_noise_removed = noise_removal(name_bw)
batch_noise_removed = noise_removal(batch_bw)
mobile_noise_removed = noise_removal(mobile_bw)
test_date_noise_removed = noise_removal(test_date_bw)
roll_noise_removed = noise_removal(roll_bw)
test_id_noise_removed = noise_removal(test_id_bw)

# Display different roi
plt.figure(figsize=[12,2])
plt.subplot(231);plt.imshow(name_noise_removed, cmap =
'gray');    plt.axis("off");plt.title("Name")
plt.subplot(232);plt.imshow(batch_noise_removed, cmap =
'gray');plt.axis("off");plt.title("Batch")
plt.subplot(233);plt.imshow(mobile_noise_removed, cmap =
'gray');    plt.axis("off");plt.title("Mobile")
plt.subplot(234);plt.imshow(test_date_noise_removed, cmap =
'gray');    plt.axis("off");plt.title("Test Date")
```

```
plt.subplot(235);plt.imshow(roll_noise_removed, cmap =
'gray');    plt.axis("off");plt.title("Roll")
plt.subplot(236);plt.imshow(test_id_noise_removed, cmap =
'gray');    plt.axis("off");plt.title("Test ID")
```



Step 2.6 : Image Pre-processing (Increase contrast)

```
name_dilated = thick_font(name_noise_removed)
batch_dilated = thick_font(batch_noise_removed)
mobile_dilated = thick_font(mobile_noise_removed)
test_date_dilated = thick_font(test_date_noise_removed)
roll_dilated = thick_font(roll_noise_removed)
test_id_dilated = thick_font(test_id_noise_removed)

# Display different roi
plt.figure(figsize=[12,2])
plt.subplot(231);plt.imshow(name_dilated, cmap =
'gray');    plt.axis("off");plt.title("Name")
plt.subplot(232);plt.imshow(batch_dilated, cmap =
'gray');plt.axis("off");plt.title("Batch")
plt.subplot(233);plt.imshow(mobile_dilated, cmap =
'gray');    plt.axis("off");plt.title("Mobile")
plt.subplot(234);plt.imshow(test_date_dilated, cmap =
'gray');    plt.axis("off");plt.title("Test Date")
plt.subplot(235);plt.imshow(roll_dilated, cmap =
'gray');    plt.axis("off");plt.title("Roll")
plt.subplot(236);plt.imshow(test_id_dilated, cmap =
'gray');    plt.axis("off");plt.title("Test ID")
```



Step 2.7 : OCR

```
name = text_recognition(name_dilated)
batch = digit_recognition(batch_dilated)
mobile = digit_recognition(mobile_dilated)
test_day = test_date_dilated[:,:82]
test_month = test_date_dilated[:, 102:168]
test_year = test_date_dilated[:, 186:]
```

```
day = digit_recognition(test_day)
month = digit_recognition(test_month)
year = digit_recognition(test_year)
roll = digit_recognition(roll_dilated)
test_id = digit_recognition(test_id_dilated)
print("Name:", name)
print("Batch:", batch)
print("Mobile:", mobile)
print("Test Date:",day,"-",month,"-",year)
print("Roll:",roll)
print("Test ID:",test_id)
```

Output (Input Image 1)

```
Name: KAZI AKIMED AKBAR
Batch: 19
Mobile: 01996966339
Test Date: 6 - 1 - 24
Roll: 1414607531
Test ID: 447
```

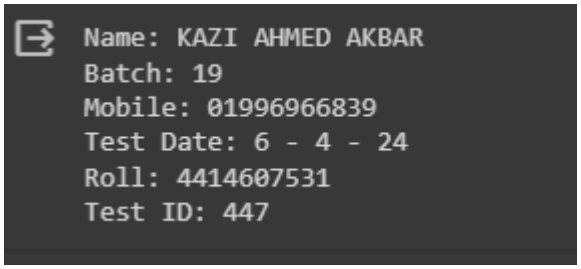
Results are quite accurate. Batch, test date, roll and test id result match with actual data. There is one mistake in 'Name' field, where the program detected 'AKIMED' while accurate value is 'AHMED'. Another mistake is 9th digit of mobile number is detected as 3 instead of 8.

Output (Input Image 2)

