WEATHER PROCESS AND ANALYSIS BASED ON RANDOM CLOUD IMAGE BASED INFORMATION

By

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science & Engineering

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
STAMFORD UNIVERSITY BANGLADESH

February, 2017

DECLARATION

We, hereby, declare that the work presented in this Thesis is the outcome of the investigation performed by us under the supervision of Tarin Kazi, Senior Lecturer, Department of Computer Science &Engineering, Stamford University Bangladesh. We also declare that no part of this Thesis and thereof has been or is being submitted elsewhere for the award of any degree or Diploma

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ABSTRACT

In modern technology, the easy way of weather process, analysis and forecast are Satellite or Radar system. But the easiest way of weather process, analysing is processed by a creating software with image processing. Researcher explores their thought about weather information based on hardware. In this paper represents the several research papers different concept combines together and proposed to a new exploration of weather process for the new generation. In this paper used to image processing tool to create base information of weather processing. The random cloud image is a valuable source of information in weather forecasting and early prediction of different atmospheric disturbances such as cyclone, typhoons, hurricanes, and storms etc. A Content-Based Image Retrieval (CBIR) system has been developed using the grey scale as retrieval features from the random image assortment. Image classification used image clustering for pixel value group into clusters based on similarity. Cluster pixel values purposes at searching for common characteristics without knowing the exact data types. Image indexing is stored pixel data to an index which is created in this research. The Euclidean distance metric is used to compute the similarity and non-similarity between the images.

Keywords: Image retrieval, Euclidean distance, Content-based image retrieval using gray scale retrieval features, noise, image clustering, k-mean cluster algorithm, image indexing, similarity and non-similarity computations.

ACKNOWLEDGEMENTS

First, I would like to thank the almighty ALLAH. Today I am successful in completing my work with such ease because He gave me the ability, chance, and cooperating supervisor.

I would like to take the opportunity to express my gratitude to Tarin Kazi, my respected supervisor. Although she was always loaded with several other activities, she gave me more than enough time in this work. She not only gave me time but also proper guidance and valuable advice whenever I faced with some difficulties. Her comments and guidance helped me in preparing my thesis report.

I would like to thank all other respected teacher of my department, who inspired me in every step. I am also thankful to my teachers who helped me in a number of ways by providing various resources and moral support.

Last of all, I am grateful to my family; who are, always with me in my every step of life.

LIST OF TABLES

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

CHAPTER-1

1.1 INTRODUCTION

The weather forecasting is the process which takes images from any portion of earth by satellite or radar then analyzing weather and monitoring atmospheric environment by image processing. There are two types of weather forecasting system one of them satellite and the other is RADAR. In Bangladesh we have two RADAR one is located in Dhaka and the other is locate in Rangpur. The Government of Japan will provide an amount of 2,881 million Japanese yen equivalent to approximately taka 186.26 corer as grant aid for the project for improvement of meteorological RADAR system in Dhaka and Rangpur.[5] That RADAR has wind velocity up to 270 km per hour within the radius of 200 km from RADAR center.[5] It forecasting of rainfall per hour within the radius of 450 km from the RADAR center.[5] But that RADAR system is not cover full of Bangladesh but satellite all of these process can easily do and it is not only covering full Bangladesh but also it cover whole earth to detect weather and forecasting fastly. There will be launched Bangabandhu-1 satellite in 16 Dec,2017.[7] It will be the first Bangladeshi geostationary communication satellite leaded by Bangladesh Telecommunication Regulatory commission.

Recently three researcher developed first nano satellite brac onnesa which will be working for weather forecast.[15] It's maintenance cost is low than Bangabandhu-1 satellite cost. In this paper all of those concept combines together and create a new concept which is easy to use and affordable for every general people. In this new concept has no extra cost. I'm working on weather process and analysis properly by image processing system using MATLAB IDE. In this process, I follow some steps to accomplish my exploration. Here I give that step point which is I used:

- MATLAB
- Convert RGB to Grayscale image
- Noise
- Pixel value
- K-mean clustering algorithm
- Centroid point of pixel values
- Euclidean distance

Here I introduce those steps, which is needed, in my research. First, I use MATLAB IDE to process an image. In MATLAB I convert an RGB image to Grayscale image. Then find out its noise so I use salt pepper noise. Then I find out its pixel value with noise. I use the k-mean clustering algorithm to cluster the image and calculate the centroid point of pixel values. Then I use the Euclidean distance formula to find the exact distance of pixel value of images.

1.2 OVERVIEW

In my research, I am working to get the proper information of weather. Here I take some random images to create base information of weather. Then I take another image, which I know its weather information, and then I tested these images to compare my base

information and find out the value where it is matched with the base information. Here I divided my created base information into three segments. They are:

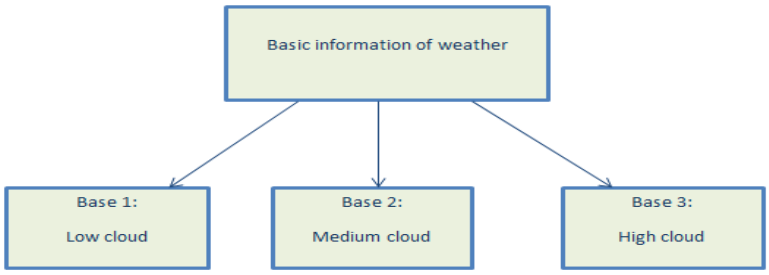


Fig-1.1: Base information of weather process

Here in my research, low cloud represents the image which sky is totally clear and there is no possibility to create any cloud, rain or storm. Medium cloud represents that image which sky has clouds and there is a possibility to rain. High cloud represents that image which sky is cover with too many clouds, it starts to rain, and there is a possibility to create a storm.

For creating this base information at first I take one image which has no cloud. Then I convert this image into grayscale image.[14][3] I also find out the quantity of noise. Here I use salt pepper noise to get the exact value of pixels, which is created based on the cloud to define how much cloud is there with black and white pixels. Then I clustered this image pixel values and find out the centroid point of clustered pixel values using k-mean clustering algorithm.[1][13][14] Then I find out the Euclidean distance of clustering centroid point using the Euclidean distance formula. Similarly, I created other two base information like low cloud image.

So I analysed several images result to identify the distance of cloud. Here three different Euclidean distance value creates three basics of weather information. Euclidean distance refers to how much similar and non-similar distance has between clouds in three types of images.

Table-1.1: B ase information of Random cloud image.

Base-1:low cloud (Euclidean distance) cloudless	Base-2:Medium cloud (Euclidean distance) starts to rain	Base-3:High cloud (Euclidean distance) storm
2.8123e+03	2.5497e+03	1.5353e+03

I also find out the normal Euclidean distance of two images using pixel values. But the value is not exact that's why the k mean clustering algorithm is used to get the exact centroid Euclidean distance value of three images.

Table-1.2: Compare new image with Base information of Random cloud image.

