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

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

Declaration by Research Scholar

I, Name of Scholar certify that the work embodied in this Ph.D. thesis is my own bonafide work carried out by me under the supervision of NAME OF Supervisor and the co-supervision of NAME OF Co-Supervisor for a period of 4 Years from 2nd jan 2025 to 10th jan 2025 at Mahatma Gandhi Central University and (Name of the Institution where work has been carried out partly or fully). The matter embodied in this Ph.D. thesis has not been submitted for the award of any other degree/diploma.

   I declare that I have faithfully acknowledged, given credit to, and referred to the research workers wherever their works have been cited in the text and the body of the thesis. I further certify that I have not willfully lifted up someone else's work, para, text, data, results, etc., reported in journals, books, magazines, reports, dissertations, theses, etc., or available at websites, and included them in this Ph.D. thesis and cited as my own work.

Date: Wednesday 15th January, 2025   **(Signature of the Scholar)**
Place: BiharShraif   **(Name of Scholar)**

Certificate by Supervisor

This is to certify that the thesis entitled " **TITLE OF THE THESIS** " is original work and has been carried out by Mr/Ms Name of Scholar Enrolment No. MGCU2021CSIT4029 under my guidance and supervision for the degree of **Doctor of Philosophy** in .... to be awarded by Mahatma Gandhi Central University, Bihar.

To the best of my knowledge and belief this thesis

    i. embodies the work of research scholar himself / herself,

    ii. has duly been completed,

    iii. fulfils the requirements of the ordinance related to Ph.D. degree of the University.

    iv. contents of the thesis do not form the basis for the award of any other degree/diploma or similar title to the research scholar or to anybody else from this or any other University/lnstitution.

(Co-supervisor's signature,name and Designation)   (Supervisor's signature,name and Designation)

Copyright Transfer Certificate

Title of the Thesis: TITLE OF THE THESIS

Name of Research Scholar: Name of Scholar

Copyright Transfer

The undersigned hereby assigns to the Mahatma Gandhi Central University all rights under copyright that may exist in and for the above thesis submitted for the award of the Ph.D. degree.

Signature of the Scholar

Note: However, the author may reproduce or authorize others to reproduce material extracted verbatim from the thesis or derivative Of the thesis for author's personal use provided that the source and the University's copyright notice are indicated.

Abstract

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

Quisque ullamcorper placerat ipsum. Cras nibh. Morbi vel justo vitae lacus tincidunt ultrices. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. In hac habitasse platea dictumst. Integer tempus convallis augue. Etiam facilisis. Nunc elementum fermentum wisi. Aenean placerat. Ut imperdiet, enim sed gravida sollicitudin, felis odio placerat quam, ac pulvinar elit purus eget enim. Nunc vitae tortor. Proin tempus

nibh sit amet nisl. Vivamus quis tortor vitae risus porta vehicula.

Acknowledgment

This M.Tech **ReportType** is the result of hard work, upon which many people have contributed and given their support. I have made this dissertation on the topic **"ReportTitel ."** I have also tried my best in this dissertation to explain all the related detail. I would like to express my sincere gratitude towards my Superviser **Supervisor**, Department of **Department**, for providing excellent guidance, encouragement, inspiration, and constant and timely support throughout this **Degree** dissertation work. He taught me how to pursue the right aim towards the work, and showed me differnt ways to approach the research problem. His wide knowledge and logical ways of thinking have been great value for me, and his understanding and guidance have provided the successful completion of the Dissertation work.

First and foremost, I would like to express my gratitude to our beloved Dean of the Computational Sciences, Information and Communication Technology and Head of Department of Computer Science and Information Technology **HodName**, for providing his kind support in various aspects. A special thanks to all the Respected Teachers of the Department of Computer Science and Information Technology.

I am always grateful to the university, our Hon'ble Vice chancellor **Vc** for providing such a good research environment.

Special thanks to Ph.D scholar, especially **Ritika Singh**, **Surbhi Kumari**, **Ibrahim Momin**, **Naushad Ahmad** and my friends **Tej Prakash**, **Gajendra Patel**, **Abhijeet Kumar**, **Amod Kumar**, **Rana Kumar**, **Krishna Murari**, **Rajan Kumar**, **Suraj**, **Md. Aamir Sohail**, **Shahzeb Khan**, and all my lovely juniors for their invaluable feedbacks, care, and moral support during this endeavor.