```
Name: KAZT AHMED AKBAR
Batch: 19
Mobile: 01996966339
Test Date: 6 - 4 - 24
Roll: 1414607531
Test ID: 447
```

Batch, mobile, roll and test id are accurate. In 'Name' field, 'KAZT' is detected instead of 'KAZI'. One other mistake is month of test date is detected as 4 instead of 1. Another mistake is 9th digit of mobile number is detected as 3 instead of 8.

Output (Input Image 3)



Name, batch, mobile and test id results are correct. There is one common mistake- month of test date and 1st digit of roll are detected as 4 instead of 1.

Observation:

Although the program has correctly detected most of the information, there is still some errors. The reason behind is that my handwriting does not perfectly match with printed text or the handwritten text dataset on which Tesseract-OCR engine was trained. Better angle, light and high-resolution image will likely reduce this problem.

Phase 3: MCQ Answer Sheet Evaluation

Steps at a glance

3.1 Selecting Different ROIs

3.2 Defining necessary functions

3.3 Defining actual answers

3.4 Detecting the circles and drawing rectangular contour around them

3.5 Sorting the contours top to bottom and then defining every 4 contour as 4 option of a single mcq

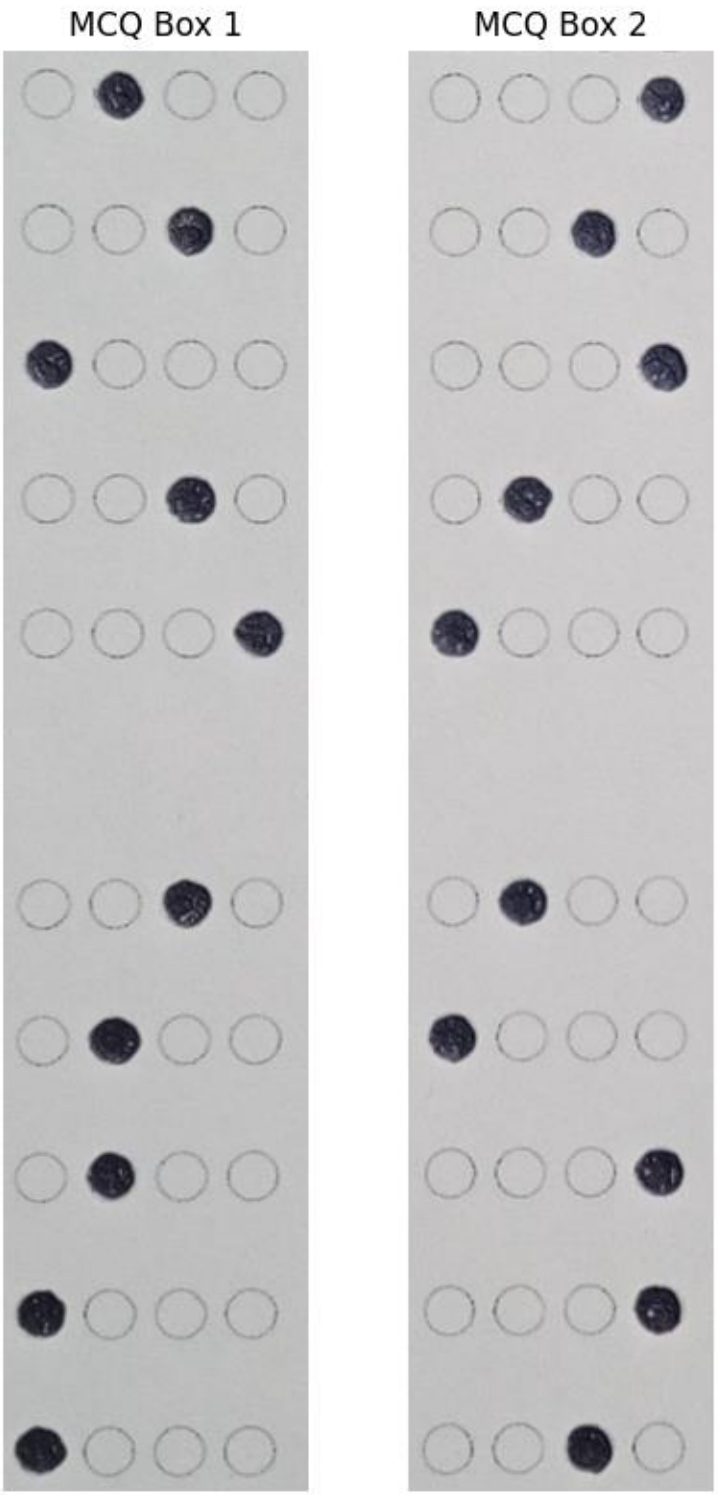
3.6 Deteting marked circles and matching them with actual answers

3.7 Print obtained mark and display actual answers on top of mcq answer sheet

Step 3.1 : Selecting Different ROIs