New image (Euclidean distance)	Base-1:low cloud (Euclidean distance)	Base-2:Medium cloud (Euclidean distance)	Base-3:High cloud (Euclidean distance)
Image-1: 1.174221316470938e+03	2.8123e+03	2.5497e+03	1.5353e+03
Image-2: 2.296576916052391e+03	Image-4	Image-2	Image-1
Image-3: 1.2412e+03			Image-3
Image-4: 2.9936e+03			

Error_n = Base_n_euclidean distance- random image_n distance

Here error_n is the Euclidean distance of base image and new image Euclidean distance non-similarity distance value.

CHAPTER-2

BACKGROUND

CHAPTER-2

2. BACKGROUND

A weather satellite is a satellite that is used to trace and locate weather system like hurricanes, thunderstorms, tornadoes, rain, hail and it also shows the temperature of water, land and air. ArthurC. Clark was the inventor of the satellite in October 1945. John Daniel's research lead to the invention of Tirous-1 in 1820.Vanguard-2 was launched on February 17, 1959 and it was unsuccessful. Tirous-1 was considered the first successful launch by NASA on April 1, 1960. There are two types of satellite GOES and POES. Geostationary operational environmental satellites (GOES) rotate with the earth. Designed to work in geostationary orbit 35,790 km. Polar Operational Environmental Satellite (POES) leads a Galaxy of weather satellite in polar orbits around the earth. It's altitude of 530 miles (850 km). These satellite pass over the poles in there continuous flight. GOES satellite sent raw environmental data to ground station then ground station sent processed environmental data to GOES then GOES satellite broadcast processed data to users.[9][6]

RADAR(Radio Detection And Ranging) is an object detection system that uses radio waves to determine the range, altitude, direction and speed of objects. It was in the late 1980s that the National Weather Service, in a tri-agency effort with the U. S. Departments of Defence and Transportation, developed a network of new Doppler weather radars (the WSR88D) across the United States.[8]

Weather radars transmit a pulse of energy into the atmosphere and if targets are present, then as the signal becomes scattered, a much smaller part of the pulse energy is reflected back to the radar. The resultant reflected signals, which we refer to as return signals, are indicated on radar displays as "reflectivity" echoes and generally show us areas of precipitation (rain, snow, etc.). The larger the target, in this cases the precipitation element, the stronger the return signal. Accordingly, not only does the location of these colour coded echoes indicate where precipitation is occurring (even though, at times, the precipitation may not reach the ground), but the colour indicates the intensity of the precipitation.. with blues and greens indicating lighter precipitation while yellows and reds depict precipitation of heavier intensities. It should be noted that very high reflectivity's (red colours) can indicate the presence of hail in more violent thunderstorms.[6][8]

But the random cloud image process is working with content based grayscale feature extraction k-mean use to cluster the image data and Euclidean distance find out the similarity of images.

CHAPTER-3

RESEARCH FOCUS

CHAPTER-3

3. RESEARCH FOCUS

In this research, totally I focused on develop a perfect weather process and analysis system. Further, I also develop software-based information on this system. In this paper creates some research problem, questions and research aim. They are:

3.1RESEARCH PROBLEM

In this research, I did not get original data of weather processing or analysing. Here I used random image data. However, in my research I find out the exact value of weather system. In satellite and RADAR, system has the problem of cost and time. This two system takes time and their maintenance cost is so high.

3.2RESEARCH QUESTION

There is some question about the research:

- Why I choose this research topic.
- Is it effective research.
- Why my concept is better than other researcher exploration on satellite and RADAR system.
- Why I take the random images.
- Why I used grayscale image.
- Why I use k-mean cluster algorithm.
- What will be the method of calculating the similarity and non-similarity between images.
- Why used the image indexing.
- What is the benefit of using salt-pepper noise.

3.3RESEARCH AIM

In Bangladesh perspective the satellite or Radar weather process and forecasting is the major topics. In our country has two radars and Bangabandhu-1 satellite will be launched Dec, 2017 but those two system maintenance cost is high and also government send a team to NASA for trained up about satellite maintenance. In my research exploration my aims at minimize the cost, time and distance.

