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COMPARING DIFFERENT COLOUR MODELS USED FOR ANALYSIS OF RADAR DATA

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Abstract— **Researchers have been working for decades to develop a model that can predict the weather with maximum accuracy using unstructured datasets. People are facing a slew of issues relating to farming, business, and property damage, among many other things, as a result of substantial weather swings. Because of the unpredictability of climatic and atmospheric circumstances, weather forecasting is becoming an increasingly important subject of research. New technology is being developed by scientists. Accurate weather forecasting aids in the avoidance of disasters, the picking of high-yield crops for a given year by farmers, and the preparation of businesses for changing circumstances. With the arrival of the AI and machine learning era, there has been a huge increase in weather research, as well as many models based on these technologies. With the coming of the Artificial Intelligence and Machine Learning era, there is significant growth in weather research. Also many models based on the Artificial Neural Network are developed to predict the accurate weather. These models required a few perplexing mathematical equations. These models study the weather from various aspects and help to get nearly accurate results. In this research we showed the comparison between different models which helps to predict the weather and we tried to figure out which is the best approach to achieve maximum efficiency and compare various parameters of the model like which one will give maximum efficiency, accuracy and data-loss.**

Keywords- Weather forecasting, LSTM, AI, ANN, Weather Elements, Accuracy, colour models.

I. INTRODUCTION

In recent years multiple methods have been studied to find the estimation of weather by predictive analysis. As many of our daily activities and businesses depend on changing weather conditions. In our vicinity it has been observed a significant loss of life and property as a result of unforeseen weather circumstances. With India close to the equator, the sub-continent would see much higher rises in sea levels than higher latitudes. Due to increase in temperature, Crop yields are expected to fall significantly because of extreme heat by the 2040s. 1-2 degrees Celsius could rise and potentially decrease rice production by about 0.75 tonnes per hectare (t/ ha) in inland zones and 0.06 t/ha in coastal regions. A more chaotic monsoon will have a grave bearing on Indian agriculture and food production. The below-normal rainfall has sparked concerns over the output of summer-sown crops.

Artificial neural networks (ANNs) are a powerful way to build a computerised system that can process nonlinear weather conditions and make predictions in a specific domain. The biological neuron model is used to inspire artificial neural networks. Nowadays weather radar is a key technology to derive quantitative precipitation estimates (QPE) with spatial and temporal resolutions. Along with that Meteorological radars provide precipitation fields with high spatial and temporal resolution to couple them with hydrological models. In an artificial neural network, a network is formed by connecting a large number of highly nonlinear neurons.

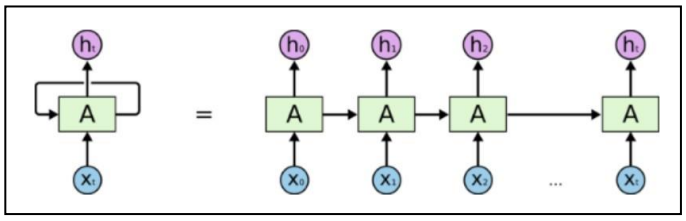
ANN is a system that receives an input, processes the data, and then produces the output based on the input. The larger the network, the more complex it will be. An input layer, one or more hidden layers, and an output layer makes up a multilayer Neural network. Because weather is a data-intensive process with a non-linear dataset, artificial neural networks can be used to make more reliable predictions. For meteorological and financial forecasting, a feed-forward neural network is commonly utilised. In addition to that artificial neural network has the advantage of being able to extract data, discover trends, and anticipate patterns that are not presented during training. An artificial neural network (ANN) is a strong data-driven, self-adaptive, flexible computational tool capable of accurately capturing the nonlinear and complicated underlying properties of any physical process. Artificial neural networks (ANNs) offer a number of unique characteristics that make this class of machine learning algorithms desirable when faced with complex pattern discovery problems.