```
import matplotlib.image as mpimg

def define_and_save_roi(image_path, x, y, width, height, output_path):
    # Read the image
    img = cv2.imread(image_path)

    # Extract the region of interest (ROI) based on the specified
coordinates and dimensions
    roi = img[y:y+height, x:x+width]

    # Save the defined area to the specified output directory
    cv2.imwrite(output_path, roi)

# Provide the path to your image file, the coordinates of the upper-
left corner pixel,
# width, height, and the output directory
image_path = "/content/registered_form.jpg"

# MCQ box 1 field
mcq_1_path = "/content/mcq_1.jpg"
define_and_save_roi(image_path, 295, 1442, 265, 1290, mcq_1_path)
mcq_1_roi = mpimg.imread(mcq_1_path)

# MCQ box 2 field
mcq_2_path = "/content/mcq_2.jpg"
define_and_save_roi(image_path, 720, 1442, 265, 1290, mcq_2_path)
mcq_2_roi = mpimg.imread(mcq_2_path)
```

```
mcq_column_path = [mcq_1_path, mcq_2_path]

plt.figure(figsize=[5,10])
plt.subplot(121);plt.imshow(mcq_1_roi); plt.axis('off'); plt.title("MCQ
Box 1")
plt.subplot(122);plt.imshow(mcq_2_roi); plt.axis('off'); plt.title("MCQ
Box 2")
```



Step 3.2 : Defining Necessary Functions

Group_into_lists: Converts a list into nested list

Is_marked: Checks if a circle is marked or not (by calculating black pixel percentage inside that area)

```
def group_into_lists(lst, group_size):
    return [lst[i:i + group_size] for i in range(0, len(lst),
group_size)]

def is_marked(image, x, y, width, height):
    # Extract the region of interest (ROI)
    roi = image[y:y+height, x:x+width]

    # Calculate total pixels, white pixels, black pixels
    total_pixels = roi.size
    white_pixels = cv2.countNonZero(roi)
    white_percentage = (white_pixels/total_pixels)*100

    # Adjust the threshold based on your image characteristics
    threshold_percentage = 70

    # Check if the percentage of edge pixels exceeds the threshold
    return white_percentage > threshold_percentage
```

Step 3.3 : Defining Actual Answers

```
answer_column_1 = [1,2,1,2,3,2,1,1,0,0]
answer_column_2 = [3,3,3,1,0,3,0,3,3,2]
answer_sheet = [answer_column_1, answer_column_2]
```

Here, 20 mcq questions are answered. They are organized in two column- (1-10) and (11-20). Their answers are written in two different list.

Step 3.4, 3.5, 3.6, 3.7

```
correct = 0  # Initialize the correct counter outside the loop
plt.figure(figsize=(6, 8))

for c, mcq_column in enumerate(mcq_column_path):
  # Read the image
  image = cv2.imread(mcq_column)
  img = image.copy()
```

```
  # Read the answers
  answers = answer_sheet[c]

