ReportTitel

A dissertation-I submitted to the Mahatma Gandhi Central University in partially fulfillment of the requirements for the award of the degree of

MASTER OF TECHONOLGY

IN

COMPUTER SCIENCE & ENGINEERING
BY

STUDENT NAME IN UPER CASE



DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY
MAHATMA GANDHI CENTRAL UNIVERSITY,
MOTIHARI, BIHAR - 845401, INDIA

August 6, 2023

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Under the Supervision of

SUPERVISOR NAME IN UPER CASE



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MOTIHARI, BIHAR - 845401, INDIA

August 6, 2023



कंप्यूटर विज्ञान और सूचना प्रौद्योगिकी विभाग Department Of Computer Science And Information Technology महात्मा गाँधी केन्द्रीय विश्वविद्यालय, बिहार-८४५४०१ MAHATMA GANDHI CENTRAL UNIVERSITY, MOTIHARI, BIHAR - 845401, INDIA

DECLARATION

This is to certify that the dissertation-I entitled "ReportTitel" is being submitted to the Department Of Computer Science And Information Technology, Mahatma Gandhi Central University, Motihari, Bihar - 845401, India in partial fulfillment of the requirements for the award of the degree of course name(Master of Technology) in Computer Science & Engineering, is a record of bonafide work carried out by me under the supervision of "Supervisor Name, Department Of Computer Science And Information Technology, Mahatma Gandhi Central University, Motihari, Bihar - 845401, India."

The matter embodied in the dissertation has not been submitted in part or full to any University or Institution for the award of any other degree or diploma.

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|---|---|
| 1 | 1 |

"I am enough of an artist to draw freely upon my imagination. Imagination is more important than knowledge. For knowledge is limited, whereas imagination encircles the world."

Albert Einstein



कंप्यूटर विज्ञान और सूचना प्रौद्योगिकी विभाग Department Of Computer Science And Information Technology महात्मा गाँधी केन्द्रीय विश्वविद्यालय, बिहार-८४५४०१ MAHATMA GANDHI CENTRAL UNIVERSITY, MOTIHARI, BIHAR - 845401, INDIA

CERTIFICATE

This is to certify that the dissertation-I entitled "ReportTitel" submitted by Student Name to the Department Of Computer Science And Information Technology, Mahatma Gandhi Central University, Motihari, Bihar - 845401, India for the award of the degree of course name(Master of Technology) in Computer Science & Engineering, is a research work carried out by him under the supervision of "Supervisor Name, Department Of Computer Science And Information Technology, Mahatma Gandhi Central University, Motihari, Bihar - 845401, India."

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Abstract

Paragraph

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Student Name (STUDENT ENROLMENT NUMBER) M.Tech(CSE)

List of Publications

1.titel of publicationpublisharAuthors - Student Name and Vipin Kumar

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List of Abbreviations

ML Machine Learning

DL Deep Learning

CNN Convolutional Neural Network

List of Symbols

D Dataset

N Number of data points

y(i) i^{th} measurement

Dedicated to Maa, and Papajee

Introduction

1.1 Introduction

Paragraph1 Paragraph2

Paragraph3

Literature Review

2.1 Literature Review

Paragraph

Paragraph

Table 2.1 REFRENCE OF TABLE

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

| Results | : |
|-----------------------|-----|
| Benchmark Models | : |
| Forecasting Object | : |
| Data Source | |
| Proposed Model | ••• |
| Paper | : |

Basics Related Roncepts

- 3.1 Basics Related Roncepts
- 3.1.1 Machine Learning

Paragraph

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 10:00 | 02-12-2022 17:00 | 34160 |
| BULANDSHAHR | 16-05-2018 13:00 | 02-12-2022 17:00 | 39869 |
| MUZAFFARNAGAR | 01-07-2018 00:00 | 03-12-2022 01:00 | 38786 |

Table 4.1:

Results and Analysis

5.1 Results and Analysis

TABLE 5.1: All Datasets RMSE.