CHAPTER-4

RESEARCH METHODOLOGY

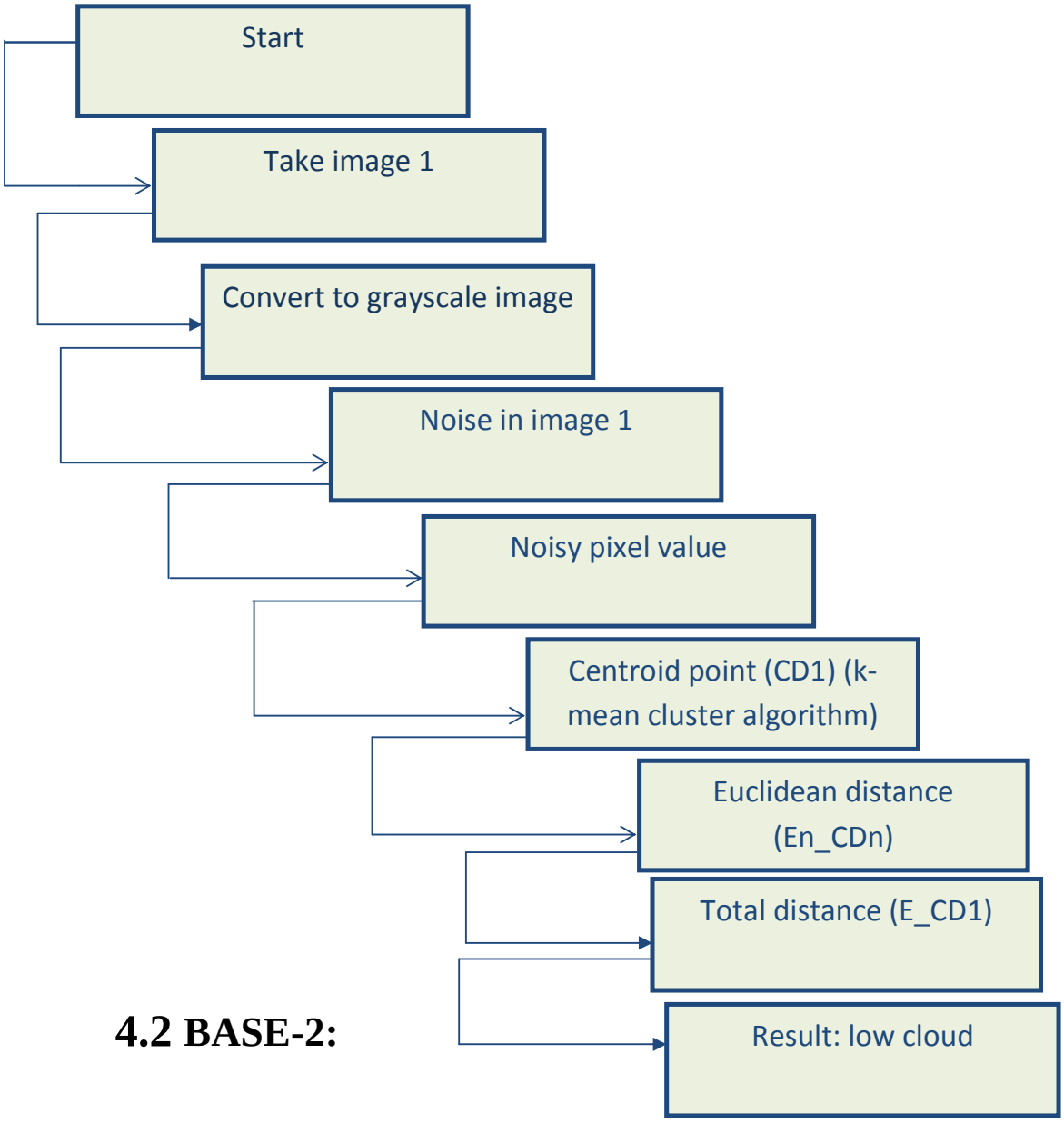
CHAPTER-4

4. RESEARCH METHODOLOGY

4.1 BASE-1:

FOR CREATING BASE-1 AT FIRST I START MATLAB AND TAKE B1.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IMAGE. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND FIND OUT CD1 AND CALCULATE THE ED1. HERE I GET THE BASE-1 INFORMATION.

For Base-1 (low cloud)



4.2 BASE-2:

FIG-4.1: Base 1(Low Cloud)

FOR CREATING BASE-2 I TAKE B2.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IMAGE. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND FIND OUT CD2 AND CALCULATE THE ED2. HERE I GET THE BASE-2 INFORMATION.

For Base-2 (medium cloud)

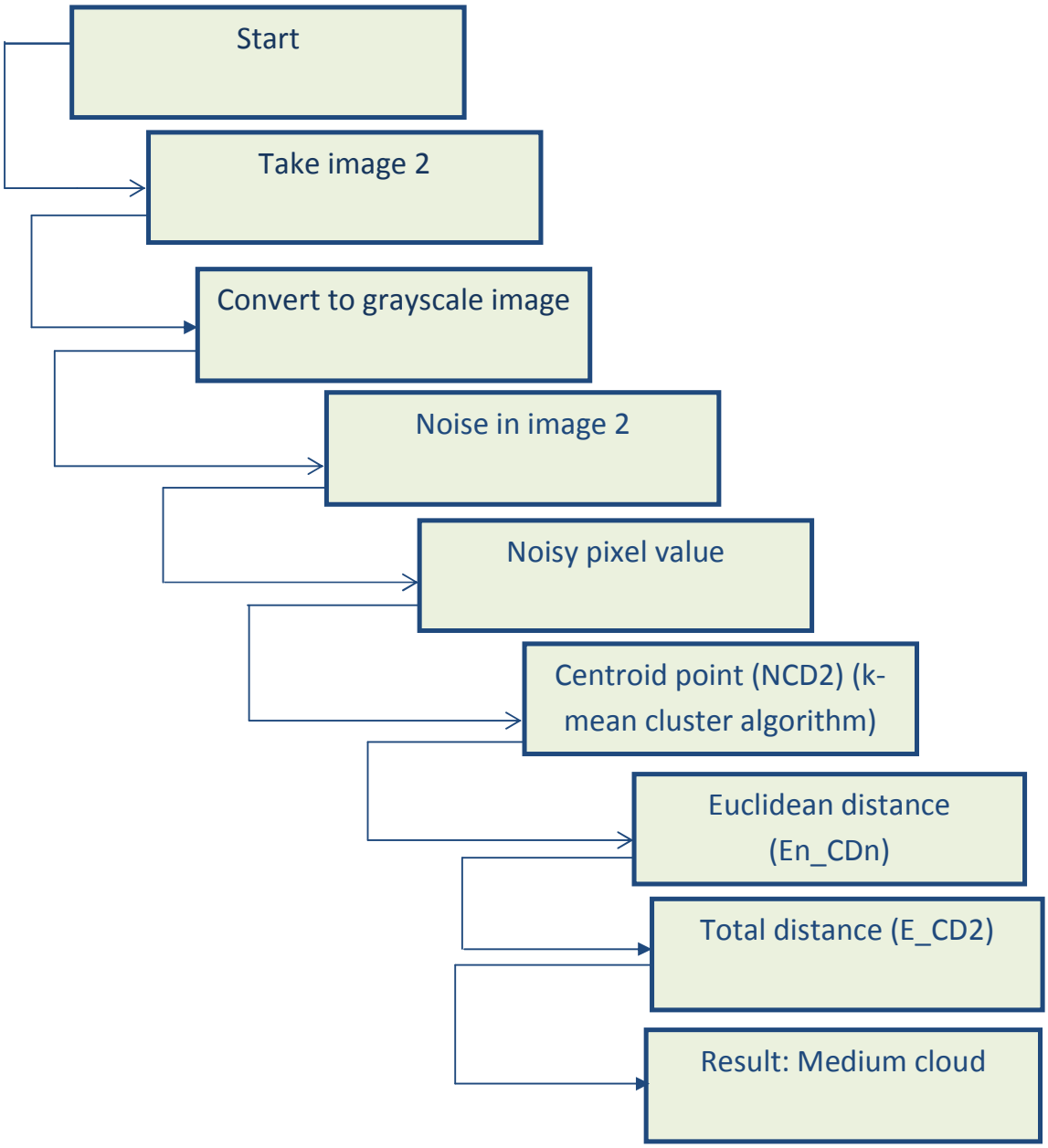
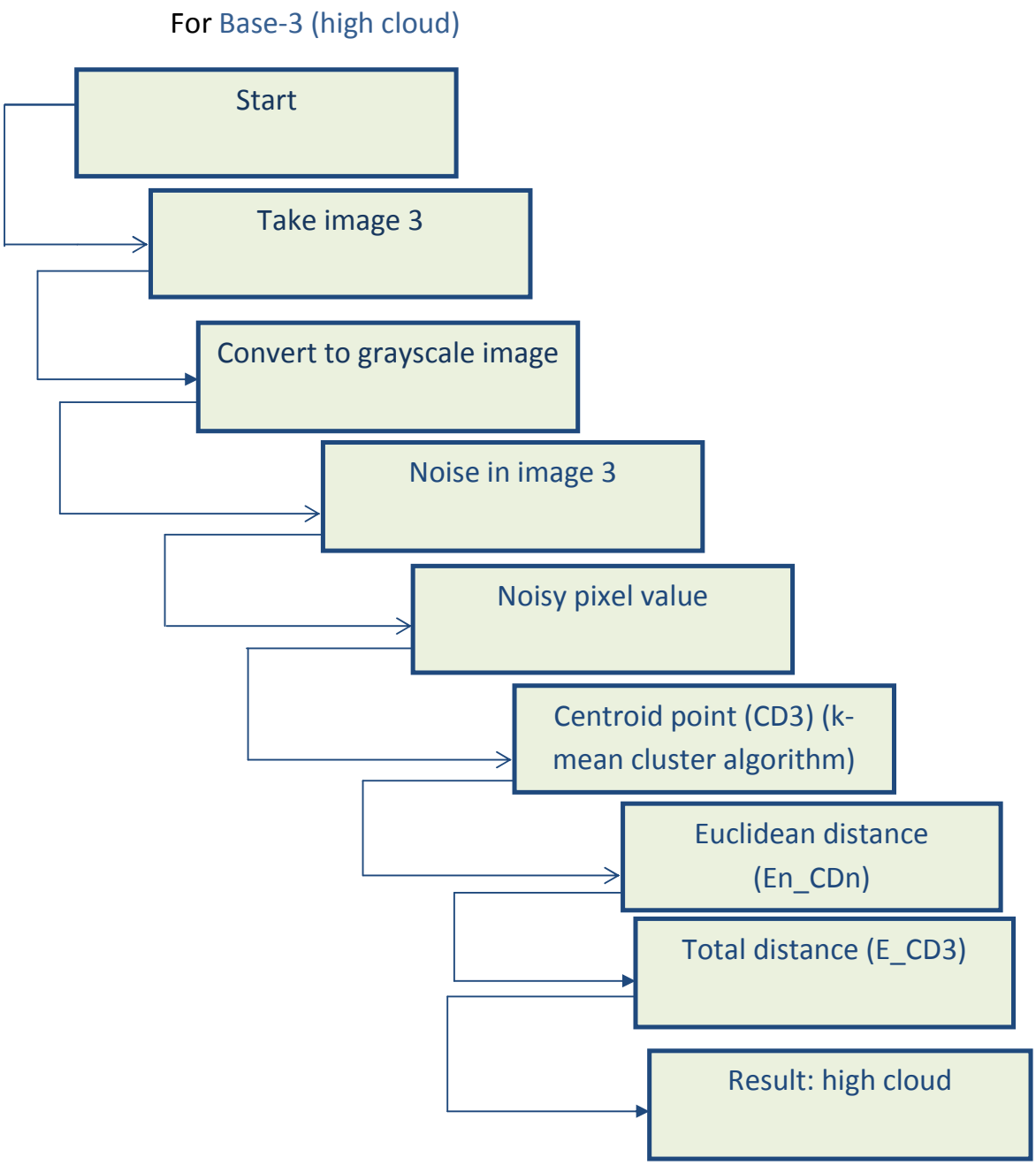


