Sunspot Activity Forecasting: Leveraging Machine Learning and Deep Learning Approaches

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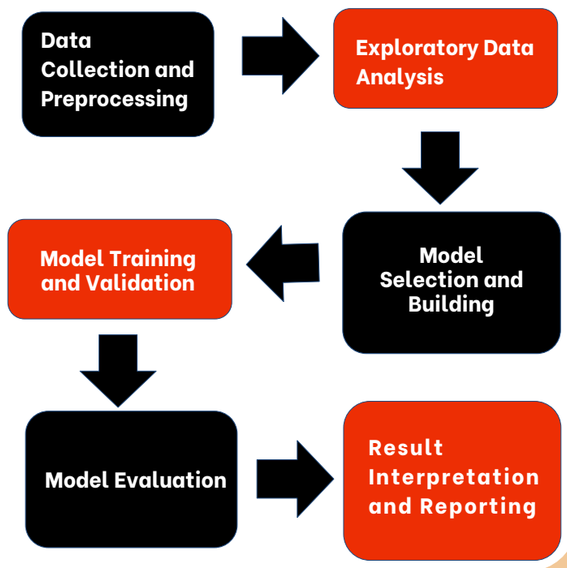
1. What are sunspots?

- **Sunspots** are areas that appear dark on the surface of the Sun.
- They are associated with a strong magnetic field. It is this field that blocks the heat, and hence the regions are cooler and thus darker.
- Sunspot activity is cyclical (the solar cycle), but with a variable period and amplitude.
- The magnetic field lines near sunspots often tangle or reorganise, this can cause a sudden explosion of energy called a **solar flare**. They are sometimes accompanied by a **coronal mass ejection** (CME).
- At a time of many sunspots, the Sun is more magnetically active, and hence there is a greater chance of solar flares and CMEs.

5. Methodology

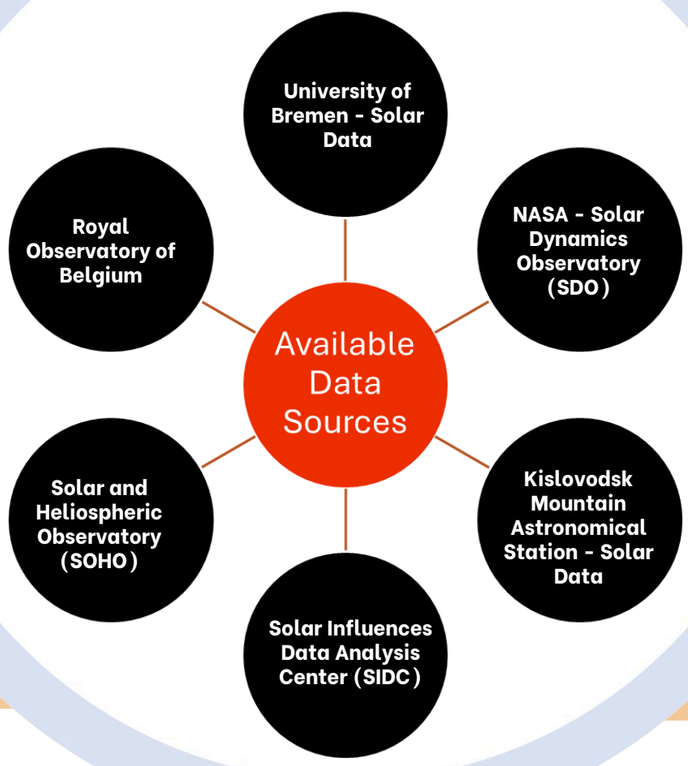
- Gathering and cleaning sunspot data to ensure accuracy and consistency.
- Analysing data to identify patterns and relationships.
- Exploring diverse ML models for enhanced accuracy.
- Utilising LSTM networks to capture sequential patterns in sunspot data for improved prediction.



