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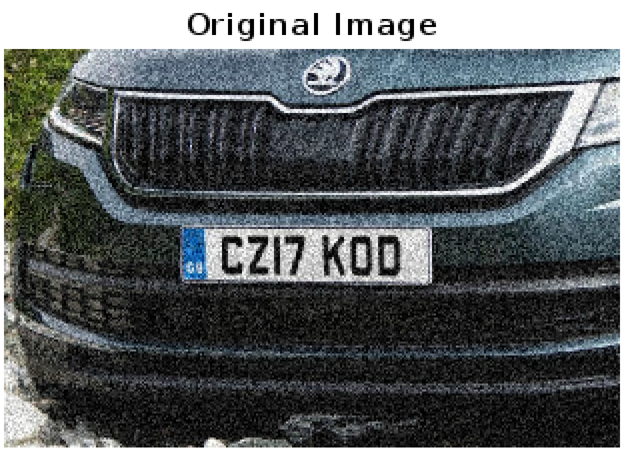
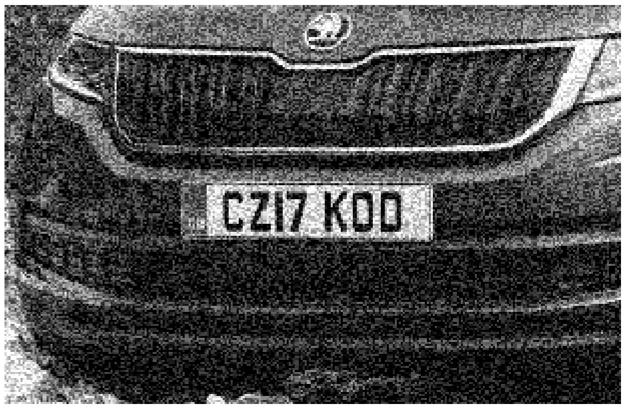
```
clc; clear; close all;
```

step 1: Image Processing

```
originalImage = imread('mainImage.jpg');
figure, imshow(originalImage);
title('Original Image');
if size(originalImage, 3) == 3
    grayImage = rgb2gray(originalImage);
else
    grayImage = originalImage;  % already grayscale
end

% use contrast stretching
adjustedImage = imadjust(grayImage);
figure, imshow(adjustedImage);
title('Grayscale Adjusted Image');
```



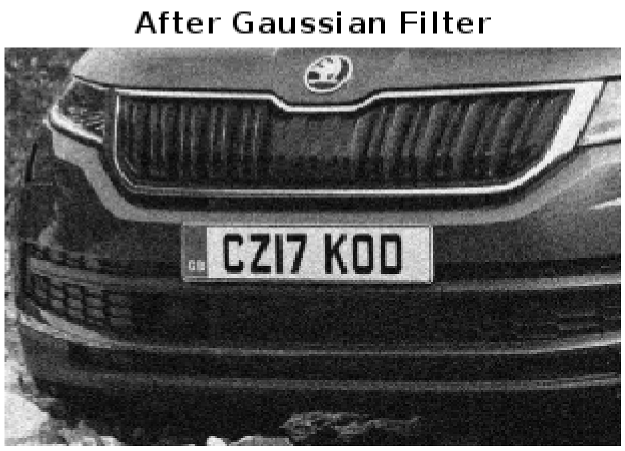
Grayscale Adjusted Image

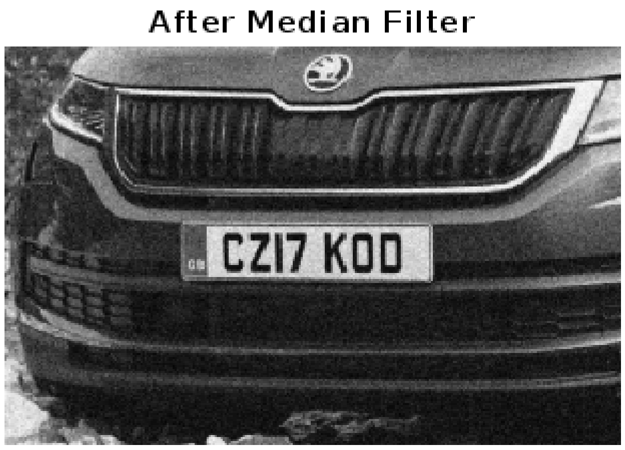


step 2: remove noise

```
% Method 1: Apply Gaussian Filter for smoothing
gaussian_filter = fspecial('gaussian', [5 5], 1);  % [size] and sigma
filtered_gaussian = imfilter(adjustedImage, gaussian_filter, 'replicate');

% Method 2: Apply Median Filter to remove salt & pepper noise
filtered_median = medfilt2(filtered_gaussian, [3 3]);

% Display Results
figure;
imshow(filtered_gaussian);
title('After Gaussian Filter');

figure;
imshow(filtered_median);
title('After Median Filter');

fprintf('Noise reduction and filtering completed \n');
```

```
Noise reduction and filtering completed
```



