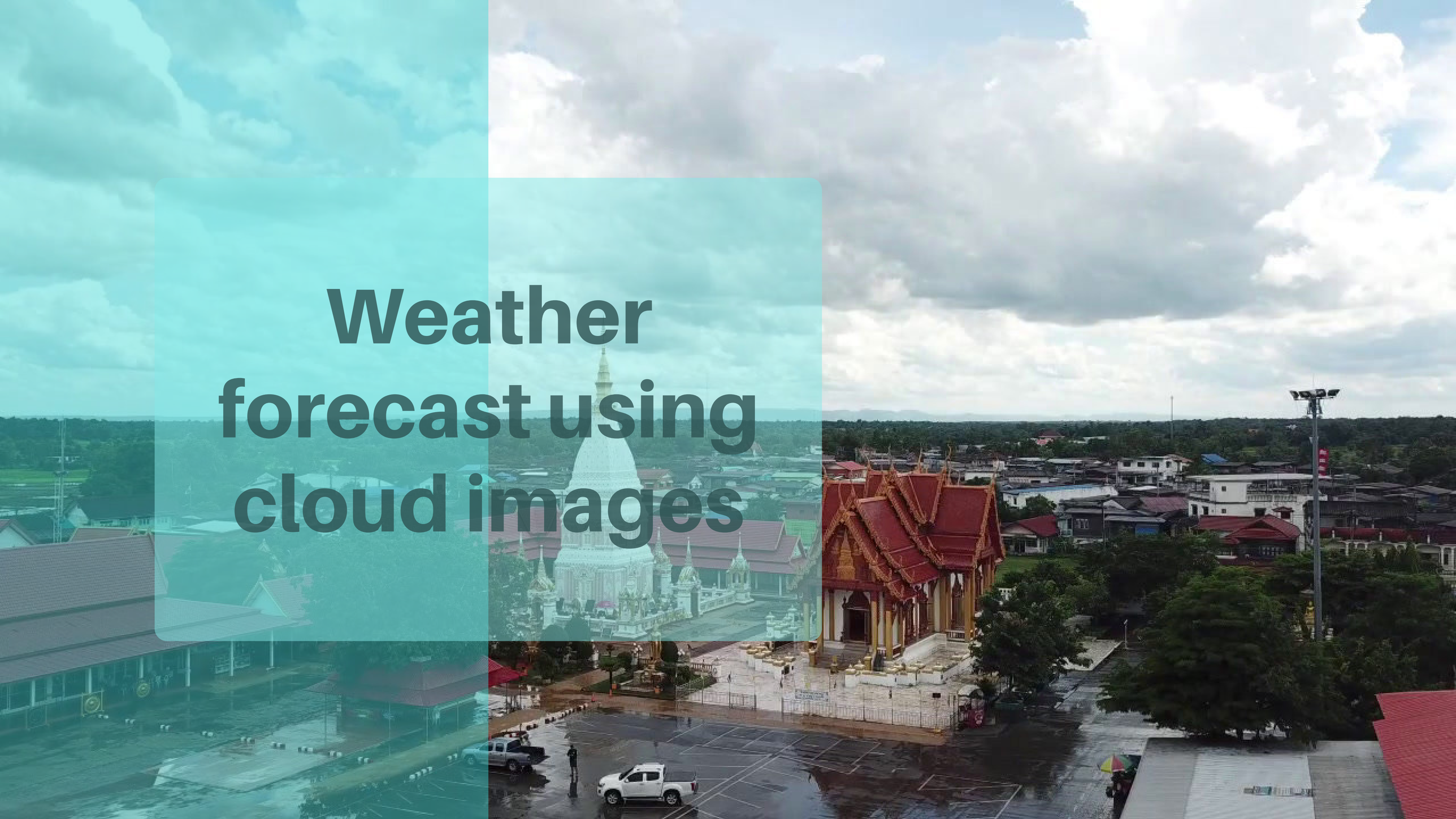
Weather forecast using cloud images



CONTENTS

REFERENCE DOCUMENT

DATASET

SWIMSEG, HYTA

ARCHITECTURE

Training - Testing

RESULT ANALYSIS

Evaluation Accuracy

REFERENCE DOCUMENT

Mrs. G. Gowri Pushpa , Hemaja Patoju , G. Sai Charan , M. Kali Charan, Pranita Jagtap from Department of Computer Science and Engineering ANITS, Vishakhapatnam, Andhra Pradesh, India, "Weather Forecasting Using Digital Image Processing"-JAC : A Journal Of Composition Theory (ISSN : 0731-6755).