II. LITERATURE REVIEW

A. RECURRENT NEURAL NETWORK

A recurrent neural system (RNN) is a type of an artificial neural network (ANN) in which connections between units form a coordinated chart that moves along a sequence. This allows it to display dynamic temporal behaviour for a given time period. Recurrent neural networks, unlike a feed forward neural network, can process sequences of inputs using their

internal memory. RNNs can remember important details about the information they received, allowing them to predict what will happen next. This is why, as compared to other techniques, they are the preferred technique for sequential data such as a time series, voice, text, financial data, audio, video, weather, and much more since they can create a far deeper understanding of the sequence and its context. In recurrent neural networks, the data goes through a loop. When it settles on a decision, it takes into consideration the present input and furthermore what it has got from the information it received previously. Long Short–Term Memory (LSTM) networks are an extension of recurrent neural networks, which essentially broadens their memory. Along these lines it is appropriate to gain from imperative encounters that have long circumstances slacking in the middle. The data in recurrent neural networks are looped again and over again. When it comes to a decision, it considers the current input as well as what it has learned from past information.

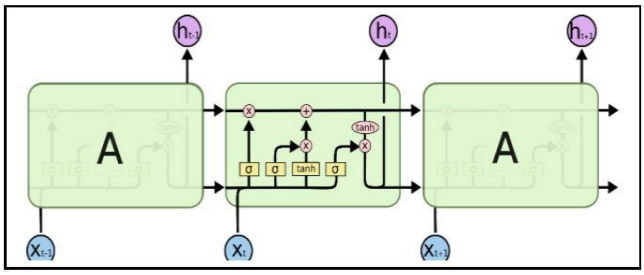


2.1 Recursive Neural Network

B. LONG SHORT–TERM MEMORY (LSTM)

Long Short–Term Memory (LSTM) networks are a type of a recurrent neural network that extends the memory of the original. In this way, crucial encounters with long lapses in the middle are acceptable to profit from. The units of Long-Short Term Memory networks are used as building units for the layers of a recurrent neural network, which is then often known as an LSTM network. Long Short–Term Memory allows recurrent neural networks to recall their inputs over a long period of time. This is because recurrent neural networks contain their data in memory that is much similar to the memory of a computer in the light of the fact that LSTM can read, write and erase data from its memory. In a recurrent neural network there are three gates. These are input, forget and output gates.

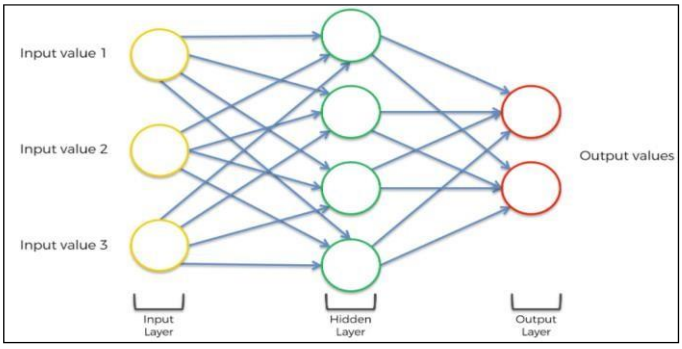
Long-Short Term Memory (LSTM) network units are used to create the layers of a recurrent neural network, which is then referred to as an LSTM network. Recurrent neural networks can recollect their inputs over a long period of time thanks to Long Short–Term Memory. This is due to the fact that recurrent neural networks store their data in memory that is very similar to computer memory, given that the LSTM may read, write, and erase data from its memory. There are three gates in a recurrent neural network, those are Input, forget, and output gates. A LSTM's gates are basic, analogue, and sigmoid in shape, implying that they range from 0 to 1. The fact that the analogue allows them to perform back propagation. Because it keeps the gradients soaked enough, LSTM solves the risky difficulties of disappearing slopes. As a result, the training is very quick, and the accuracy is high.



2.2 LONG SHORT–TERM MEMORY (LSTM)

C. ARTIFICIAL NEURAL NETWORK (ANN)

An artificial neural network (ANN) is a computing system patterned after the operation of neurons in the human brain. Artificial Neural Networks can be best viewed as weighted directed graphs that are commonly organised in layers. These layers feature many nodes which imitate biological neurons of the human brain that are interconnected and contain an activation function. The first layer receives the raw input signal from the external world-- analogous to optic nerves in human visual processing. Each successive layer gets the output from the layer preceding it, similar to the way neurons that are situated further from the optic nerve receive signals from those closest to them.



2.3 Artificial Neural Network

D. COLOUR MODELS

A colour model is an abstract mathematical model that describes how colours can be represented as a set of numbers (e.g., a triple in RGB or a quad in CMYK). Colour models can usually be described using a coordinate system, and each colour in the system is represented by a single point in the coordinate space.

