# TITLE OF THE THESIS


Thesis submitted in partial fulfilment
for the Award of

**DOCTOR OF PHILOSOPHY**

in

**Subject**

By

**NAME OF RESEARCH SCHOLAR**

Under the supervision of

**NAME OF Supervisor**

**DEPARTMENT OF ..**

**SCHOOL OF..**

**MAHATMA GANDHI CENTRAL UNIVERSITY**

Motihari, East Champaran, Bihar-845401

Jan,2025 MGCU2021CSIT4029

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# Acknowledgment

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**Name of Scholar**
**MGCU2021CSIT4029**
**Degree(CSE)**

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviations

**USA** United States of America

# List of Symbols

$F$ force

# Chapter 1

# Introduction

Maecenas mi massa, fermentum eu, venenatis et, cursus id, ipsum. Morbi vehicula justo faucibus mauris. Donec non neque. Fusce id mi ut neque tincidunt posuere. Suspendisse quis enim. Cras porttitor. Sed quis velit. Aliquam vel augue at wisi blandit suscipit. Duis ut justo. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Etiam bibendum wisi quis augue. Nulla lorem odio, sollicitudin vitae, vehicula nec, dapibus ultricies, purus. In vitae tellus at odio cursus congue. Quisque tincidunt tempus metus. Aenean et nulla nec dolor dapibus ultricies. Phasellus commodo vulputate arcu. Sed enim. Phasellus quis leo. Aliquam iaculis, turpis nec aliquet rutrum, pede risus porta diam, id ullamcorper erat est sed eros. Fusce ornare.

## 1.1 Introduction

Paragraph1 SDSDS DJBKJFH DHOIUHFOIS SJKHFKS Drewil and Al-Bahadili (2022)

Paragraph2

Paragraph3

Call methodUnited States of America (USA)

Call methodUSA

Call method $F$

### 1.1.1 pm2

loram12

#### 1.1.1.1 pm2

loram12

# Chapter 2

# Literature Review

## 2.1 Literature Review

Paragraph

Paragraph

Table 2.1 REFRENCE OF TABLE

Table 2.1: Summarizing of Related work to pridict $PM_{2.5}$

| **Paper** | **Proposed Model** | **Data Source** | **Forecasting Object** | **Benchmark Models** | **Results** |
|---|---|---|---|---|---|
| | | | | | |
| ... | ... | ... | ... | ... | ... |

# Chapter 3

## Basics Related Roncepts

## 3.1 Basics Related Roncepts

### 3.1.1 Machine Learning

Paragraph

# Chapter 4

# Methodology

## 4.1 Methodology

Table 4.1: 17 Indian cities dataset, with start and end dates and sample counts.

| **DataSets** | **Fast_Day** | **Last_Day** | **No of Samples** |
|---|---|---|---|
| BHIWADI | 20-12-2017 15:00 | 02-12-2022 16:00 | 43394 |
| JODHPUR | 01-12-2015 00:00 | 02-12-2022 16:00 | 61409 |
| SINGRAULI | 08-12-2017 11:00 | 03-12-2022 01:00 | 43695 |
| ANKLESHWAR | 04-02-2019 18:00 | 03-12-2022 00:00 | 33535 |
| LUDHIANA | 01-05-2017 00:00 | 03-12-2022 01:00 | 49010 |
| DURGAPUR | 06-12-2020 15:00 | 03-12-2022 00:00 | 17434 |
| YAMUNA_NAGAR | 03-01-2019 14:00 | 02-12-2022 16:00 | 34299 |
| CHARKHI_DADRI | 03-03-2020 15:00 | 02-12-2022 17:00 | 24099 |
| JIND | 10-01-2019 09:00 | 03-12-2022 01:00 | 34145 |
| KURUKSHETRA | 07-01-2019 18:00 | 03-12-2022 01:00 | 34208 |
| SONIPAT | 01-01-2019 00:00 | 02-12-2022 17:00 | 34362 |
| DHARUHERA | 04-01-2019 12:00 | 02-12-2022 04:00 | 34265 |
| AMBALA | 08-01-2019 12:00 | 02-12-2022 09:00 | 34174 |
| HISAR | 10-01-2019 10:00 | 03-12-2022 00:00 | 34143 |
| FATEHABAD | 09-01-2019 | 02-12-2022 | 34160 |

Table 4.1 :

# Chapter 5

# Results and Analysis

## 5.1 Results and Analysis

Table 5.1: All Datasets RMSE.