Weather Forecasting Using Digital Image Processing

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Abstract- To predict the conditions of the atmosphere for a given location Weather Forecasting is used. It is the application of science and technology. Weather forecast is more helpful for people as it predicts how the future weather is going to be and people may plan accordingly. Farmers will be the most beneficial one's as they may know the rainfall prediction and grow crops accordingly. The weather forecast can be done in many ways like using the previous data or analyzing the current clouds. The authors predict the weather using the status of the clouds. The author used methodologies like Normalization, Clustering, and Cloud mask algorithm to predict the weather more accurately. Normalization is done using RGB values of each pixel. In many fields of research and in industrial and military applications Digital-image processing has become economical.

Keywords - Weather forecasting, normalization, clustering, and cloud mask algorithm.

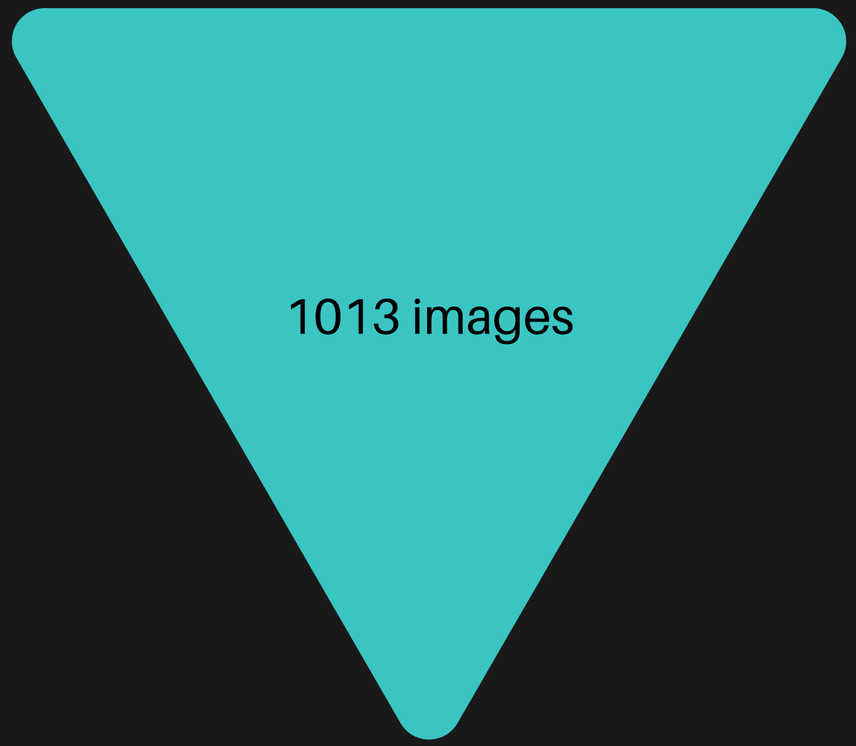
I. INTRODUCTION

Weather forecasting [1] means predicting the weather and telling how the weather changes with change in time. Change in weather occurs due to movement or transfer of energy. Many meteorological patterns and features like anticyclones, depressions, thunderstorms, hurricanes and tornadoes occur due to the physical transfer of heat and moisture by convective processes. Clouds are formed by evaporation of water vapor. As the water cycle keeps on evolving the water content in the clouds increases which in turn leads to precipitation. This is how the convective process happens and also the change in weather. Many factors like temperature, rainfall, pressure, humidity, sunshine, wind and cloudiness are considered for predicting the weather. It is also possible to identify the different types of clouds associated with different patterns of weather. These patterns of weather help in predicting the weather forecast.