- *CMYK*: The four ink colours used in offset printing are represented by these initials: Cyan, Magenta, Yellow, and Black. It works by overlapping tiny dots of transparent inks to produce the illusion of a new blended hue. In a CMYK format, most colours can be

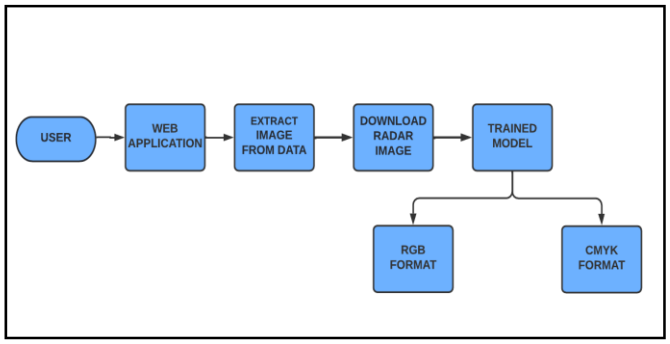
accurately reproduced. Print advertising in multiple colours is recommended for use. **Pros:** CMYK allows you to effortlessly make gradients, blends, photographs, and multi-coloured pictures. **Cons:** Some colours aren't possible to make in the process format. The printer, the material surface you're printing on, and other factors all have an impact on CMYK. Expect a certain amount of volatility.

- *RGB:* All digital colours are made up of three different wavelengths of light: red, green, and blue. R, G, and B may each be created in 256 depths, resulting in a total of nearly 16 million colour choices. Because we're looking at the source of the light rather than a reflection, these colours can be far brighter and more intense than anything printed inks can produce. Anything digital is a good idea (including TV) **Pros:** vibrant hues that cover the entire spectrum. There is no limit to the number of colours that can be used in a project. **Cons:** To print, RGB colours must be converted to CMYK. Because CMYK lacks the range of RGB, the colour will often appear darker and duller.

- *HSV*: Hue Saturation Value (HSV) is a cylindrical colour model that remaps the RGB primary colours into dimensions that are easier for humans to understand. Like the Mansell Colour System, these dimensions are hue, saturation, and value. *Hue* specifies the angle of the colour on the RGB colour circle. A 0° hue results in red, 120° results in green, and 240° results in blue. *Saturation* controls the amount of colour used. A colour with 100% saturation will be the purest colour possible, while 0% saturation yields grayscale. *Value* controls the brightness of the colour. A colour with 0% brightness is pure black while a colour with 100% brightness has no black mixed into the colour. Because this dimension is often referred to as brightness, the HSV colour model is sometimes called HSB.

III. METHODOLOGY

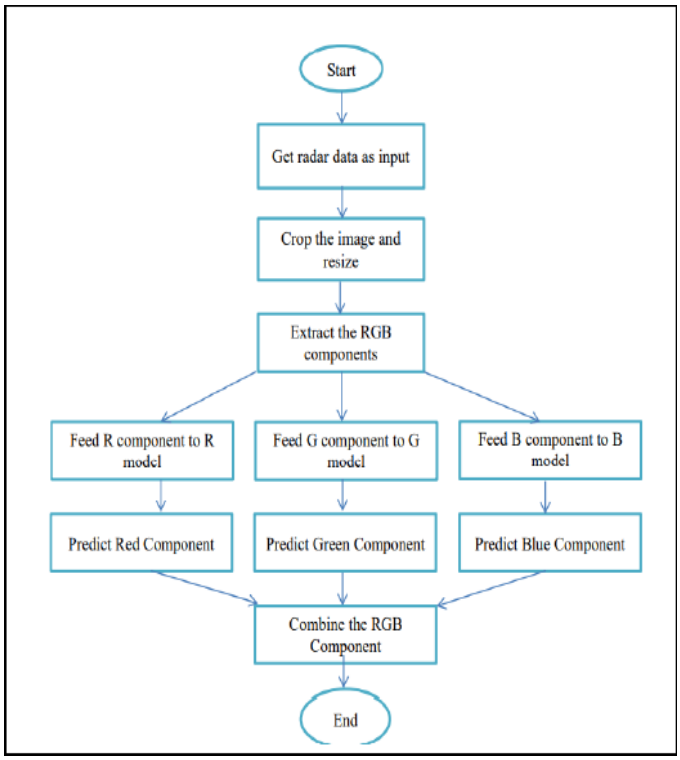
Here the model's flow is depicted in the diagram. A web application that uses weather data to retrieve current weather conditions and forecast weather for the next two weeks. It was decided to develop a trained model using web application. The user can view the radar data in the 'Weather Forecast' section in graphical format, as well as has ability to download the essential a piece of information. The radar data that has been downloaded is then used as a parameter in the model to forecast the weather throughout the next hour and a half. In addition, the output is in the form of radar. More over the analysing of the weather prediction model is done using colour formats such as CYMK, RGB & HSV.