FIG-4.2: Base 2(Medium cloud)

4.3 BASI

FOR CREATING BASE-3 I TAKE B3.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IMAGE. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND FIND OUT CD3 AND CALCULATE THE ED3. HERE I GET THE BASE-3 INFORMATION.



4.4 IMAG] FIG-4.3: Base 3(High Cloud)

TO GET OUTPUT BN I TAKE IM1.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IM. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND FIND OUT NCD1 AND CALCULATE THE NEN_CD1. HERE I GET THE BN INFORMATION.

For new image 1

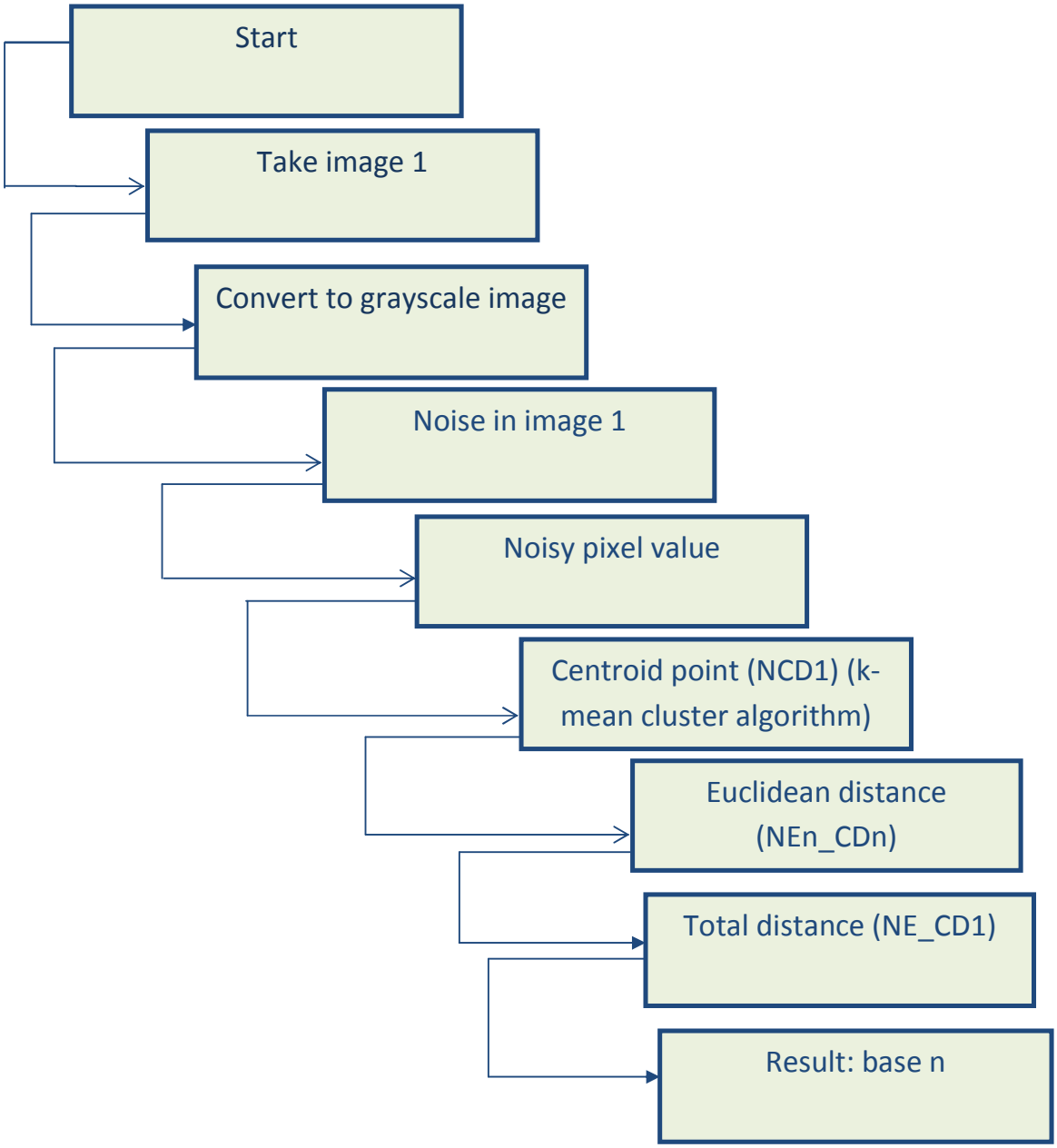


FIG-4.4: New Image 1 for base n

4.5 IMAGE-2:

TO GET OUTPUT BN I TAKE IM2.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IM. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL

VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND FIND OUT NCD2 AND CALCULATE THE NEN_CD2. HERE I GET THE BN INFORMATION.