In the past, people used barometric pressure, current weather conditions, sky condition to predict whereas now there are many computer based models that consider the atmospheric factors to predict the weather. These methods are not accurate and the reason is due to the chaotic nature of the atmosphere as it keeps on changing. Even predicting weather for a longer period of time will not be accurate that is why most of the current forecasting [1] models predict weather

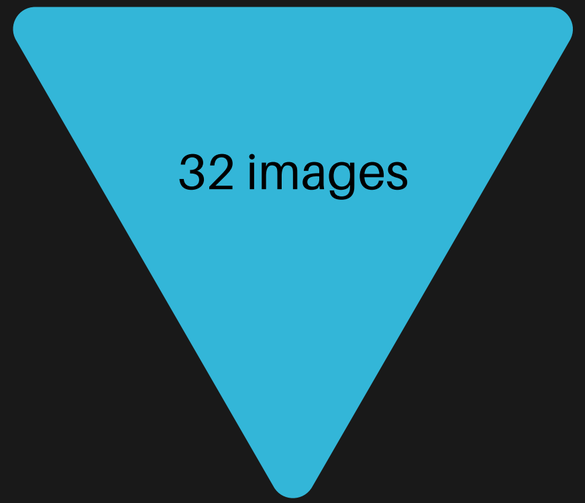
DATASET

Training



SWIMSEG dataset

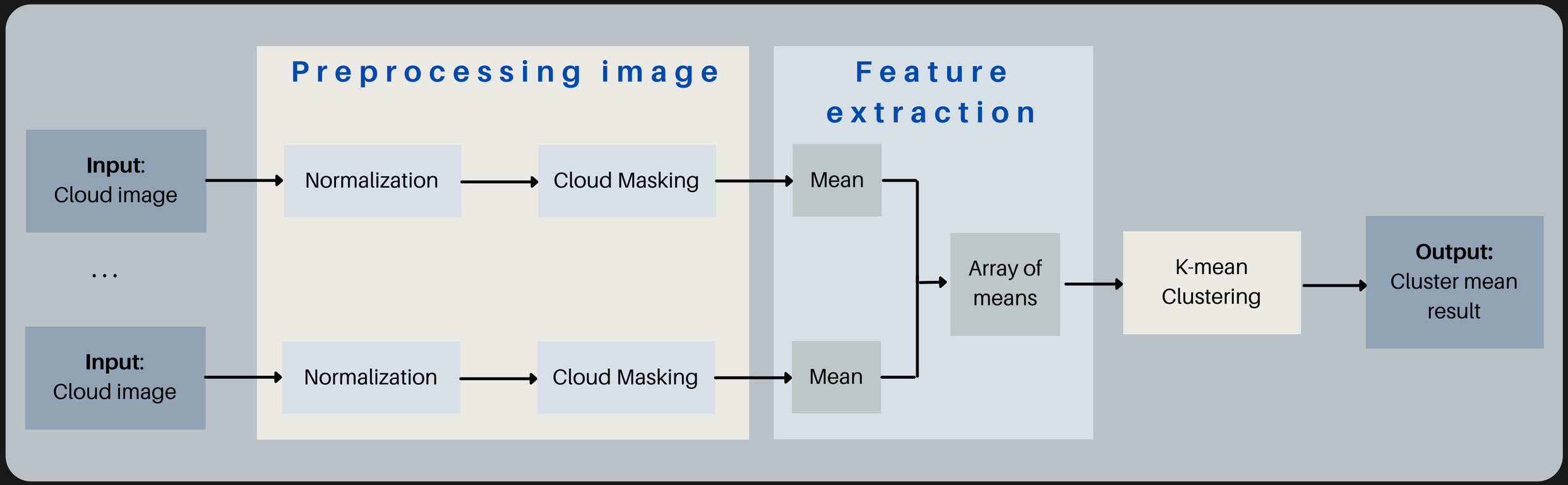
Testing



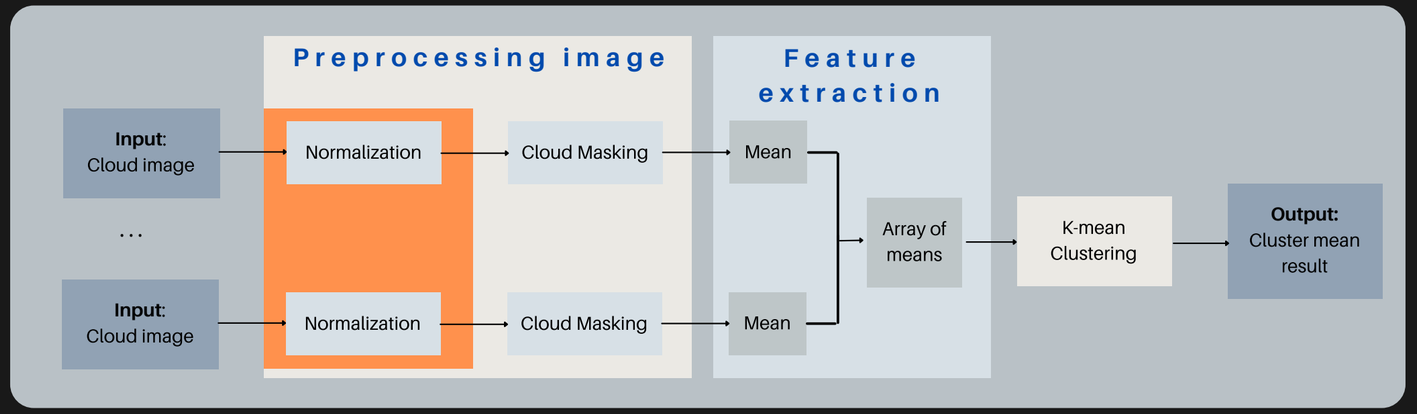
HYTA dataset

ARCHITECTURE

- Training



ARCHITECTURE

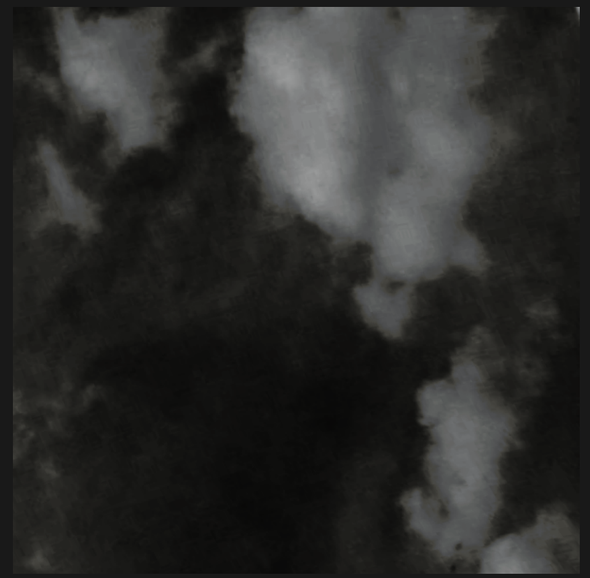


- Training

1. Normalization

- Change the input image to **grayscale image** by adjusting the intensity range of the BGR pixels to all BGR values in that pixel.