2. What is the primary objective to research on sunspot prediction?

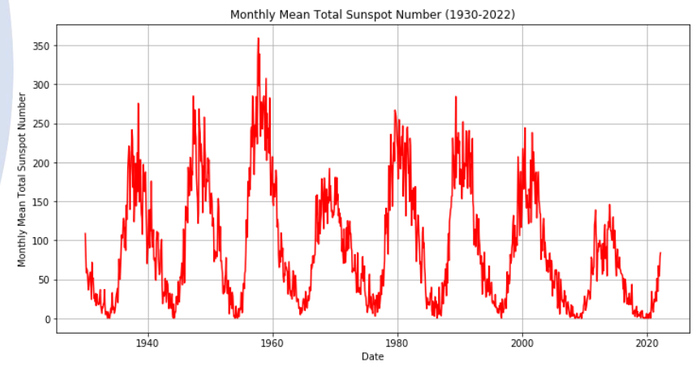
To analyse the variation in the sunspot number with time. How might the next cycle be predicted? This is an important aspect of predicting the activity on the Sun's surface, which creates a type of weather called **space weather**.

4. Data Sources



6. Results

The plot shows how sunspot activity changes over time, indicating the periodic nature of sunspot numbers and providing insights into the solar cycles.

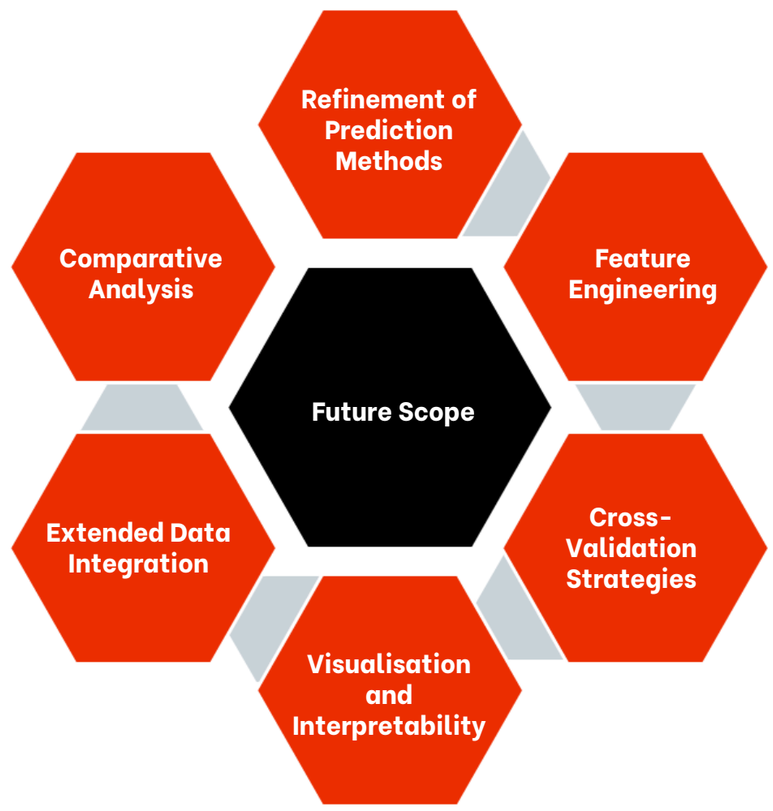


3. Why are sunspots significant?

These are the different aspects of the importance of sunspot prediction:

1. Impact on Satellite Communications
2. Forecasting Geomagnetic Storms
3. Influence on Earth's Climate
4. Mitigating Radio Communication Disruptions
5. Safeguarding Power Grids
6. Ensuring Astronaut Safety
7. Adaptation for GPS Systems
8. Advancing Solar Physics Research
9. Planning Space Missions
10. Enhancing Global Readiness

7.Future Scope



References:
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2.Stetson, H.T., 2013. Sunspots and their effects. Read Books Ltd.
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M. M. Mahdi, M. M. Anisuzzaman Nour Tipu, C. Halder and K. F. Rahman, "Comparative Analysis of Prediction of Coronal Mass Ejections (CME) based on Sunspot Activities Using Various Machine Learning Models," 2019 International Conference on Robotics,Electrical and Signal Processing Techniques (ICREST), Dhaka, Bangladesh, 2019, pp. 588-591, doi: 10.1109/ICREST.2019.8644272.
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Further information
Please see
https://github.com/meekhasaji/Sunspots
for the code and data

Please email:
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if you have a question or comment.