| HAMELINADI TAM Seq LSTM Bi- LSTM Bi- BHIWADI 23.13 57.2 22.34 24.2 19.6 48.14 45.98 43.5 55.3 JODHPUR 27.54 26.68 32.94 22.35 22.08 50 40.87 43.55 52.63 SINCRAULI 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 62.87 52.63 ANKLESHWAR 18.41 10.1 8.7 21.61 13.63 17.79 50.61 22.5 ANKLESHWAR 8.4 11.12 22.14 10.1 8.3 41.28 68.75 24.76 24 | DataSets | BiLS- | CNN | GRU | Seq2- | V- | S- | CNN | CNN_ CNN_ GRU | GRU_ |
|--|---------------|-------|-------|-------|-------|-------|-------|-------|---------------|-------|
| VADI 23.13 57.2 22.34 24.2 19.6 48.14 45.98 43.5 HPUR 27.54 26.68 32.94 22.35 22.08 50 40.87 43.55 HPUR 27.54 26.68 32.94 22.35 22.08 50 40.87 43.55 HESHWAR 18.53 16.68 37.15 27.34 21.61 13.63 17.79 50.61 22.2 HIANA 8.4 11.12 22.14 10.1 8.3 21.15 25.66 24.76 GAPUR 6.14 8.77 20.34 9.48 8.78 15.28 62.87 46.28 62.87 45.67 GAPUR 8.4 11.12 22.14 10.1 8.3 11.58 45.65 24.76 48.78 15.80 45.76 24.76 GAPUR 20.43 34.57 56.27 36.33 38.18 66.14 72.39 45.63 45.63 WKHELDADRI 18.4 72.41 </th <th></th> <th>TM</th> <th></th> <th></th> <th>Seq</th> <th>LSTM</th> <th>LSTM</th> <th>Bi-</th> <th>LSTM</th> <th>Bi-</th> | | TM | | | Seq | LSTM | LSTM | Bi- | LSTM | Bi- |
| VADI 23.13 57.2 22.34 24.2 19.6 48.14 45.98 43.5 IPUR 27.54 26.68 32.94 22.35 22.08 50 40.87 43.55 IRAULI 10.92 15.5 27.34 21.61 13.63 17.79 50.61 22.2 HANDA 8.4 11.12 22.14 10.1 8.3 46.28 6.87 43.55 GAPUR 8.4 11.12 22.14 10.1 8.3 21.15 25.66 24.76 GAPUR 8.4 11.12 22.14 10.1 8.3 15.28 66.8 24.76 GAPUR 8.4 11.12 22.14 10.1 8.3 15.28 9.62 13.76 UNA_NAGAR 8.7 26.27 36.33 38.18 66.14 72.39 45.63 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 IRALA 20.14 | | | | | | | | LSTM | | LSTM |
| IPUR 27.54 26.68 32.94 22.35 22.08 50 40.87 43.55 IRAULI 10.92 15.5 27.34 21.61 13.63 17.79 50.61 22.2 IRAULI 10.92 15.5 27.34 21.61 13.63 17.79 50.61 22.2 HIANA 8.4 11.12 22.14 10.1 8.3 46.28 62.85 68.72 GAPUR 8.4 11.12 22.14 10.1 8.3 21.15 25.60 24.76 24.76 GAPUR 8.4 8.7 8.78 15.28 9.62 13.76 WKHI_DADRI 18.42 20.34 9.48 8.78 15.28 9.62 13.76 WKHI_DADRI 18.42 20.43 27.35 26.27 36.71 46.16 45.27 PAT 2.14 7.03 43.56 27.32 26.7 65.77 39.71 46.16 45.14 ALA 2.58 2.44 | BHIWADI | 23.13 | 57.2 | 22.34 | 24.2 | 19.6 | 48.14 | 45.98 | 43.5 | 35.3 |
| RAULI 10.92 15.5 27.34 21.61 13.63 17.79 50.61 22.2 LESHWAR 18.53 16.68 37.15 23.78 18.38 46.28 62.85 68.72 HIANA 8.4 11.12 22.14 10.1 8.3 21.15 25.66 24.76 GAPUR 6.14 8.27 20.34 9.48 8.78 15.28 62.85 68.72 UNA_NAGAR 37.34 34.57 56.27 36.33 38.18 66.14 72.39 45.62 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 RKHI_DADRI 18.42 20.43 27.32 26.7 62.73 30.71 43.59 RALA 20.14 20.23 20.47 40.01 40.10 40.11 ALA 20.24 22.54< | JODHPUR | 27.54 | 26.68 | 32.94 | 22.35 | 22.08 | 50 | 40.87 | 43.55 | 52.63 |
| LESHWAR 18.53 16.68 37.15 23.78 18.38 46.28 62.85 68.72 HIANA 8.4 11.12 22.14 10.1 8.3 21.15 25.66 24.76 GAPUR 6.14 8.27 20.34 9.48 8.78 15.28 9.62 13.76 UNA_NAGAR 37.34 34.57 56.27 36.33 38.18 66.14 72.39 45.63 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 OKSHETRA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 IKAT 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 RUHERA 26.74 28.93 34.6 24.06 25.19 43.02 24.01 22.96 RALA 28.34 46.79 47.93 33.98 30.99 63.29 43.16 49.1 | SINGRAULI | 10.92 | 15.5 | 27.34 | 21.61 | 13.63 | 17.79 | 50.61 | 22.2 | 26.5 |
| HIANA 8.4 11.12 22.14 10.1 8.3 21.15 25.66 24.76 GAPUR 6.14 8.27 20.34 9.48 8.78 15.28 9.62 13.76 UNA_NAGAR 37.34 34.57 56.27 36.33 38.18 66.14 72.39 45.63 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 OKSHETRA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 PAT 27.14 72.03 43.56 27.32 26.7 65.77 39.71 43.59 RALA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 RABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 | ANKLESHWAR | 18.53 | 16.68 | 37.15 | 23.78 | 18.38 | 46.28 | 62.85 | 68.72 | 69.38 |