For image 2

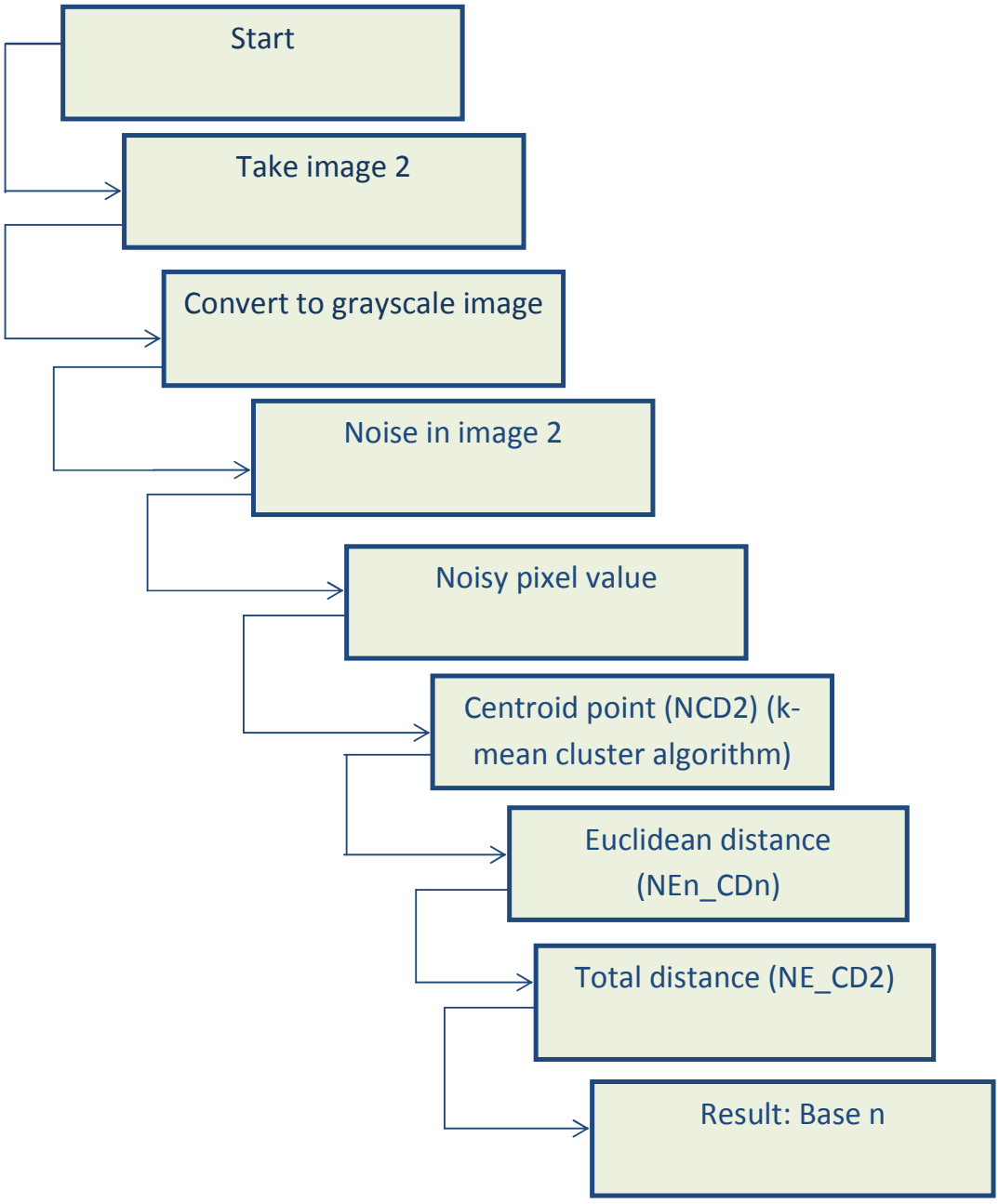


FIG-4.5: New image 2 for base n

4.6 IMA

TO GET OUTPUT BASE N I TAKE IM3.TIF AS A INPUT THEN CONVERT IT GRAYSCALE IMAGE. IT'S HAS SALT PEPPER NOISE SO I GET NOISY PIXEL VALUES THEN I DIVIDED THEM INTO THREE CLUSTER AND

FIND OUT NCD3 AND CALCULATE THE NEN_CD3.HERE I GET THE BASE N INFORMATION.

