© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 03 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
Special Edition
NCASIT 2023, 29th April 2023
Department of Computer Engineering,
St. Vincent Pallotti College of Engineering & Technology, Nagpur,

EXTRACTION OF RADAR ELEMENTS

Rahul Deshmukh
Dept. of Computer Engineering,
SVPCET, Nagpur, MH, India

Sebi James
Dept. of Computer Engineering,
SVPCET, Nagpur, MH, India

Shreyas Kumar
Dept. of Computer Engineering,
SVPCET, Nagpur, MH, India

Akhil Benny
Dept. of Computer Engineering,
SVPCET, Nagpur, MH, India

Dr.Sunil Wanjari
Dept. of Computer Engineering,
SVPCET, Nagpur, MH, India

Brijesh Kanaujiya
Regional Meteorological Centre,
IMD, New Delhi, NDL, India

Keywords- Weather forecasting, RAW files, Reflectivity factor, Spectrum width, Velocity factor, Total Power.

I. ***Abstract***— Significant weather swings are causing a wide range of problems for people, including those involving agriculture, aviation, and property damage, among many other things. The unpredictable nature of climatic and atmospheric conditions has made weather forecasting a more and more essential area of study. The experts are keeping an eye on emerging technologies and diverse atmospheric trends. Weather forecasting is largely beneficial in disaster prevention like proper aviation operation, farming and various business demands. Boom of AI and ML has helped in increasing the scope of weather-related research with the help of various models. Before digging into analysis part and model training, extraction of data is much more important. Proper data mining and its study will help one to observe the patterns and selection and training of models.

In this research we have tried to build a web application to figure out a few essential parameters related to radar data from multiple raw files which could be used to make accurate presumptions of weather conditions. To list out them separately they are reflectivity factor, velocity factor, spectrum width, total power. Proper extraction of these radar elements and then accordingly selecting the model will succeed to a system worthy of accuracy and maximum efficiency.

Keywords- Weather forecasting, RAW files, Reflectivity factor, Spectrum width, Velocity factor, Total Power.

I. INTRODUCTION

Weather forecasting is one of the great successes of environmental science in the 20th century, which continued rapidly at a sustained rate in the beginning of the 21st century. Climatology and weather forecasting is important since it helps in presumption of future conditions. As, Weather forecasting is the essence of analysing prior historical data, so having adequate and large memory units will be extremely beneficial. Weather plays an important role. Weather radar has made significant advancements over the past 50 years and has assumed increasingly significant roles in a variety of meteorological and climatological applications. Its capacity to identify and issue warnings for risks related to localized severe storms, such as hail, tornadoes, strong winds, and heavy precipitation, has proven particularly significant. Larger weather systems like hurricanes, which frequently feature comparable phenomena but can cover very huge areas, are also monitored by weather radar. The upcoming trends of nature being highly unpredictable leading to the evolution of

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 03 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
Special Edition
NCASIT 2023, 29th April 2023
Department of Computer Engineering,
St. Vincent Pallotti College of Engineering & Technology, Nagpur,

technology which explores the functionality of radar. Thus, understanding cloud migration and any associated risks is crucial. Some clouds, like the cumulonimbus, provide a clear and present hazard to aviation, while others merely signal a potential issue. Still other clouds have no impact at all. When determining the safest circumstances for an airplane to take off, we take into consideration factors like wind speed, temperature, cloud cover, and density. So, basically we are trying to extract the parameters for which then will be put into a selected model and will be used to predict whether a particular cloud's density will cause a turbulence or not. And if it becomes a hindrance factor, then factors like wind speed and cloud velocity will be useful in adjusting it accordingly to prevent the turbulence by tracking the time required for a cloud cover to escape from the vicinity of the aircraft.

II. LITERATURE REVIEW

A. *Radio detection and raging (Radar)*

Doppler radar is a tool used in weather forecasting to determine an object's direction, velocity, or speed. When weather forecasting radar speaks, it is used to identify whether movement in the aerosphere is horizontally towards or away from it. It is typically used to map the earth's surface from space and measure aerosphere parameters.

.

B. *Python*

C. *Pyart*

D. *Django*

E. *Matplotlib*

F. *Radar Elements* –

- *Reflectivity Factor* - The amount of transmitted power that is reflected back to the radar receiver by precipitation is known as "reflectivity". The colors show the strength of the radar's returned energy, represented in decibel (dBZ) levels. Right of the image is where you'll find the color scale. The intensity of the downpour rises with the dBZ values
- *Velocity Factor* - The rate at which the distance or range between two places changes is referred to as the radial velocity, line-of-sight velocity, radial speed, or range rate of a target with regard to an observer. It is analogous to the vector projection of the relative velocity between the target and the observer onto the relative direction joining the two places. The observer on Earth is typically assumed to be the point in astronomy, hence the radial velocity represents the rate at which the object is moving away from the Earth.
- *Spectrum Width* - The variance is used to calculate the spread of the Doppler power spectrum, also known as the spectral width. The spectral width is determined by:

  1. The scatter's spread, or the range of terminal fall speeds (which is more prominent for rain than for snow).
  2. Air turbulence (higher levels of strong convection)
  3. Vertical wind shear (along a gust front, for example)
  4. Antenna movement

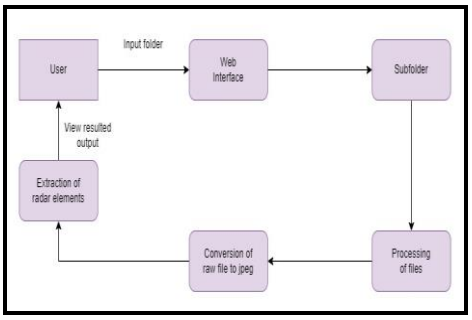
  The distribution of velocities inside a single radar pixel is known as spectrum width. On radar, a volume is represented by one pixel. There may be literally millions of separate hydrometeors contained within this volume. Each hydrometeor will move at its own rate and in its own direction. Individual hydrometeors inside the radar pixel volume have significantly varied radial velocities when there is turbulence in the environment.
- *Total Power* - Total power is related to doppler power spectrum. We can plot the Doppler power spectra of the data using the power spectra and one can also easily obtain the mean radial velocity and radar reflectivity factor.So power is dependent on these radar elements

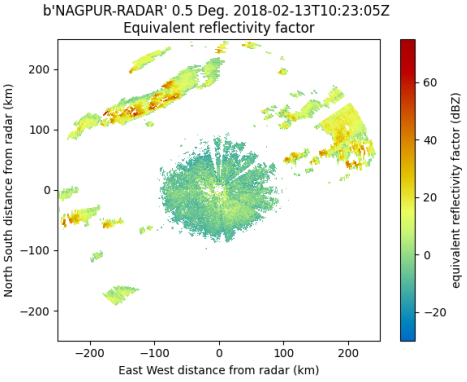
III. METHODOLOGY

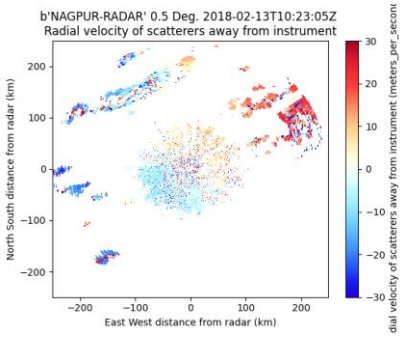
The model's flow can be studied from the given diagram. Initially the user will access the application and select the folder containing raw files. After accessing the folder, a sub folder will be created to store the converted image. Here RAW files from radar system will get converted to jpeg format. Further after processing the image

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 03 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
Special Edition
NCASIT 2023, 29th April 2023
Department of Computer Engineering,
St. Vincent Pallotti College of Engineering & Technology, Nagpur,

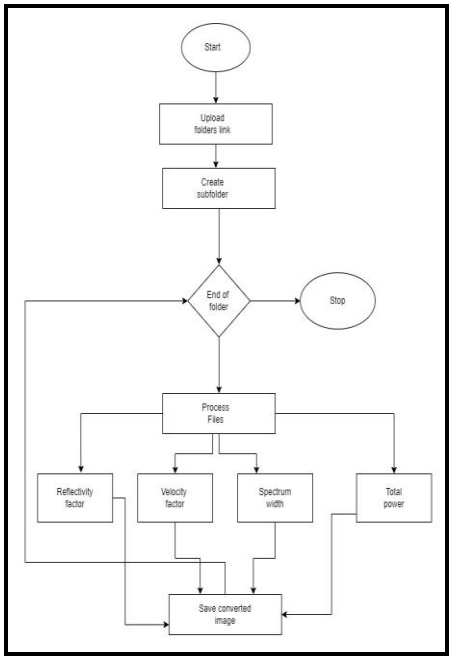
radar elements like reflectivity factor, velocity will be plotted and the resulting image will be stored in a folder.

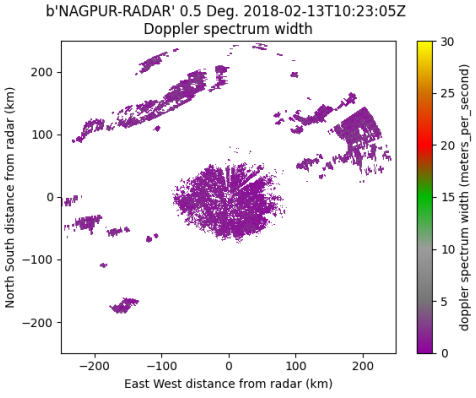






3.1 DATA FLOW OF SYSTEM

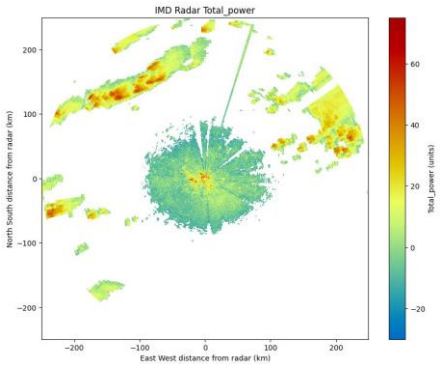




3.2 FLOWCHART OF SYSTEM

IV. RESULTS OBTAINED

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 03 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
Special Edition
NCASIT 2023, 29th April 2023
Department of Computer Engineering,
St. Vincent Pallotti College of Engineering & Technology, Nagpur,



V. DATA SETS USED IN TESTING

Here the raw files captured by radar at different intervals provided by Indian Meteorological Department (IMD) Delhi. Using the PY-ART library and these raw files were further converted into JPEG images to obtain radar elements like reflectivity factor, velocity factor, spectrum width, total power. Further which will be used for analysis that is to get proper values by feeding to a model.