  # Convert the image to grayscale
  gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

  # For counting pixel
  _, thresh = cv2.threshold(gray, 170, 255, cv2.THRESH_BINARY_INV)

  # Apply GaussianBlur to reduce noise and help contour detection
  blurred = cv2.GaussianBlur(gray, (5, 5), 0)

  # Use HoughCircles to detect circles in the image
  circles = cv2.HoughCircles(
    blurred, cv2.HOUGH_GRADIENT, dp=1, minDist=50, param1=50,
param2=30, minRadius=10, maxRadius=100)

  circles = np.round(circles[0, :]).astype("int")

  # Check if any circle is found
  print(f"Checking MCQ Column {c+1}")

  # Declare a list to store contour boundary data
  rectangles = []

  # Draw rectangular contours around each circle
  for (x, y, r) in circles:
        x1, y1 = x - r, y - r
        x2, y2 = x + r, y + r
        cv2.rectangle(image, (x1, y1), (x2, y2), (0, 255, 0), 4)
        rectangles.append((x1, y1, 2*r, 2*r))

  # Sorting rectangular contours as top to bottom
  rectangles = sorted(rectangles, key=lambda rect: rect[1])

  # Defining every 4 circle to be parts of a single mcq
  rows = group_into_lists(rectangles, 4)
  sorted_row = []

  # Sorting 4 circles left to right in a row
  for i, row in enumerate(rows):
    row = sorted(row, key=lambda rect: rect[0])
    sorted_row.append(row)

  correct_figure = []
  for m, n in enumerate(answers):
    p, q, r, s = sorted_row[m][n]
    correct_figure.append((p, q, r, s))
```

```
  for (x, y, w, h) in correct_figure:
    cv2.rectangle(img, (x, y), (x+w, y+h), (0, 255, 0), 4)

  # Loop to evaluate each mcq (row of 4 options)
  for index, row in enumerate(sorted_row):

    answer = answers[index] # read the answer for each quextion

    flag = 0
    choice = 0

    for i, r in enumerate(row):
      (x, y, w, h) = r
      if is_marked(thresh, x, y, w, h):
        flag = flag + 1
        choice = i

    if flag == 1:
      if choice == answer:
        correct = correct + 1
      else:
        p, q , r, s = sorted_row[index][choice]
        cv2.rectangle(img, (p, q), (p+r, q+s), (0, 0, 255), 4)

  # Display the image with contours using plt.imshow
  plt.subplot(1, 2, c+1)
  plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
  plt.title(f'MCQ Box {c+1}')
  plt.axis('off')