For image 3

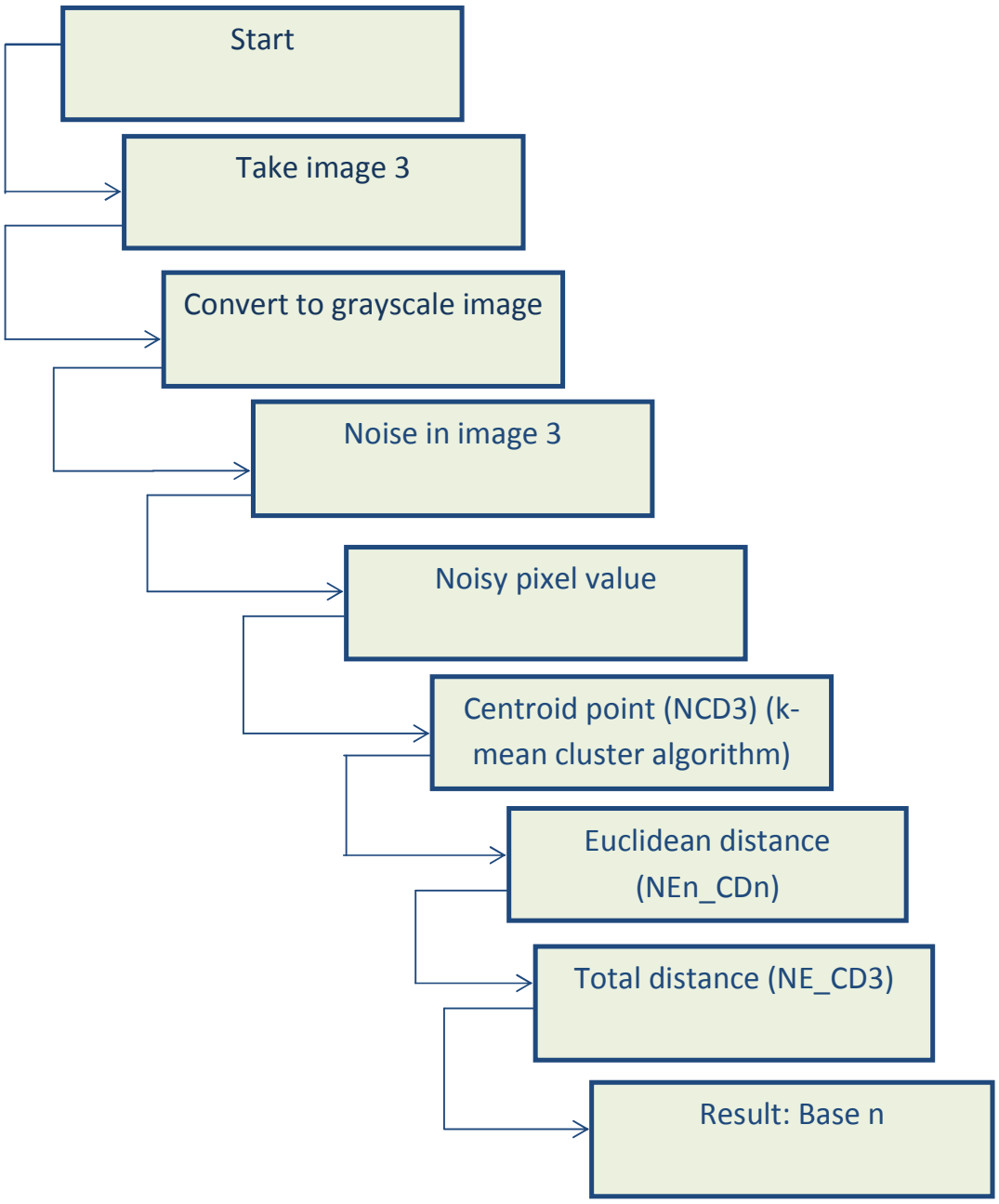


FIG-4.6: New image 3 for base n

4.7 K-MEAN CLUSTER ALGORITHM WORKS:

How the k-mean clustering algorithm works?

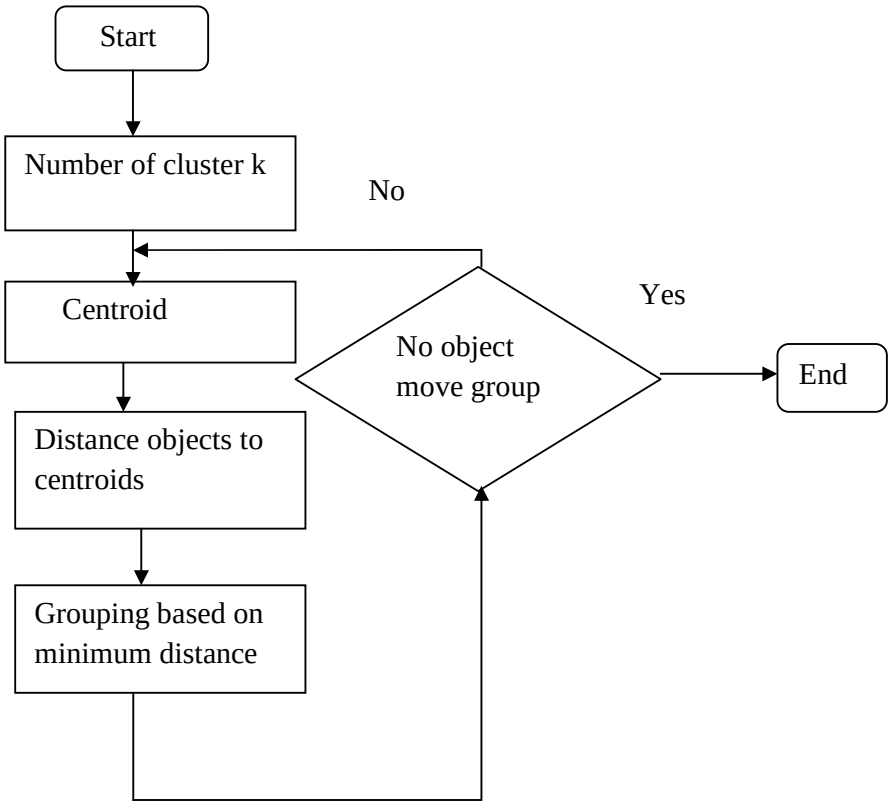


FIG-4.7: K-mean clustering algorithm.

4.8 COMPARE BETWEEN BASE IMAGE AND NEW IMAGE AND EXECUTE SIMILARITY AND NON-SIMILARITY:

Compare and error execution:

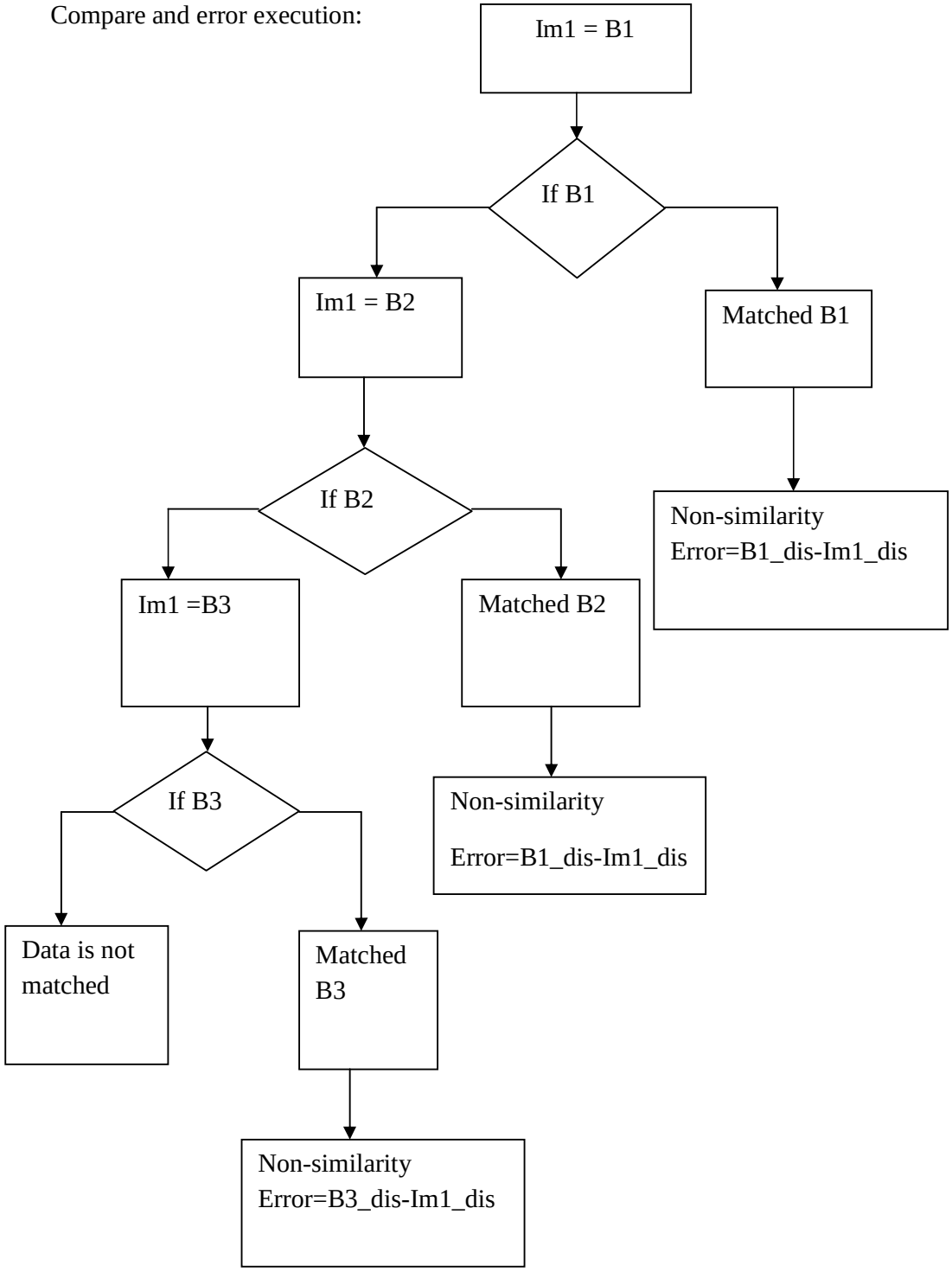


FIG-4.8: compare and execute the error between base image and new image.

