# Research Paper.

## Summary

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# Introduction

→ Image segmentation is the classification of an image into different groups.

→ Image segmentation is utilised to extract an object from image from its background.

→ This technique is quiet useful in various field like health care, image processing, traffic image, pattern recognition etc.

→ In medical field it is quite useful in extracting important data from raw images (diagnosis purpose).

→ For image segmentation various processes can be used like:

- threshold based
- edge based
- cluster based
- neural network based

→ Out of all this techniques clustering is most

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efficient way of image segmentation.

→ We will learn about K-means method for cluster formation which is most efficient way of formation of clusters.

# Contrast Enhancement using Partial Contrast Stretching (P.C.S)

→ The first step for image segmentation is to improve quality of image.

→ This can be achieved by Partial Contrast Stretching (P.C.S)

→ It involves stretching and Compression process.

→ This technique increases contrast level and brightness of image.

→ This technique is used to scale down the ~~range of~~ pixel values of image.

→ Owing to which the range of pixels for output image increases and owing to which contrast and

brightness increases

→ for example,
We have an image with pixel values which can range upto many bits. We need to scale it down to 8 bit pix value. Hence we first use to threshold lower range and higher range of value to smaller values [compression]
like values less than 80 and more than 200 pixel values are compressed to range 0-20 and 230-255 respectively.

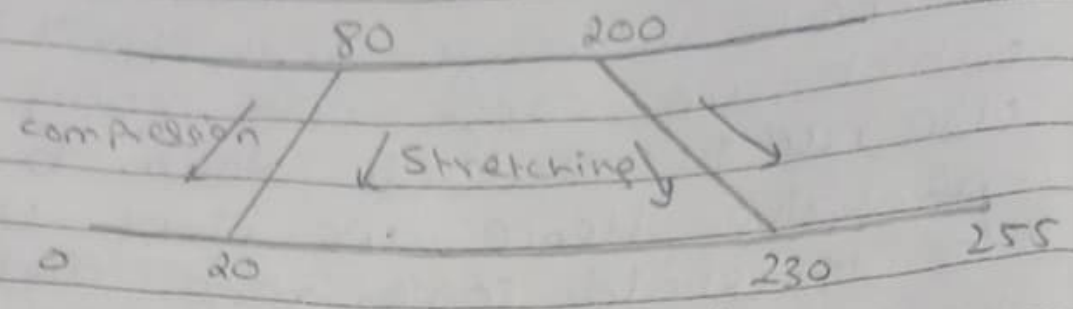
Remaining all pixel values [81-229] are stretched across range [21-229].
Hence image turns out to be more bright and contrasting.

Formulae.

$$p_k = \frac{(max - min) * [q_k - f_{min}]}{(f_{max} - f_{min})} + min$$

max and min = desired maximum and minimum pixel values of output image.
$q_k$ = pixel value of input image
$p_k$ = pixel value of output image.

$f_{max}$ and $f_{min}$ = maximum and minimum values of input image.




Partial Compression Stretching.

# Subtractive Clustering Algorithm

→ It is used to decide initial centroid of cluster based on population of surrounding data points.

→ It helps us to find cluster centroid as well as minimum number of cluster centroid required initially befor initiations of clustering process.

→ It distributes data space into gridding points.

→ And potential of each points is obtained.

→ Grid points with many data points surrounding it will have high potential.

→ And Grid point with highest number of data points surrounding it will be chosen as first cluster centre.

→ And grid points near first cluster centre will have their potential reduced.

→ Now same process is calculated for other grid pts.

→ By this way we get large number of cluster centre.

→ This process continues until all grid pts have their potential reduced below threshold minimum value.

→ Consider collection of n data pts.
$X: \{x_1, x_2, x_3, \ldots, x_n\}$. Each pt has potential to be cluster centre, hence it is called as potential cluster centre.
Potential at a pt is obtained by formulae.

$$P_n = \sum_{i=1}^{n} e^{\frac{-4\times n - x_i^2}{ra^2}} \qquad ra = \text{constant}$$

After getting datapt with maximum potential, we need to reduce the potential of surrounding data pts.

$$P_n = P_n - P_1 e^{\frac{-4 \times n - x_1^2}{r_b^2}}$$

$r_b$ = constant

Hence an amount of potential is subtracted from each data point as a function of distance from first cluster centre.

This process continues until sufficient number of cluster centres are obtained.

# K-means clustering algorithm.

→ This algorithm is used to divide an image into k-clusters.