Mother and **Father**, it is impossible to thanks adequately for everything you have done, from loving me unconditionally to rising me in a stable household, where your persistent efforts and traditional values taught your children to celebrate and embrace life. I could not have asked for better parents or role-models. You showed me that anything is possible with faith, hard work and determination.

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

Plagiarism Verification Certificate

Date: _____

Title of the Thesis:

_____

_____

_____

Name of the Research Scholar: _

Name of the Supervisor: _

Department: _

This is to report that the above thesis was scanned for similarity detection. Process and outcomes are given below:

Software used: _____ **Date:** _____

Similarity Index: _____

The complete report is submitted for review by the Supervisor.

Checked by

(University Library In-Charge)

Name and Signature

_____

The complete report of the above thesis has been reviewed by the undersigned. (Check Box)

The Similarity Index is below accepted norms.   [   ]

OR

The Similarity Index is above accepted norms, because of the following reasons:

1. _____

2. _____   [   ]

The thesis may be considered to be sent for being examined.

Signature of Scholar   Signature of Supervisor

Strictly Confidential

Panel of External Examiners
To Evaluate the Thesis for the Degree of Ph.D. of Mahatma Gandhi Central University

Date: _____

Name of the Research Scholar	
Term of Registration	
Department	
Title of Thesis:	

Panel of Examiners:

1.	Name: Address: E-mail: Phone No.:	2. Name: Address: E-mail: Phone No.:
3.	Name: Address: E-mail: Phone No.:	4. Name: Address: E-mail: Phone No.:
5.	Name: Address: E-mail: Phone No.:	6. Name: Address: E-mail: Phone No.:

Note: Note: Complete postal address including the name of the City in which the Department/university is located Pin/Zip Code, e-mail and Phone number must also be sent for obtaining quick consent from the experts. In case of e-mail ID please ensure that the same is written LEGIBLY or types correctly.

Signature of the Supervisor

For the use of office

S. Nos. _____ approved from panel of Examiner's.

(Hon'ble Vice−Chancellor)

Controller of Examinations

Format of Examiner's Report

Mahatma Gandhi Central University, Motihari - 845401, Bihar

Recommendation on Ph. D. Thesis

Name of the Research Scholar:

Title of the Thesis :

Please give your **specific recommendation** by ticking (✓) any one of the following, with signature underneath and enclose your **detailed report** on separate sheet(s) with your signature, name, and address.

The thesis **be accepted** for the award of the Ph. D. degree   [ ]

OR

The thesis **is acceptable** for the award of the Ph. D. degree subject to the
clarification of **certain points at the time of Viva-Voce.** (Please enclose   [ ]
the points)

OR

The thesis **is not acceptable in the present form** but **may be accepted**
subject to **modification/clarification/revision.**   [ ]
(Please enclose your suggestions for modification etc. desired) After
modification the **thesis need not be referred back to me.**

OR

The thesis **is not acceptable in the present form** but **may be accepted**
subject to **modification/clarification/revision.** (Please enclose your   [ ]
suggestions for modification etc. desired) After modification the **thesis
should be referred back to me for final assessment.**

OR

The thesis be **rejected.** (Please enclose your comments).   [ ]

Place . . . .   Signature of the Examiner . . . .

Date . . . .   Name and Address of the Examiner . . . .

. . . .

Encl: a. Detailed report on separate sheet(s)

          b. List of points for clarification

Format of Examiner's Report on Revised Thesis

Mahatma Gandhi Central University, Motihari - 845401, Bihar
Recommendation on Revised Ph. D. Thesis

Name of the Research Scholar:
Title of the Thesis :

Please give your **specific recommendation** by ticking (✓) any one of the following, with signature underneath and enclose your **detailed report** on separate sheet(s) with your signature, name, and address.

The thesis **be accepted** for the award of the Ph. D. degree   [   ]

OR

The thesis be **rejected.** (Please enclose your comments).   [   ]

Place . . . .   Signature of the Examiner . . . .
Date . . . .   Name and Address of the Examiner . . . .
. . . .

Encl: Detailed report on separate sheet(s)

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

1.1.1   pm2

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	BiLSTM	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.