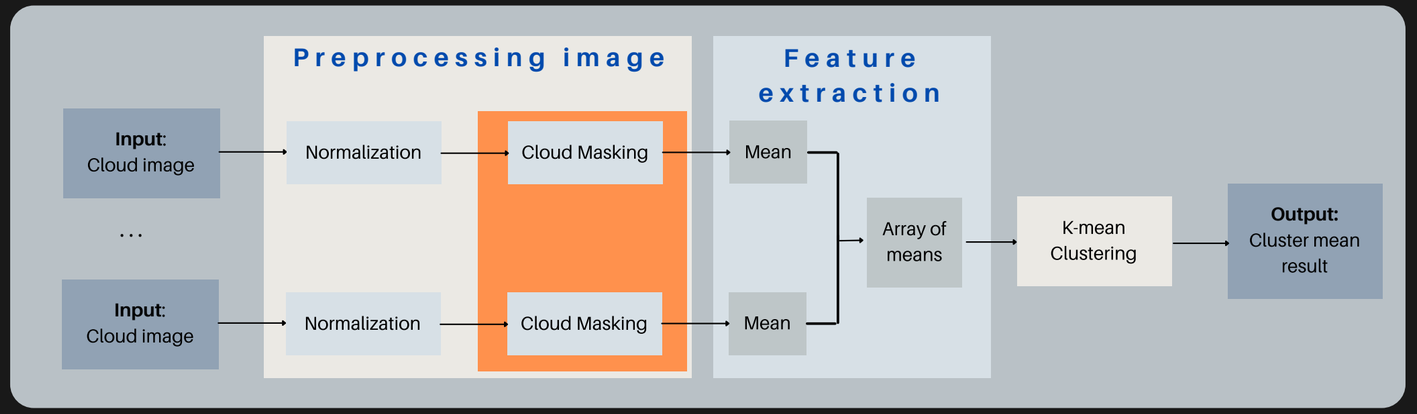
Code: 0.2126*B+0.0722*G+0.7152*R



- Increase the intensity to get a clear distinction between the clouds and the sky.
(Using arithmetic operations)

Code: f = (255/1)*(f/(255/1))**2

ARCHITECTURE



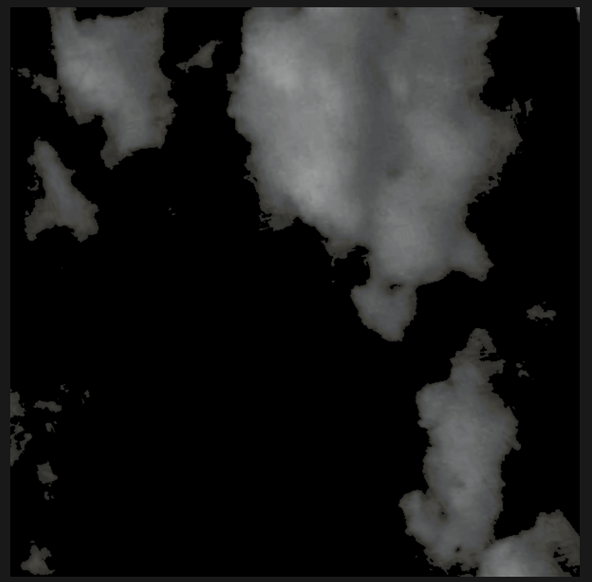
- Training

2. Cloud Masking algorithm

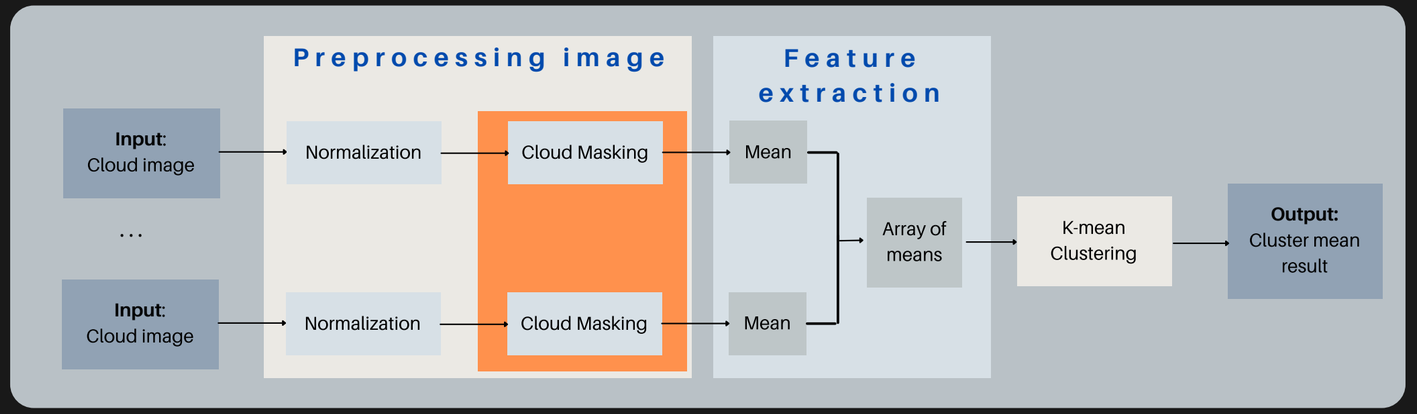
- **Threshold the image** by using cv2.THRESH_TOZERO with threshold = mean intensity value of the image that will cut out all the information that has intensity lower than or equal to the threshold to keep only the cloud information of the image.