print(f"Marks: {correct}/20")
```

Output (Input Image 1)

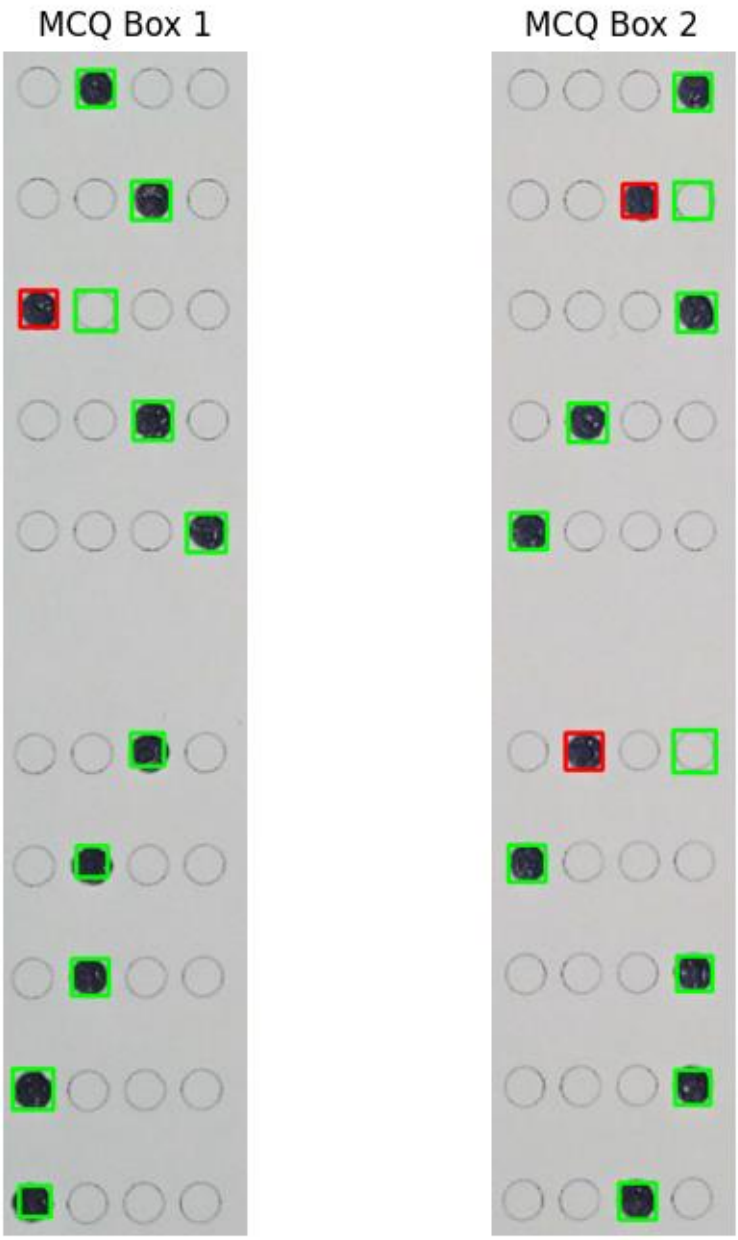
```
Checking MCQ Column 1
Checking MCQ Column 2
Marks: 17/20
```

17 questions are answered correct, 3 are wrong. So scored mark is 17.

From the figure below, we get the same result.

Green border means correct answer.

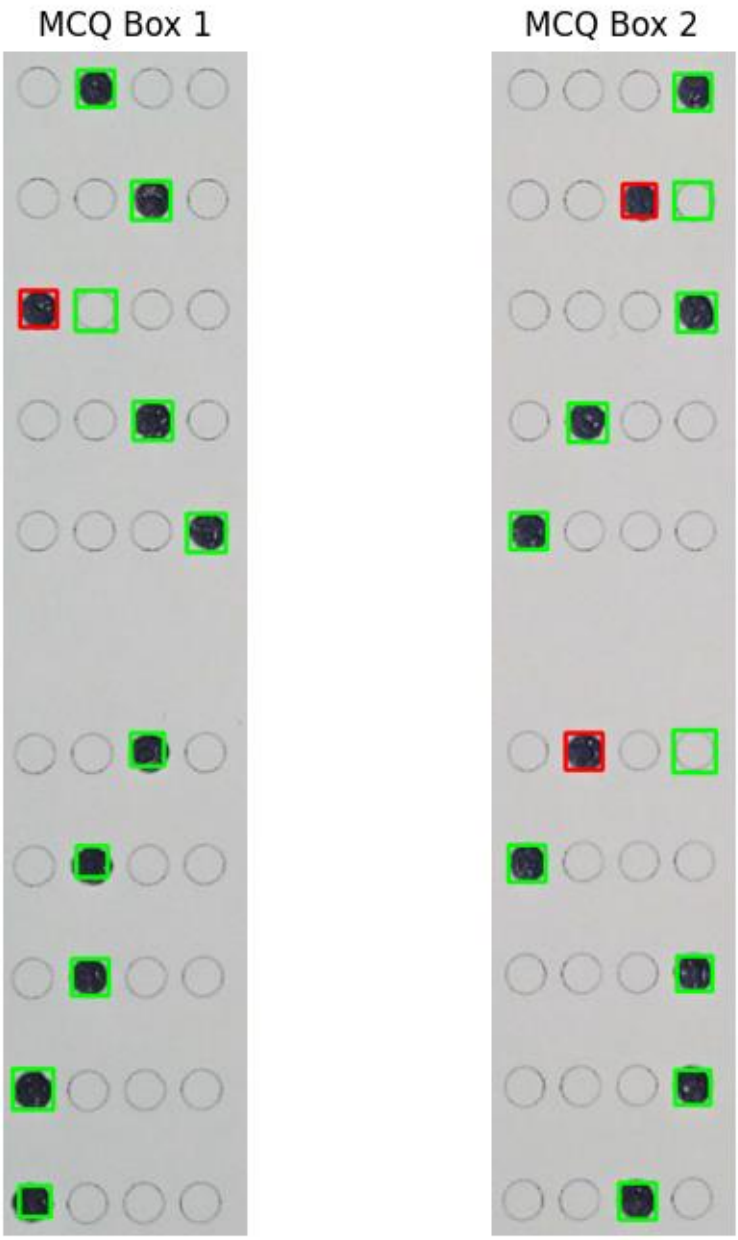
Red border means incorrect answer



Output (Input Image 2)