CHAPTER-5

DATA TYPE

CHAPTER-5

5.1 DATA COLLECTION

.xlsx file to pixel data store and .mat file to cluster, index and Euclidean distance data stored.

5.2 DATA ANALYSIS

In this research all images pixel data store in .xlsx file to data analysis by MATLAB using k-mean cluster algorithm and similarity and non-similarity value analysis by Euclidean distance.

CHAPTER-6

LITERATURE REVIEW

CHAPTER-6

6. LITERATURE REVIEW

Researchers explore satellite and Radar system to process and forecast weather correctly. At first in our world, researchers and meteorological employee predicted the weather. There are no exact resources to explore the perfect weather system. They are just predicted the weather. Now-a-days many researcher explore many techniques to get a proper information of weather. Recently researchers explore satellite base weather forecast. Here a researcher search and analysis content based satellite cloud image retrieval. Another researcher discover the nano satellite and using MATLAB to process weather information and forecast. [15]

The recent research papers on hardware and software implementation of weather satellite imaging earth station, content based satellite cloud image retrieval, and vector quantization method based on satellite cloud image impressed me and also convince me that. I appreciate their integrative relevance to my research area.[2][3][4] In my research, the concept of techniques which I used, it should be able to exhibit that my proposed area has not been studied before. Here I describe my that techniques:

6.1 Content based Grayscale feature:

In this research, I converted a RGB image to a grayscale image. Gray scale image is an image which has two colors, black and white. This types of images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum(e.g. infrared, visible light, ultraviolet etc.). this technique I used to understand the exact portion of cloud and how much cloud is there.

Fig-6.1: convert RGB image to Grayscale image

6.2 Noise:

Here I use noise to get the exact value of weather. In image processing system has many kind of noise. But I use the salt pepper noise. Salt pepper noise is a noise

sometimes seen on images. It presents itself as occurring black and white pixels. In this process noise perfectly find out the cloud pixel values.

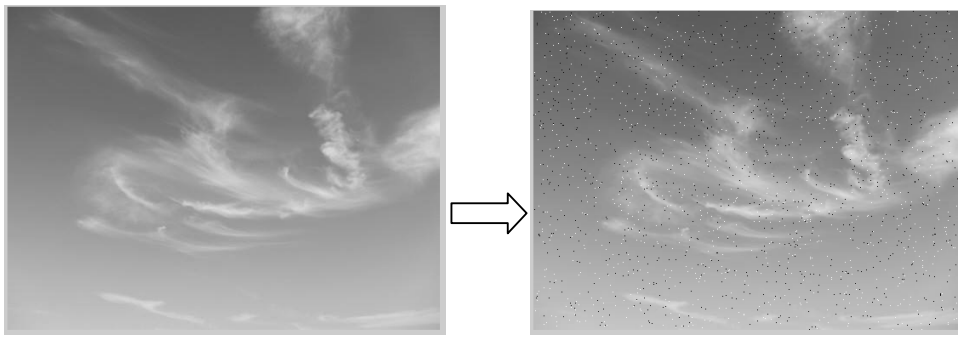


Fig-6.2: Noise (salt-pepper)

6.3 Image clustering:

Image clustering and categorization is a bunch of high-level description of image content. The concept is to trace a mapping of the archive images into classes such that the set of classes provide essentially the same information about the image archive as the entire image-set collection. Image clustering use many cluster algorithm like fuzzy c-mean cluster, nearest neighbour cluster and k-mean cluster algorithm. Here I use k-mean cluster algoritm to cluster images pixel value.[1]

6.3.1 k-mean cluster algorithm:

k-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in my research. k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, adoration as a prototype of the cluster.[13][14]

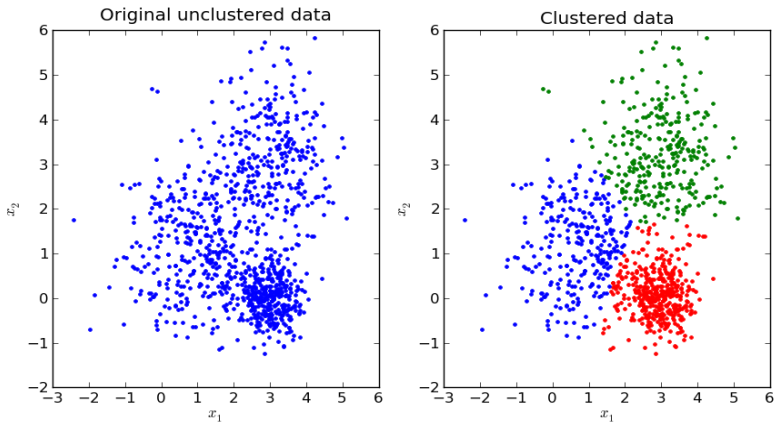


Fig-6.3.1: clustered data using k-mean clustering algorithm.

6.3.2 Centroid point:

Centroid point is the value of every pixel values midpoint. In my research paper I use k-mean clustering algorithm to find the pixels centroid point.[13]

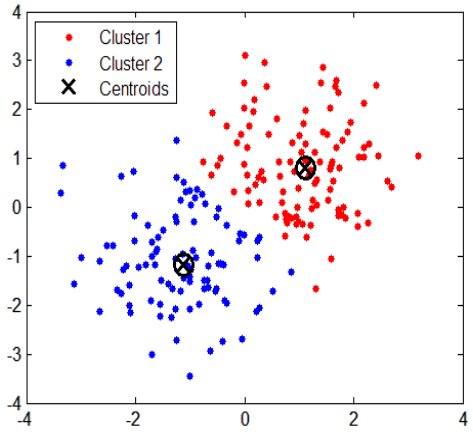


Fig-6.3.2: centroid point of k-mean cluster algorithm.

6.4 Euclidean distance:

Euclidean distance is the metric that calculate the distance between two points or pixels. Here I use Euclidean distance to find out the similarity and non-similarity between image pixel values. The formula is:

$$E\_distance(x,y) = \sqrt{(x-y)^2}$$

Euclidean distance measure the distance between clusters of images. In my proposed exploration I divide all images in three clusters individually. Then observe the similarity and non-similarity between two images.