Code: _, n = cv2.threshold(f, mean_all_pixels, 255, cv2.THRESH_TOZERO)

$$\texttt{dst}(x,y) = \begin{cases} \texttt{src}(x,y) & \text{if } \texttt{src}(x,y) > \texttt{thresh} \\ 0 & \text{otherwise} \end{cases}$$



ARCHITECTURE

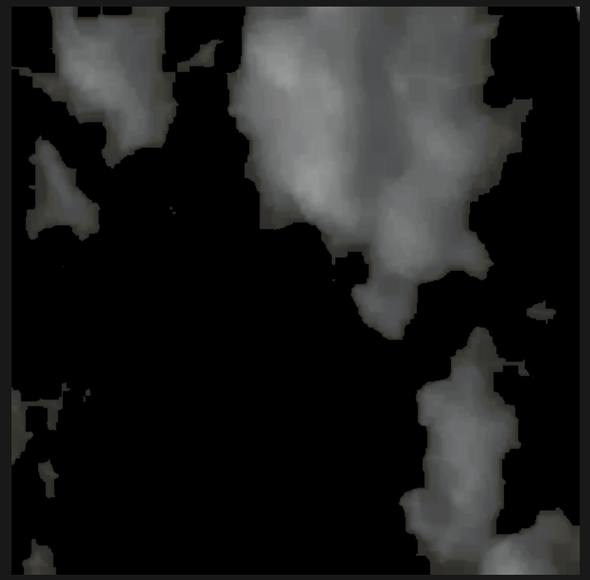


- Training

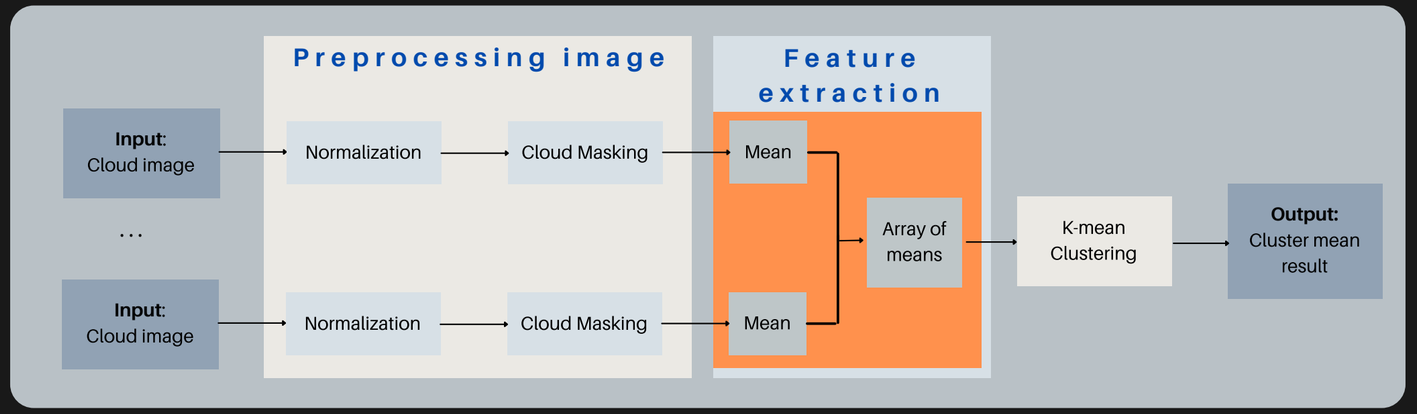
2. Cloud Masking algorithm

- Using **morphology operation (closing)** to fill some gaps between cloud areas and get little cloud edges that may be threshold out.