```
Checking MCQ Column 1
Checking MCQ Column 2
Marks: 17/20
```

Marked options were same as first input image. So obtained marks is same.

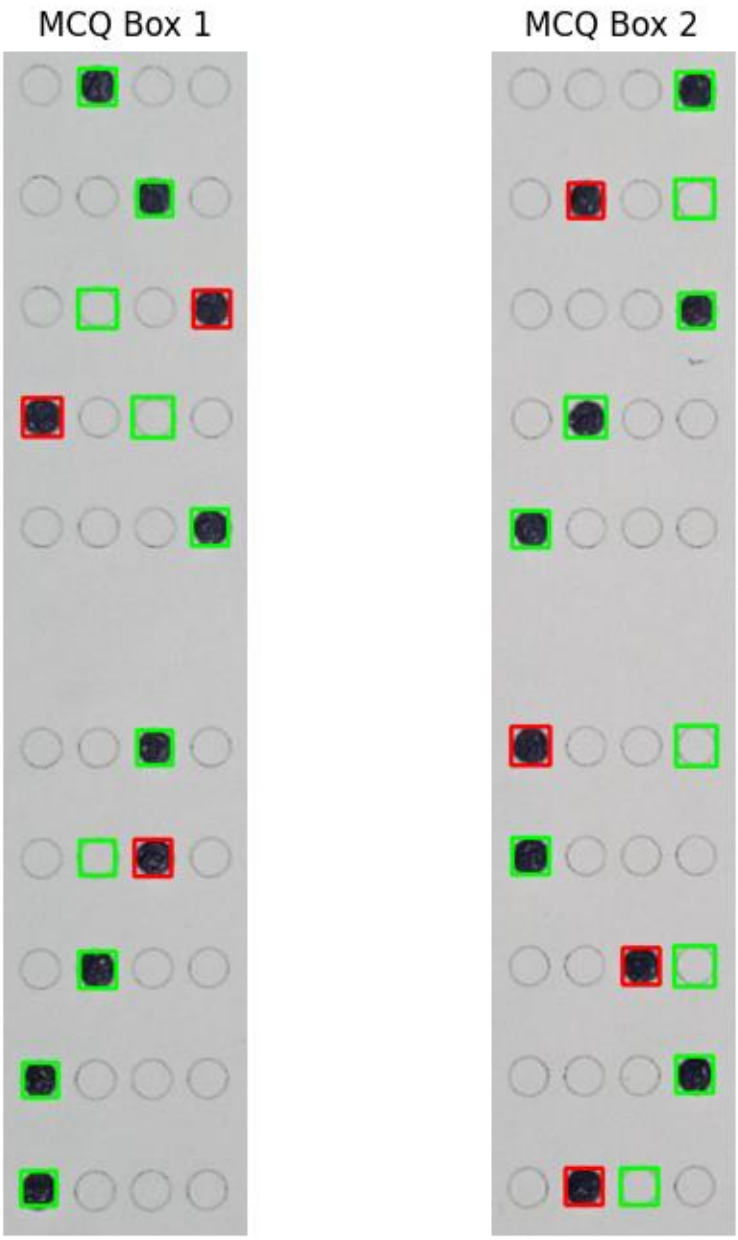


Output (Input Image 3)

```
Checking MCQ Column 1
Checking MCQ Column 2
Marks: 13/20
```

Here, 13 answers are correct and 7 answers are incorrect.

Following image also shows the same result.



I have been able to evaluate the answer sheet with 100% accuracy.

Conclusion

Information extraction with OCR is a little bit difficult and some errors were found in output. However, image registration and mcq evaluation has been done successfully.