VI. FINAL REPORT AND ANALYSIS

The above found out factor will be a primary data set for the further model tests. These factors play an important role in analysing perfect weather conditions. This system can be beneficial to prevent turbulent instances. The above performed steps lead to successful data extraction from raw files. These extracted data in form of jpeg will be useful in data analysis and plotting of values. Raw images from radar are not that easy to be accessed and to be studies by normal human. So, conversion of it necessary for its further study. Basically, the prediction is based on images rather than data files which are stored in database. So, to operate and automate on it we need image format like png, jpeg etc. which makes it easy to read and understand using AI/ML . Python's graphical libraries are very handy in plotting out the graph.

VII. CONCLUSION

The User Interface and Neural Network (Backend Part) make up the majority of the model. Together, these elements contribute to the creation of an ideal functioning model. We are developing an application which will convert raw files to jpeg format and extract radar elements. This further will be used to analyse and to plot exact values for model training.

Few observations made:

1. The distribution of velocities within a single radar pixel is referred to as spectrum width.
2. Power spectrum is dependent on e mean radial velocity and radar reflectivity factor.
3. Raw files are much more complicated then image files like jpeg due to high storage and accessibility issues.
4. Batch transformation of files is much more handy and efficient way of conversion.
5. Reflectivity is directly proportional to power.
6 Velocity is directly proportional to spectrum width.

VIII. ACKNOWLEDGMENT

We, as a group, are deeply grateful to the Indian Meteorological Department (IMD), Delhi for providing the required resources for this research. We are also very obliged to our esteemed college and our department for guiding and helping us through the difficulties we faced throughout our research and their critical feedback played a significant role in shaping our research.

IX. REFERENCES

1. https://www.jrps.in/uploads/2022/ncasit-2022/48.pdf
2. James W Wilson, N Andrew Crook, Cynthia K Mueller, Juanzhen Sun, and Michael Dixon, "Nowcasting thunderstorms: A status report," Bulletin of the American Meteorological Society, vol. 79, no. 10, pp. 2079–2100, 1998.
3. Peter Lynch, "The origins of computer weather prediction and climate modeling," Journal of Computational Physics, vol. 227, no. 7, pp. 3431–3444, 2008.
4. Neil I Fox and James W Wilson, "Very short period quantitative precipitation forecasting," Atmospheric Science Letters, vol. 6, no. 1, pp. 7–11, 2005..

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 14 Issue: 03 | April - June 2023
Paper is available at http://www.jrps.in | Email : info@jrps.in
Refereed & Peer Reviewed
Special Edition
NCASIT 2023, 29th April 2023
Department of Computer Engineering,
St. Vincent Pallotti College of Engineering & Technology, Nagpur,

5. A Bellon and GL Austin, "The accuracy of short-term radar rainfall forecasts," Journal of hydrology, vol. 70, no. 1-4, pp. 35– 49, 1984
6. Neill EH Bowler, Clive E Pierce, and Alan Seed, "Development of a precipitation nowcasting algorithm based upon optical flow techniques," Journal of Hydrology, vol. 288, no. 1-2, pp. 74–91, 2004.
7. Frank Steinbrücker, Thomas Pock, and Daniel Cremers, "Large displacement optical flow computation without warping," in 2009 IEEE 12th International Conference on Computer Vision. IEEE, 2009, pp. 1609–1614.
8. Yu Liu, Du-Gang Xi, Zhao-Liang Li, and Yang Hong, "A new methodology for pixel-quantitative precipitation nowcasting using a pyramid lucas kanade optical flow approach," Journal of Hydrology, vol. 529, pp. 354–364, 2015.
9. Sarvesh Landge, Brijesh Kanaujiya, Dr. Sunil M. Wanjari, Aditya Taksande, Rachit Khandelwal, Shienell Amair, "Radar Vision - Weather Forecasting Using CNN-LSTM " ICCAE2021: International Conference on Computing and Applied Engineering Grand Inn, GOA-INDIA GOA, India, July 23-24, 2021.
10. Nayan Agrawal, Jasneet Kaur saini, Aditya Sharma, Moin Sheikh, Dr. Sunil M. Wanjari "Weather Forecasting: Era of Artificial Intelligence" IRJET2020: International Journal of Engineering and Technology, vol. 07, Issue 04, April , 2020.
11. https://www.osti.gov/biblio/1339572
12. https://www.theweatherprediction.com/habyhints/245/#:~:text=Spectrum%20width%20is%20the%20distribution,speed%20and%20direction%20of%20movement