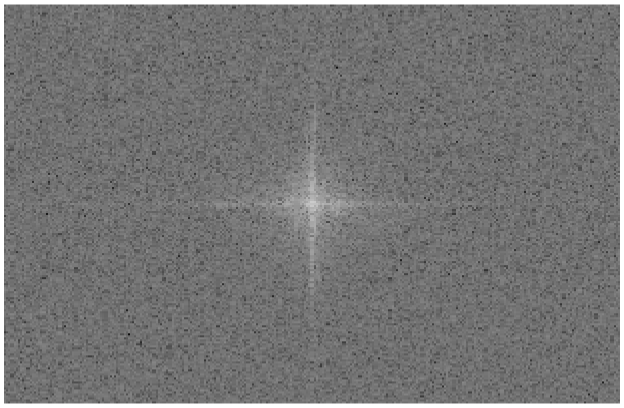


step 3: Fourier Transform

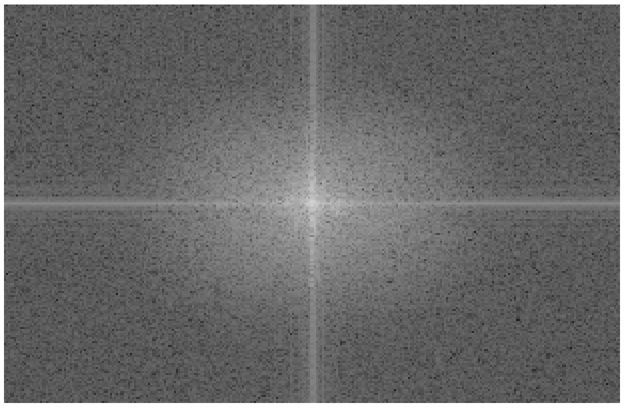
```
F = fft2(adjustedImage);
%get the centered spectrum
Fsh = fftshift(F);
%apply log transform
S2 = log(1+abs(Fsh));
figure;
imshow(S2,[]);title('FFT Spectrum before filtering car image')

F = fft2(filtered_median);
%get the centered spectrum
Fsh = fftshift(F);
%apply log transform
S2 = log(1+abs(Fsh));
```

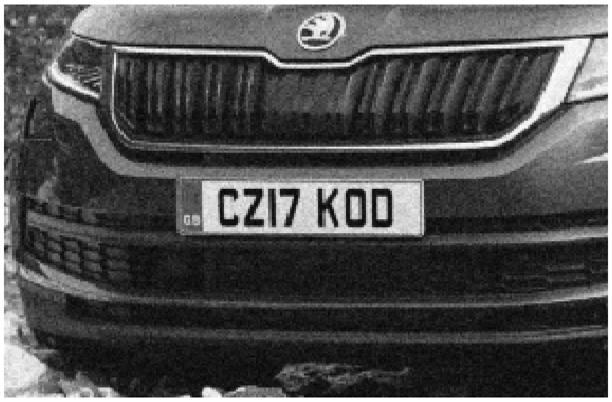
```
figure;
imshow(S2,[]);title('FFT Spectrum after filtering car image')

%reconstruct the Image
F = ifftshift(Fsh);
f = ifft2(F);
figure;
imshow(f,[]),title('reconstructed car image from FFT')
```