3.1 DATA FLOW OF SYSTEM

A. FLOW OF RGB MODEL:

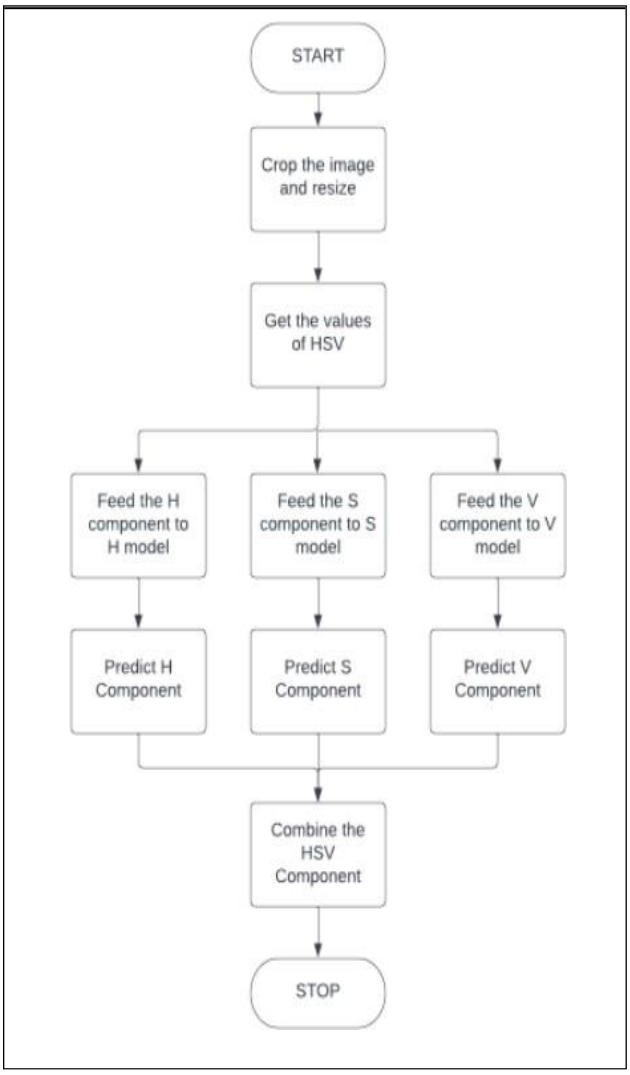
In RGB approach, the system break down the image in three different color which is Red, Green and Blue. Later on this color values are analyzed and image is predicted. Below is the flow chart for the RGB Model.