→ K-means involves 2 phases
- Firstly to decide the centre of cluster.
- Next is to take all datapts closer to cluster centroid in one cluster.

→ In order to check for nearest centroid we calculate it by euclidean distance.

→ Once grouping/clustering is done, we recalculate new centroid position for cluster.

→ Again grouping of data pts take place, this process continues until the distances of all pts in cluster from its centroid is minimum and does not changes after many iterations.

→ Centroid for each cluster is the point to which sum of distances from all the objects in that cluster is minimized. This is done by k-mean

→ K-means algorithm

- Initial number of clusters k and its centre
- For each pixel of image calculate the Euclidean distance d, between the centre and each pixel of of image

$$d_e = \|P(x,y) - C_k\|$$

- Assign all the pixels to the nearest centre based on distance d. (forming clusters)

- After all clusters formed, find new centroid by taking algebraic sum of all vector positions of data pts of a cluster.

$$C_k = \frac{1}{K} \sum_{y \in C_k} \sum_{x \in C_k} P(x, y)$$

- Repeat all process untill it satisfies tolerance value
- Reshape the cluster pixel into image.

→ centroid (initial) for k means must not be chosen randomly or else it would form different cluster every time.

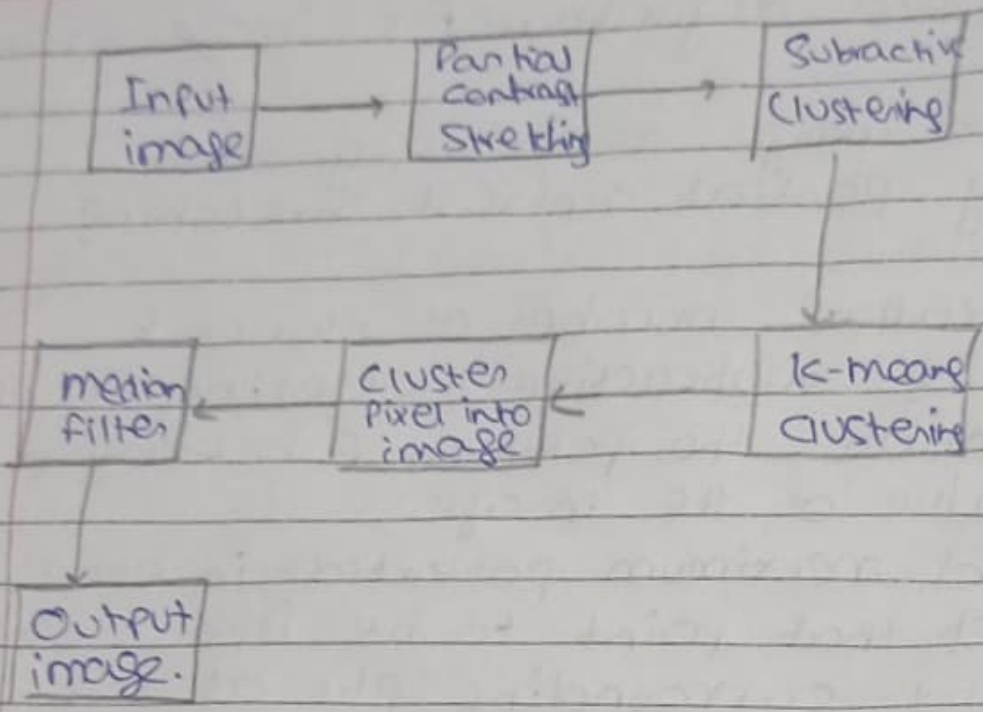
# median filter.

→ After image segmentation is done, we need to remove noise/disturbance present in image.

→ Hence we use median filter for that purpose.

# Proposed algorithm for Image Segmentation

1. Load image to be segmented
2. Apply partial contrast stretching (To improve Brightness and Contrast)
   Initialize number of cluster k
3. Using subtractive clustering technique calculate the potential for every pixel value of the image.
4. Find maximum potential in step 3 and set that point to be first cluster ~~point~~ center and surrounding pts as lower potential
5. Update potential of all grid points/data pts.
6. Again find maximum potential pts, continue until k cluster centers are obtained.
7. Use k center as initial center and start k-mean algorithm.
8. Find Euclidion distance of each centroid from every pixel of image.
9. Assign pixel with minimum euclidean distance as part of cluster with that centroid.
10. Recalculate new centre position.
11. Continue above k-mean algorithm untill error value is minum
12. Reshape the cluster into image.
13. Apply median filter to remove noise/disturbance




Proposed algorithm.