FFT Spectrum before filtering car image



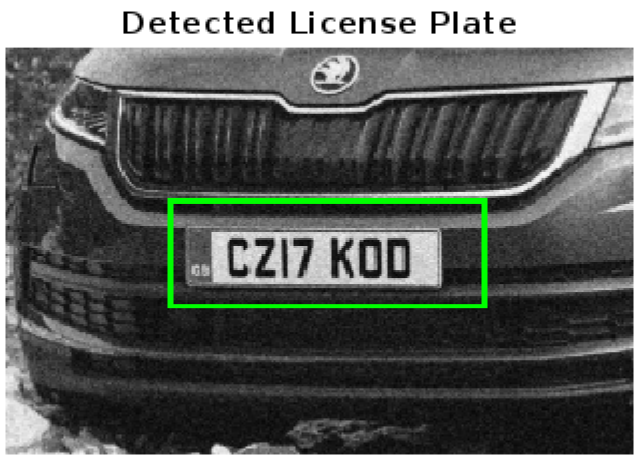
FFT Spectrum after filtering car image



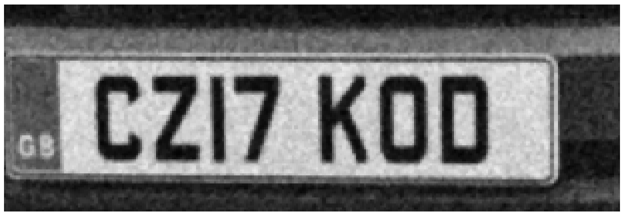


step 4: licence plate detetion

```
% Load the license plate detector using the XML file
plateDetector = vision.CascadeObjectDetector('licensePlate.xml');

% Detect license plates in the image
bboxes = step(plateDetector, filtered_median);

% Check if any plate is detected
if ~isempty(bboxes)
    % Show the original image with detected plates
    figure, imshow(filtered_median);
    hold on;
    for i = 1:size(bboxes, 1)
        % Draw a green rectangle around each detected plate
        rectangle('Position', bboxes(i,:), 'EdgeColor', 'g', 'LineWidth', 2);
    end
    title('Detected License Plate');

    % Crop the first detected license plate from the image
    bbox = bboxes(1,:); % Get the first detected bounding box

    % Calculate the new bounding box by reducing 5% from each side
    x = bbox(1);
    y = bbox(2);
    w = bbox(3);
    h = bbox(4);

    % Reduce 5% from each side
    x = x + 0.05 * w; % Shift left by 5% of width
    y = y + 0.05 * h; % Shift up by 5% of height
    w = w - 0.1 * w;  % Reduce the width by 10% (5% from each side)
    h = h - 0.1 * h;  % Reduce the height by 10% (5% from each side)
    % Make sure the new coordinates are within the image boundaries
    x = max(x, 1);
    y = max(y, 1);
    w = min(w, size(filtered_median, 2) - x);
    h = min(h, size(filtered_median, 1) - y);

    % Crop the image using the new bounding box
    plateImage = imcrop(filtered_median, [x, y, w, h]);

    % Show the cropped license plate in a new figure
    figure, imshow(plateImage);
    title('Cropped and Resized License Plate');
else
    % If no plates are detected, display a message
    disp('No plate detected.');
    return; % Stop execution if no plate detected
end
```



Cropped and Resized License Plate



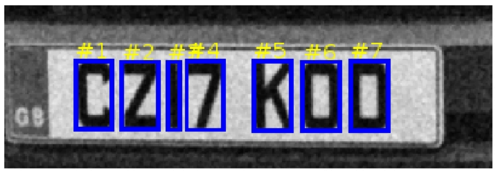
Step 5: Character Segmentation

```matlab
% 1. Adaptive Thresholding
T = adaptthresh(plateImage, 0.79);
binary_plate = imbinarize(plateImage, T);
binary_plate = ~binary_plate;

% 2. Remove small noise
binary_plate = bwareaopen(binary_plate, 50);

% 3. Extract object properties
props = regionprops(binary_plate, 'BoundingBox', 'Centroid', 'Area');

% 4. Filter by size: exclude very small or very large objects
areas = [props.Area];
min_area = 80;
max_area = 2000; % To exclude large frames
valid_idx = find(areas >= min_area & areas <= max_area);
filtered_props = props(valid_idx);

% 5. Extract Y-centroid to find the baseline
centroids = cat(1, filtered_props.Centroid);
mean_y = mean(centroids(:,2));
tolerance = 25;

% 6. Filter characters in the same line
line_idx = abs(centroids(:,2) - mean_y) < tolerance;
filtered_props = filtered_props(line_idx);
centroids = centroids(line_idx,:);

% 7. Sort from left to right
[~, sort_idx] = sort(centroids(:,1));
filtered_props = filtered_props(sort_idx);
```