Code: kernel = np.ones((15, 15), np.uint8)
n = cv2.morphologyEx(n, cv2.MORPH_CLOSE, kernel)



ARCHITECTURE



- Training

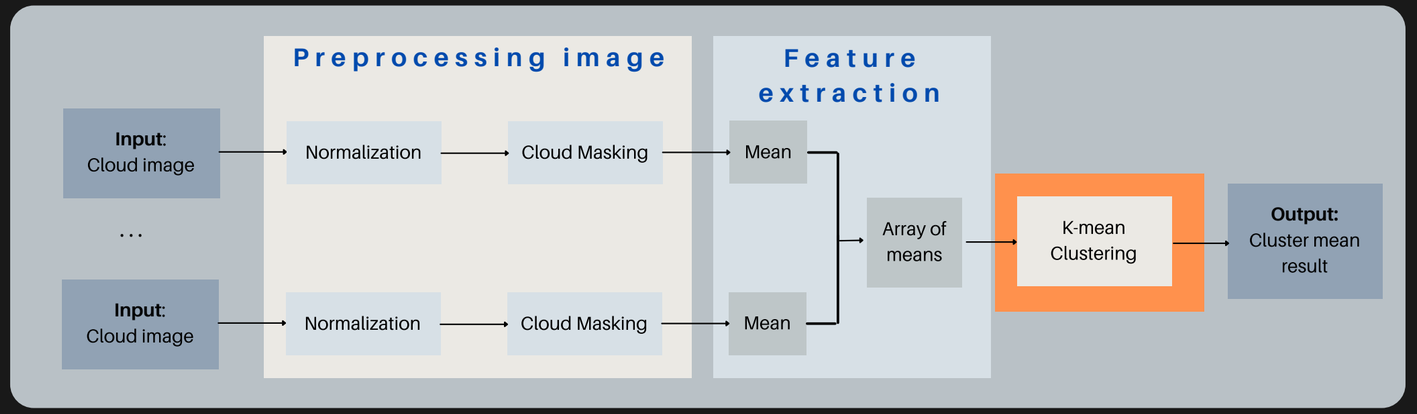
3. Feature Extraction

- **Extract the feature of the cloud** part by finding the mean value of the cloud area (where intensity value of that pixel not equal to 0).

** divided by the number of pixels where intensity value is not equal to 0 **

All of these processes (1-3) are done for all the images in the training and testing dataset.

ARCHITECTURE

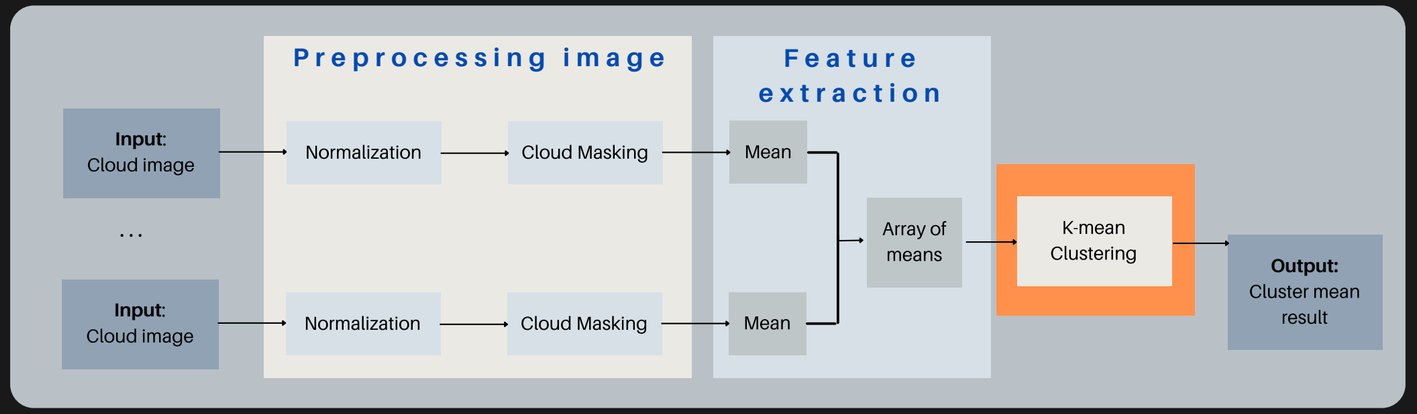


- Training

4. K-mean clustering algorithm

- Initial cluster mean: [[min+1], [(min+Max)/2], [max-1]].
- For each training image, find the nearest cluster by using Euclidean distance.
- Add cluster size and label index for training image.
- Update mean of that cluster index.
- Do it until no more cluster index changes.