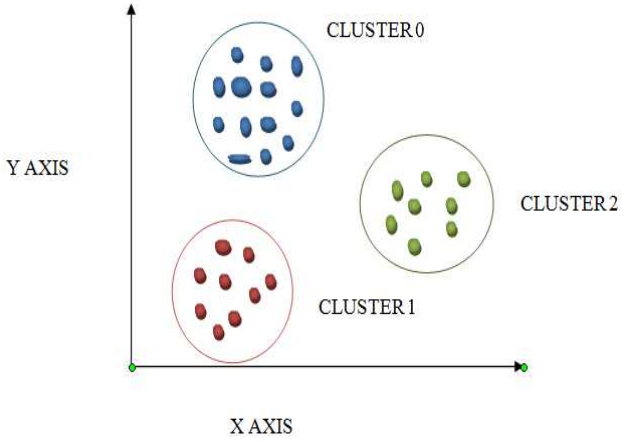


FIG-6.4: Euclidean distance between cluster data.

CHAPTER-7

CONCLUSION

CHAPTER-7

CONCLUSION

7.1 DISCUSSION

In my research, the concept of techniques which I used, it should be able to exhibit that my proposed area has not been studied before so I think it is better concept to bringing up.

This research effectively works. Other research invention is so complex and costly. But this exploration is so simple to use anyone and understandable. Also it is explore without any cost.

My concept is better than satellite or Radar system because in this paper combines with several researcher concept. The most significant part is, this paper explore the random cloud images weather information which gives the exact value of any other process.

In my research paper I did not get the original meteorological data. Because the data of meteorological is confidential.

In this research, I converted a RGB image to a grayscale image.[14][3] Gray scale image is an image which has two colors, black and white. These types of images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet etc.). This technique I used to understand the exact portion of cloud and how much cloud is there

K-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in my research. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, adoration as a prototype of the cluster.

Euclidean distance is the metric that calculate the distance between two points or pixels. Here I use Euclidean distance to find out the similarity and non-similarity between image pixel values. The formula is:

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Here I use noise to ge[illegible] In image processing system has many kind of noise. But I use the salt pepper noise. Salt pepper noise is a noise

sometimes seen on images. It presents itself as occurring black and white pixels. In this process noise perfectly find out the cloud pixel values.

7.2 FUTURE WORK

In my research paper, there is an easy process to find out the exact weather information. In my work I have briefly discussed about the k-mean clustering algorithm how it's return the correct value.

In future, I will be upgrading this process and also I will make it as software for general people. So I will add this process data in mysql database system and there will be a process to take an image as an input then query that image and calculate the image and returning the expected value.

CHAPTER-8

APPENDIX

APPENDIX

For base image

```
clc;
clear all;
close all;
A1=imread('n1.tif');
A1=rgb2gray(A1);
Y1=imnoise(A1,'salt & pepper',0.01);
title('Base image');
alldata= xlsread('n1.xls','hour','A2:J10250');
[IDX,CD]=kmeans(alldata(:,6:9),3);
a1=alldata(IDX==1,:);
a2=alldata(IDX==2,:);
a3=alldata(IDX==3,:);
c=[0 0 0 0 0 0 0 0 0 0 ];
b1= CD(1,:);
b2=CD(2,:);
b3=CD(3,:);
```

For compare image

```
clc;
clear all;
close all;
B1=imread('n1.tif');
B1=rgb2gray(B1);
Z1=imnoise(B1,'salt & pepper',0.08);
title('New image');
alldata= xlsread('cm.xls','hour','A2:J5678');
```

```
[IDX,CD]=kmeans(alldata(:,6:9),3);

c1=alldata(IDX==1,:);

c2=alldata(IDX==2,:);

c3=alldata(IDX==3,:);

e=[0 0 0 0 0 0 0 0 0 0 ];

d1= CD(1,:);

d2=CD(2,:);

d3=CD(3,:);
```

BIBLIOGRAPHY

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[1] Hole, Aboli W., and L. R. Prabhakar. "Design and implementation of content based image retrieval using data mining and image processing techniques." database 3.3 (2015): 219-224.

[2] X. Liu, Z. Duan, X. Yang and W. Xu, "Vector Quantization Method Based on Satellite Cloud Image", International Journal of Signal Processing, Image Processing and Pattern Recognition, vol. 8, no. 11, pp. 27-44, 2015.

[3] Upreti, Deepak. "Content-based satellite cloud image retrieval." the Faculty of Geo-Information Science and Earth Observation of the University of Twente (2011).

[4] C. Patil, T. Chavan and M. Chaudhari, "Hardware and software implementation of weather satellite imaging earth station", 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2016.

[5] Government of the people's republic of Bangladesh Ministry of Finance Economic Relations Division, "The project for improvement of meteological RADAR System in Dhaka and Rangpur", 2015.

[6] Meteorology, "Weather satellites", Slideshare.net, 2017. [Online]. Available: https://www.slideshare.net/msjoseph/weather-satellites?qid=b588c93b-f099-4a42-8791-2e3f4e8fb060&v=&b=&from_search=3. [Accessed: 21- Mar- 2017].

[7] "Bangabandhu-1", En.wikipedia.org, 2017. [Online]. Available: https://en.wikipedia.org/wiki/Bangabandhu-1. [Accessed: 21- Mar- 2017].

[8] "Tornadoes - A Radar and Satellite Perspective", Laits.utexas.edu, 2017. [Online]. Available: http://www.laits.utexas.edu/kimmel_tornado/html/index-0.html. [Accessed: 21- Mar- 2017].

[9] "Geostationary Operational Environmental Satellite", En.wikipedia.org, 2017. [Online]. Available: https://en.wikipedia.org/wiki/Geostationary_Operational_Environmental_Satellite. [Accessed: 21- Mar- 2017].

[10] "What Is the Difference Between Satellite & RADAR Pictures? | Techwalla.com", Techwalla, 2017. [Online]. Available: https://www.techwalla.com/articles/what-is-the-difference-between-satellite-radar-pictures. [Accessed: 21- Mar- 2017].

[11] Qina, Kun, Min Xua, and Shuying Yuea Yi Dub. "CLOUD MODEL AND HIERARCHICAL CLUSTERING BASED SPATIAL DATA MINING METHOD AND APPLICATION."

[12] Kambhampaty, Viswanath, Rohith Gali, and R. A. Prasad. "Short term tornado prediction model using satellite imagery." IEEE proceedings of the 1st international conference on systems informatics, modelling and simulation, Sheffield. 2014.

[13] T. Mekonnen and K. Raimond, Drought Prediction, 1st ed. Saarbrücken: LAP LAMBERT Academic Publishing, 2014.

[14] Zahradnikova, Barbora, Sona Duchovicova, and Peter Schreiber. "Image mining: Review and new challenges." IJASA) International Journal of Advanced Computer Science and Applications 6.7 (2015): 242-246p.

[15] Age, "Brac students make nano satellite", The Asian Age, 2017. [Online]. Available: http://dailyasianage.com/news/47988/brac-students-make-nano-satellite. [Accessed: 21- Mar- 2017].