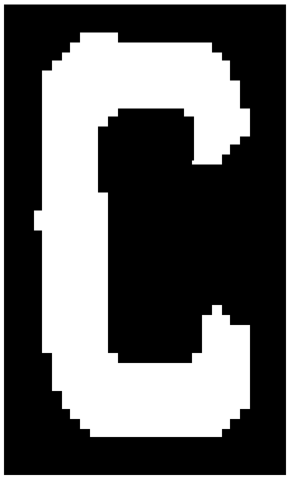
```
% 8. Display bounding boxes with numbering
figure, imshow(plateImage);
title('Final Filtered Bounding Boxes');
hold on;
for i = 1:length(filtered_props)
    bbox = filtered_props(i).BoundingBox;
    rectangle('Position', bbox, 'EdgeColor', 'b', 'LineWidth', 2);
    text(bbox(1), bbox(2)-10, sprintf('#%d', i), 'Color', 'yellow',
'FontSize', 10);
end
hold off;

% 9. Crop, resize, and apply Fourier Transform on each character
for i = 1:length(filtered_props)
    bbox = filtered_props(i).BoundingBox;
    expand = 5;
    x1 = max(bbox(1) - expand, 1);
    y1 = max(bbox(2) - expand, 1);
    x2 = min(bbox(1) + bbox(3) + expand, size(binary_plate,2));
    y2 = min(bbox(2) + bbox(4) + expand, size(binary_plate,1));
    width = x2 - x1;
    height = y2 - y1;

    % Crop and resize the character image
    char_img = imcrop(binary_plate, [x1, y1, width, height]);
    char_img = imresize(char_img, [50 30]);

    % Display character image
    figure, imshow(char_img);
    title(['Character #' num2str(i)]);

    % Fourier Transform
    F = fft2(char_img);
    Fsh = fftshift(F);
    S2 = log(1 + abs(Fsh));
    figure;
    imshow(S2, []);
    title(['FFT Spectrum of Character #' num2str(i)]);

    % Inverse FFT to reconstruct
    F = ifftshift(Fsh);
    f = ifft2(F);
    figure;
    imshow(real(f), []);
    title(['Reconstructed Character # ' num2str(i)], 'from FFT');
end

disp('Characters have been segmented and Fourier transformed ');
```

```
Characters have been segmented and Fourier transformed
```