ARCHITECTURE



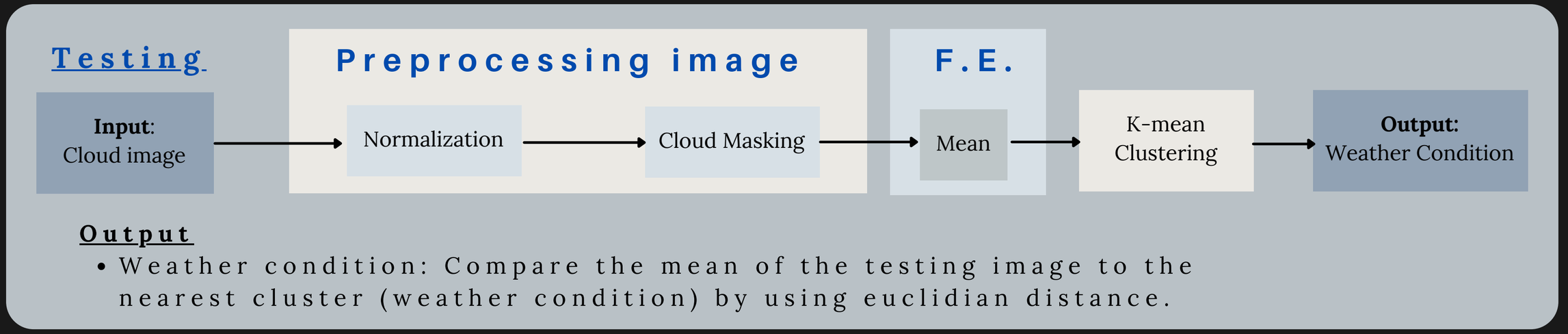
- Training

4. K-mean clustering algorithm

- Sort cluster mean.
- Label each cluster (Cluster 0: Sunny, Cluster 1: Cloudy, Cluster 2: High chance of rain).

ARCHITECTURE

- Testing



Do pre-processes and feature extraction like training dataset.

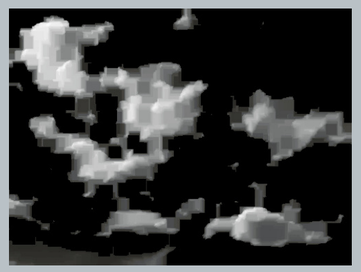
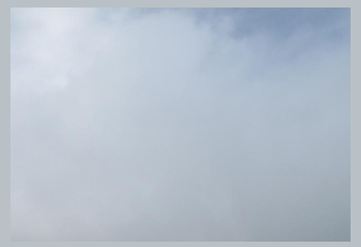
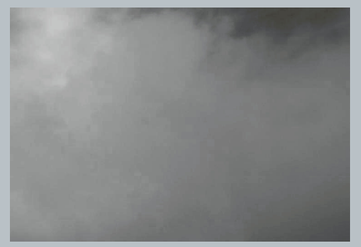
Result Analysis

- Cluster mean result

Cluster 0 SUNNY	Cluster 1 CLOUDY	Cluster 2 HIGH CHANCE OF RAIN
mean = 59.346	**mean = 112.251**	**mean = 175.905**

Result Analysis

- Cluster classification

Input	Normalized	Cloud masked			
			mean = 121.511	Cluster 1	CLOUDY
			mean = 157.222	Cluster 2	HIGH CHANCE OF RAIN

If we use preprocessed images for training and testing, we will get 78.125% accuracy of weather prediction, which is higher than using normal images with 62.5% accuracy.

Result Analysis

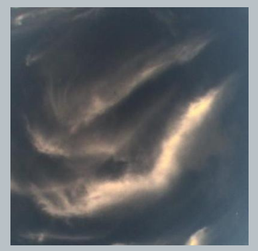
- Cluster classification

Input | Normalized | Cloud masked



mean = 47.001 | Cluster 0 | SUNNY

Wrong prediction



mean = 73.001 | Cluster 0 | SUNNY

If we use preprocessed images for training and testing, we will get 78.125% accuracy of weather prediction, which is higher than using normal images with 62.5% accuracy.

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6231356021 Vorapon Khunakornkorbkij