| DataSets | BiLS-TM | CNN | GRU | Seq2-Seq | V-LSTM | S-LSTM | CNN_ Bi-LSTM | CNN_ LSTM | GRU_ Bi-LSTM |
|---|---|---|---|---|---|---|---|---|---|
| **BHIWADI** | 23.13 | 57.2 | 22.34 | 24.2 | 19.6 | 48.14 | 45.98 | 43.5 | 35.3 |
| **JODHPUR** | 27.54 | 26.68 | 32.94 | 22.35 | 22.08 | 50 | 40.87 | 43.55 | 52.63 |
| **SINGRAULI** | 10.92 | 15.5 | 27.34 | 21.61 | 13.63 | 17.79 | 50.61 | 22.2 | 26.5 |
| **ANKLESHWAR** | 18.53 | 16.68 | 37.15 | 23.78 | 18.38 | 46.28 | 62.85 | 68.72 | 69.38 |
| **LUDHIANA** | 8.4 | 11.12 | 22.14 | 10.1 | 8.3 | 21.15 | 25.66 | 24.76 | 23.77 |
| **DURGAPUR** | 6.14 | 8.27 | 20.34 | 9.48 | 8.78 | 15.28 | 9.62 | 13.76 | 24.39 |
| **YAMUNA_NAGAR** | 37.34 | 34.57 | 56.27 | 36.33 | 38.18 | 66.14 | 72.39 | 45.63 | 74.13 |
| **CHARKHI_DADRI** | 18.42 | 20.43 | 27.96 | 18.43 | 18.06 | 40.71 | 46.16 | 45.27 | 43.48 |
| **JIND** | 24.17 | 26.42 | 34.35 | 25.85 | 19.41 | 79.22 | 62.13 | 43.59 | 50.95 |
| **KURUKSHETRA** | 27.14 | 72.03 | 43.56 | 27.32 | 26.7 | 65.77 | 39.71 | 88.12 | 53.74 |
| **SONIPAT** | 12.56 | 15.98 | 22.4 | 15.41 | 10.9 | 43.02 | 24.01 | 22.96 | 46.77 |
| **DHARUHERA** | 26.74 | 28.93 | 34.6 | 24.06 | 25.19 | 53.18 | 31.93 | 35.01 | 46.22 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **AMBALA** | 22.58 | 28.96 | 41.08 | 19.92 | 16.92 | 57.43 | 40.71 | 34.14 | 63.85 |
| **HISAR** | 28.34 | 66.79 | 47.93 | 33.98 | 30.99 | 63.29 | 43.16 | 49.1 | 62.46 |
| **FATEHABAD** | 14.37 | 38.36 | 72.71 | 15.51 | 15.58 | 38.38 | 74.38 | 76.75 | 72.64 |
| **BULANDSHAHR** | 7.39 | 8.87 | 19.79 | 11.19 | 7.2 | 14.98 | 9.61 | 13.16 | 11.51 |
| **MUZAFFARNAGAR** | 11.88 | 16.13 | 13.72 | 14.2 | 12.75 | 22.21 | 15.91 | 23.6 | 21.9 |

Table 5.2: Average Rankings of RMSE by (N*N) Friedman Test

| Algorithm | Ranking |
|---|---|
| BiLSTM | 2.1176 |
| CNN | 4.2941 |
| GRU | 5.7059 |
| Seq2Seq | 3.1176 |
| V-LSTM | 1.7059 |
| S-LSTM | 7.1176 |
| CNN-BiLSTM | 6.5294 |
| CNN-LSTM | 6.9412 |
| GRU-BiLSTM | 7.4706 |


Figure 5.1: Actual vs Predicted of BiLSTM for All Datasets

# Chapter 6

# Conclusion

## 6.1 Conclusion

# References

Ghufran Isam Drewil and Riyadh Jabbar Al-Bahadili. Air pollution prediction using lstm deep learning and metaheuristics algorithms. Measurement: Sensors, 24: 100546, 2022.

# Appendices

# Chapter A

## Supporting Information


Figure A.1: Caption of image 2.

# Chapter B

## Supporting Information


Figure B.1: Caption of image 2.

# List of Publications and Presentations

## Refereed Journals/Manuscripts Under Preparation

1. A. Autohr, and B. Author. Article title, *Journal Name*, year, **vol.**, xxxx–xxxx.

## Book

1. A. Autohr, *Book title*, Under preparation.

## Conference Abstracts/Posters/Presentations

1. A. Autohr, B. Author, and C.D. Author, Title of the talk/poster, *Conference Name*, Place, Country, day month year.

2. A. Autohr, B. Author, and C.D. Author, Title of the talk/poster, *Conference Name*, Place, Country, day month year.