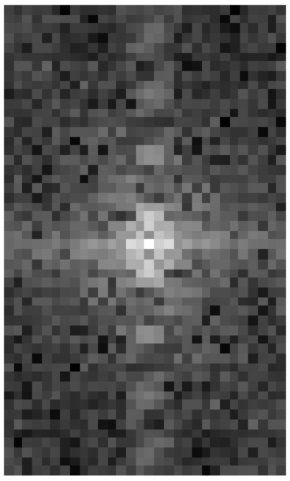
Final Filtered Bounding Boxes

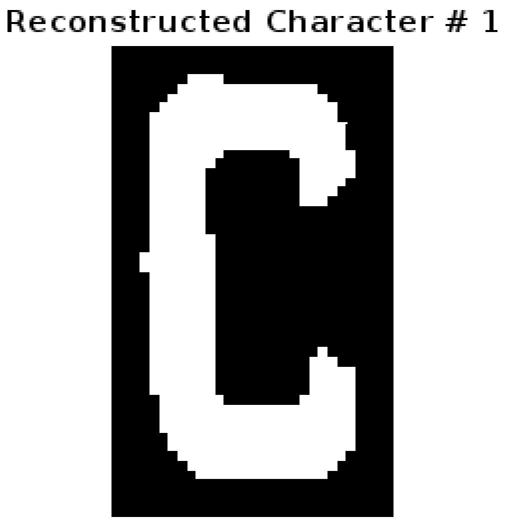


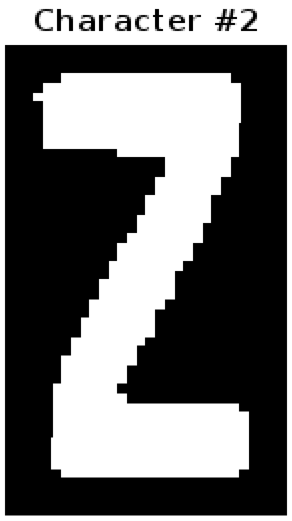
Character #1



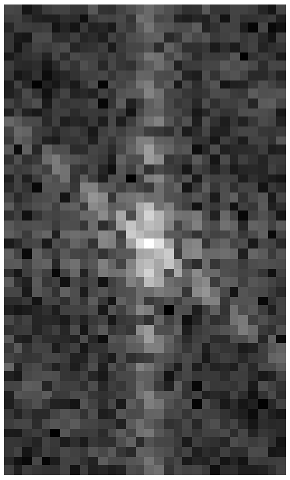
FFT Spectrum of Character #1



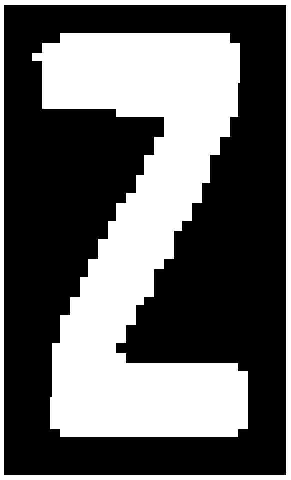

Reconstructed Character # 1


Character #2

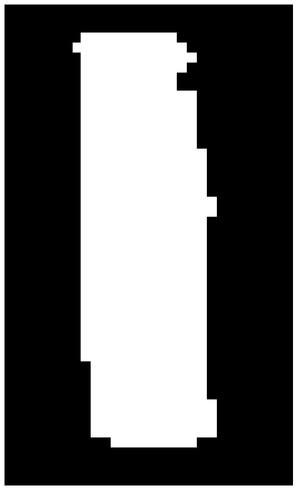
FFT Spectrum of Character #2



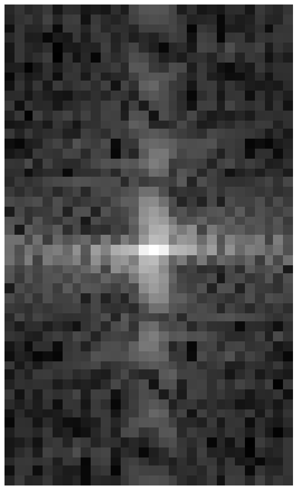
Reconstructed Character # 2



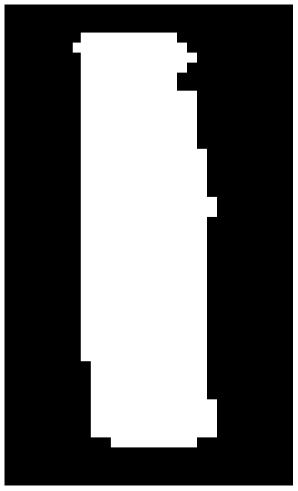
Character #3



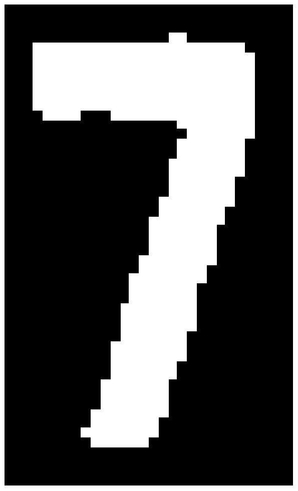
FFT Spectrum of Character #3



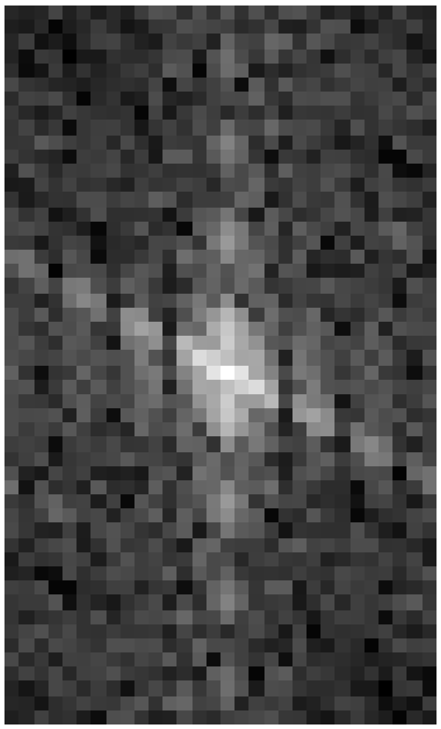
Reconstructed Character # 3



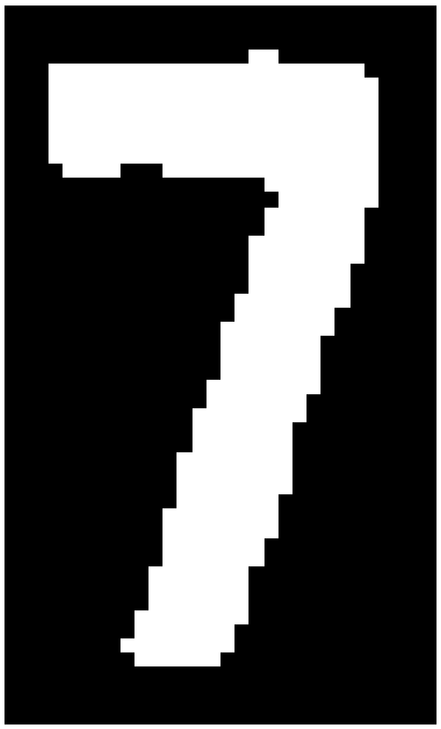
Character #4



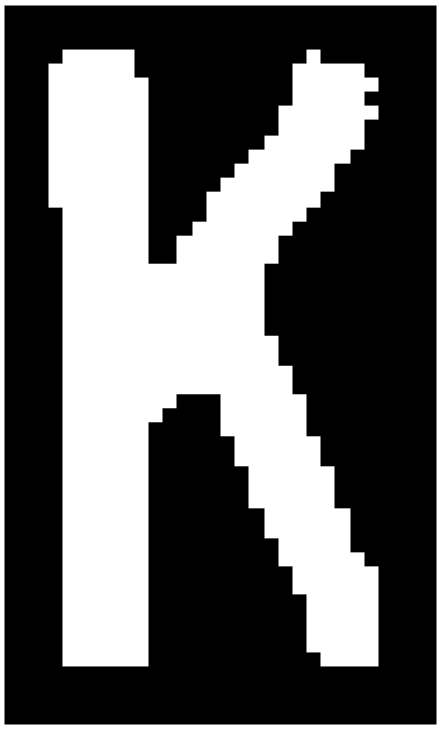
FFT Spectrum of Character #4



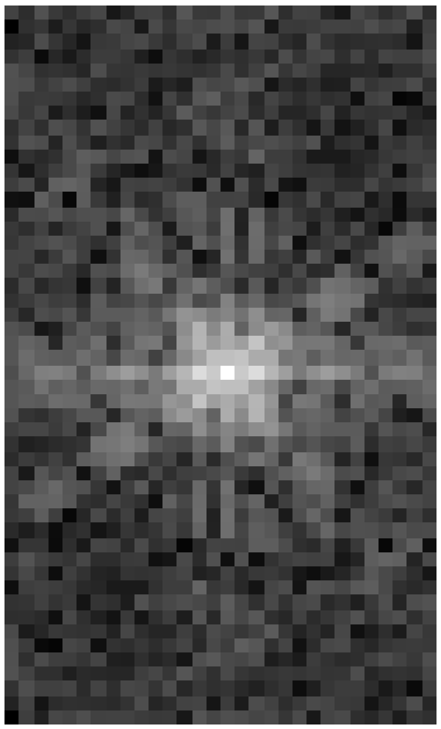
Reconstructed Character # 4