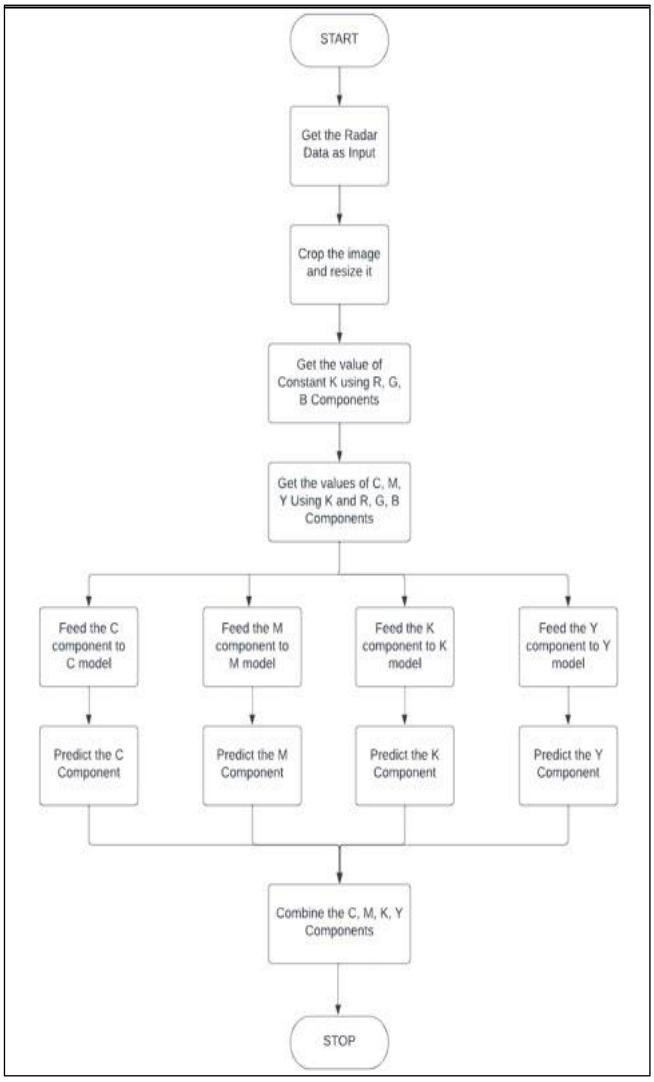
3.2 FLOWCHART FOR THE RGB MODEL

B. HSV MODEL:

In the HSV model, the procedure is same as in RGB model only difference is that the image is break down into three different parameters instead of the color. These parameters are Hue, Saturation, Value i.e., HSV. Based on these parameters the image is predicted. Flow of the system is same as that of RGB system/model.



3.3 FLOWCHART FOR HSV MODEL



3.4 FLOWCHART FOR CMKY MODEL

C. CMKY MODEL:

In the CMKY model, the procedure is same as in RGB model only difference is that the image is break down into four different color parameters instead of three. These parameters are CYAN, MAGENTA, YELLOW AND KEY (Black). Based on these parameters the image is predicted. Flow of the system is same as that of RGB system/model.

D. DATA SET USE IN TESTING:

We have used the raw files of a particular day captured by radar at different intervals provided by Regional Meteorological Centre, IMD, Nagpur. The raw files are special type of file format which contains data in multidimensional array format which we used to plot a graph of a particular field using PY-ART library and further was converted into PNG images to feed into the model.

IV. FINAL REPORT AND ANALYSIS

Training a single model is one of the traditional approaches, but due to the huge amount of data it required high computational power. To overcome those drawbacks one model is prepared where the component of data is separated into three components RED, GREEN, BLUE. These three sets of data are small as compared to parent data which helps to

reduce the computational power. But the major drawback which we face was the lack of accuracy of which we get after the computations. To overcome this problem, we tried to convert these RED, BLUE, GREEN components into CYAN, MAGENTA, YELLOW, AND KEY (Black) components which are later on used to get the result. However, we may be able to increase the accuracy with the help of this but we found that we have a great data loss.

While implementing the HSV model we found that the accuracy of the system is low as well as the loss of data in the HSV model is more as compared to RGB and CMYK models. The HSV model works on the principle of the value of saturation of colour. But the data we got is a bit unclear due to which the reading of the saturation value for the pictures is not appropriate so we can't use the HSV model for the implementation of this System. There may be any other approach to implement this system in the HSV colour model. The best approach in the field of time series prediction working as a sequential model is to use a Recurrent Neural Network. In the field of weather forecasting, the previous year's data or historical data is the essence for the prediction of results. For this, we had used the LSTM model i.e. Long Short-Term Memory Unit model.

V. CONCLUSION

The main components of the model are the Neural Network (Backend part) and User interface. These components together help to create a perfect working model. As we stated in the beginning, we are trying to compare the previous model based on the three different colour models based on RGB, CMKY & HSV Components.

Following are the results of the product:

1. In comparison of accuracy factor, we found that CMKY model gives us the maximum accuracy.
2. While comparing the data loss factor, we found that HSV models have maximum data loss.
3. The level of accuracy of the different models is as follows: CMKY > RGB > HSV
4. The data loss of the in different model is as follows: HSV > CMKY > RGB
5. After understanding all the models and comparing different Factors we found that RGB is most appropriate for implementing this system.

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