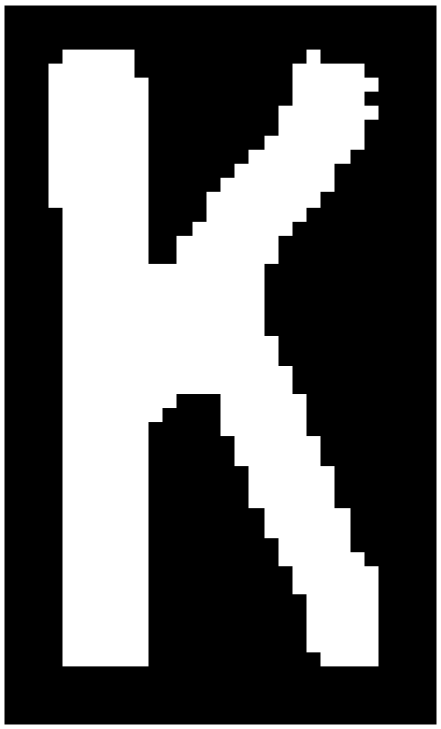
Character #5



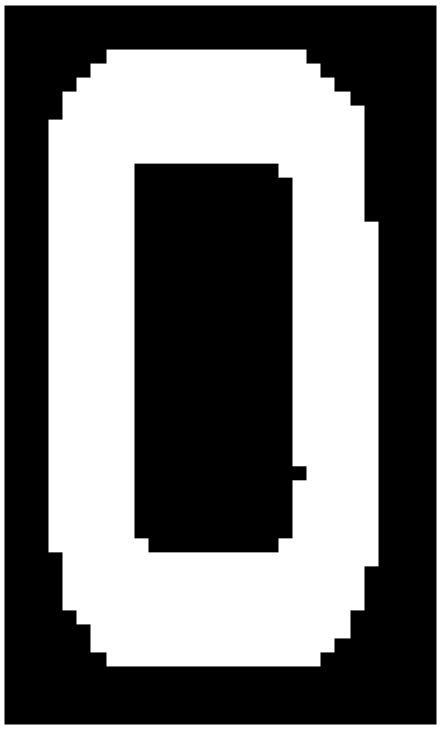
FFT Spectrum of Character #5



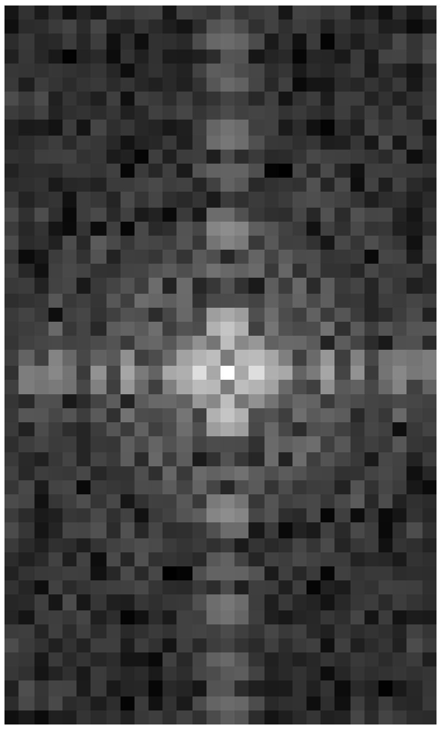
Reconstructed Character # 5



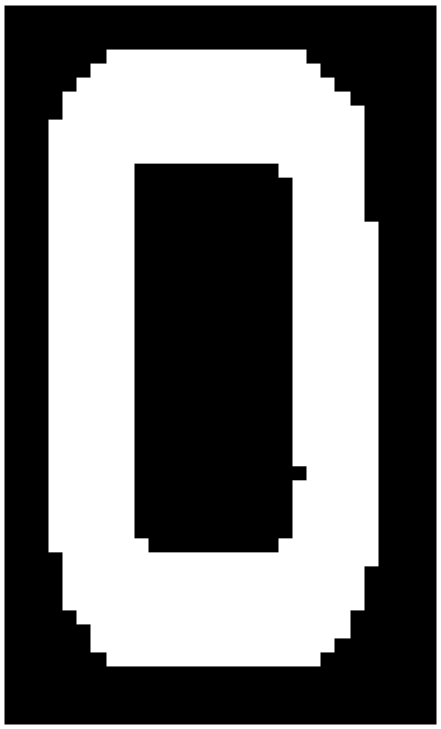
Character #6



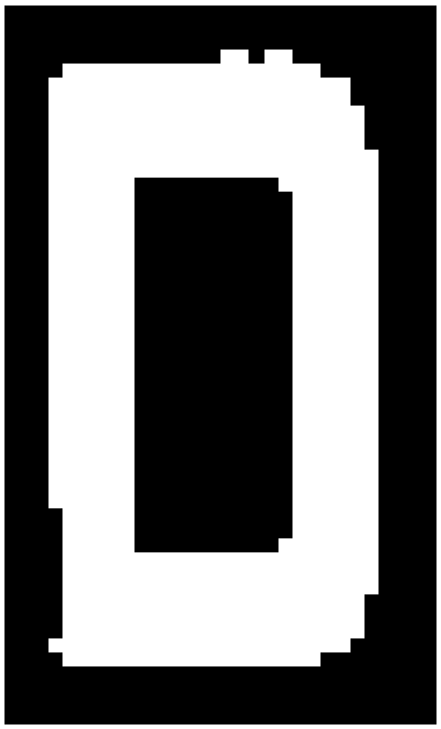
FFT Spectrum of Character #6

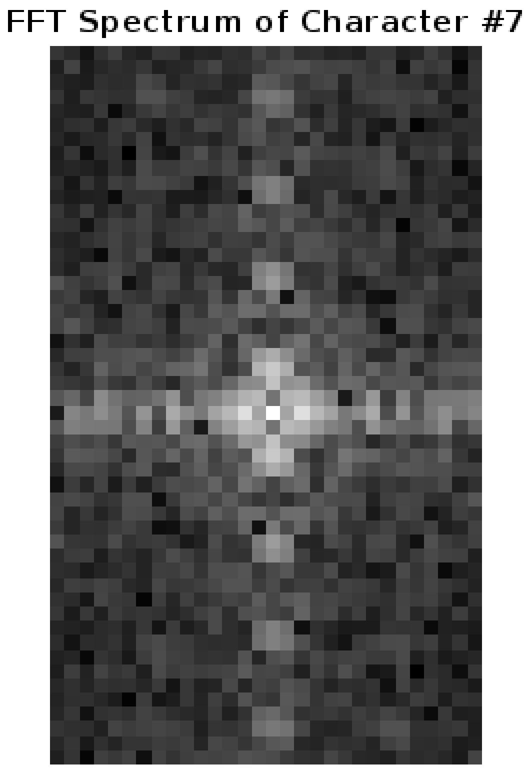


Reconstructed Character # 6

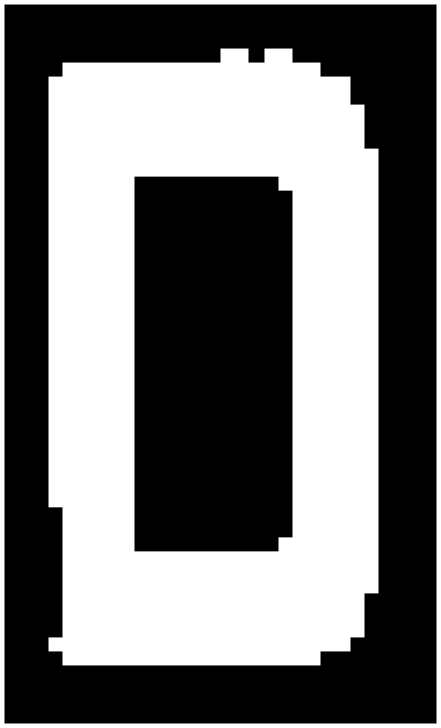


Character #7




FFT Spectrum of Character #7

Reconstructed Character # 7



step 6: OCR

```
% Detect edges using Prewitt operator
edges = edge(filtered_median, 'prewitt');

% Find regions (connected components) and their bounding boxes
regions = regionprops(edges, 'BoundingBox', 'Area');

% Initialize detected plate text to empty string
detectedPlateText = '';

% Initialize maxTextLength to zero
maxTextLength = 0;

for i = 1:numel(regions)
    bbox = regions(i).BoundingBox;

    % Filtering Step
    width = bbox(3);
    height = bbox(4);
    aspect_ratio = width / height;

    % Keep regions with reasonable size and shape
    if width > 80 && height > 20 && aspect_ratio > 2 && aspect_ratio < 6
```

```
        croppedRegion = imcrop(filtered_median, bbox);
        ocrResult = ocr(croppedRegion);

        detectedText = strtrim(ocrResult.Text);
        detectedText = regexprep(detectedText, '[^A-Za-z0-9 ]', '');

        if ~isempty(detectedText) && length(detectedText) > maxTextLength
            maxTextLength = length(detectedText);
            detectedPlateText = detectedText;
        end
    end
end

% Print the detected plate text
if ~isempty(detectedPlateText)
    disp(['Detected Plate Text: ', detectedPlateText]);
else
    disp('No valid plate text detected.');
    return; % Stop execution if no plate text detected
end
```

```
Detected Plate Text: CZI7 KOD
```

Step 7: Check if Plate is Allowed to Enter after OCR

```
% Define the Database of allowed plates
allowedPlates = {...
    'DL6S BYX', ...
    'EA0202AA', ...
    '8117 MP7', ...
    'DJ53096', ...
    'MAT1234', ...
    'ENG2025', ...
    'TEST432', ...
    'CZI7 KOD'
    };

% Initialize entry permission flag
isAllowed = false;

% Compare detected plate with allowed plates database
for i = 1:length(allowedPlates)
    if strcmpi(detectedPlateText, allowedPlates{i})
        disp([' Access Granted: Car with Plate ', allowedPlates{i}, ' is
allowed to enter.']);
        isAllowed = true;
        break;
    end
end

if ~isAllowed
```

```
    disp(' Access Denied: Car with Plate not authorized to enter.');
end
```

```
 Access Granted: Car with Plate CZI7 KOD is allowed to enter.
```

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