| GAPUR 6.14 8.27 20.34 9.48 8.78 15.28 9.62 13.76 UNA_NAGAR 37.34 34.57 56.27 36.33 38.18 66.14 72.39 45.63 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 UKSHETRA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 UKSHETRA 27.14 72.03 43.56 27.32 26.7 65.77 39.71 48.59 RUHERA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R AS 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.91 23.6 ANDSHAHR 7.39 8.87 | LUDHIANA | 8.4 | 11.12 | 22.14 | 10.1 | 8.3 | 21.15 | 25.66 | 24.76 | 23.77 |
| UNA_NAGAR 37.34 34.57 56.27 36.33 38.18 66.14 72.39 45.63 RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 KCHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 CHARLICA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 IPAT 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 RUHERA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 RABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 <th>DURGAPUR</th> <th>6.14</th> <th>8.27</th> <th>20.34</th> <th>9.48</th> <th>8.78</th> <th>15.28</th> <th>9.62</th> <th>13.76</th> <th>24.39</th> | DURGAPUR | 6.14 | 8.27 | 20.34 | 9.48 | 8.78 | 15.28 | 9.62 | 13.76 | 24.39 |
| RKHI_DADRI 18.42 20.43 27.96 18.43 18.06 40.71 46.16 45.27 UKSHETRA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 UKSHETRA 27.14 72.03 43.56 27.32 26.7 65.77 39.71 88.12 IPAT 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 RUHERA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 ANDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | YAMUNA_NAGAR | 37.34 | 34.57 | 56.27 | 36.33 | 38.18 | 66.14 | 72.39 | 45.63 | 74.13 |
| UKSHETRA 24.17 26.42 34.35 25.85 19.41 79.22 62.13 43.59 IPAT 27.14 72.03 43.56 27.32 26.7 65.77 39.71 88.12 RUHERA 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 ALA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 ANDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARINA- 11.88 16.13 13.72 14.27 22.21 15.91 23.6 | CHARKHI_DADRI | 18.42 | 20.43 | 27.96 | 18.43 | 18.06 | 40.71 | 46.16 | 45.27 | 43.48 |
| IPAT 72.03 43.56 27.32 26.7 65.77 39.71 88.12 IPAT 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 RUHERA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 NDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.27 12.75 22.21 15.91 23.6 | JIND | 24.17 | 26.42 | 34.35 | 25.85 | 19.41 | 79.22 | 62.13 | 43.59 | 50.95 |
| RUHERA 12.56 15.98 22.4 15.41 10.9 43.02 24.01 22.96 RUHERA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 NNDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.27 22.21 15.91 23.6 | KURUKSHETRA | 27.14 | 72.03 | 43.56 | 27.32 | 26.7 | 65.77 | 39.71 | 88.12 | 53.74 |
| ALA 26.74 28.93 34.6 24.06 25.19 53.18 31.93 35.01 ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 NNDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | SONIPAT | 12.56 | 15.98 | 22.4 | 15.41 | 10.9 | 43.02 | 24.01 | 22.96 | 46.77 |
| ALA 22.58 28.96 41.08 19.92 16.92 57.43 40.71 34.14 R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 NNDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | DHARUHERA | 26.74 | 28.93 | 34.6 | 24.06 | 25.19 | 53.18 | 31.93 | 35.01 | 46.22 |
| R 28.34 66.79 47.93 33.98 30.99 63.29 43.16 49.1 HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 NNDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | AMBALA | 22.58 | 28.96 | 41.08 | 19.92 | 16.92 | 57.43 | 40.71 | 34.14 | 63.85 |
| HABAD 14.37 38.36 72.71 15.51 15.58 38.38 74.38 76.75 ANDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | HISAR | 28.34 | 62'99 | 47.93 | 33.98 | 30.99 | 63.29 | 43.16 | 49.1 | 62.46 |
| ANDSHAHR 7.39 8.87 19.79 11.19 7.2 14.98 9.61 13.16 AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | FATEHABAD | 14.37 | 38.36 | 72.71 | 15.51 | 15.58 | 38.38 | 74.38 | 22.92 | 72.64 |
| AFFARNA- 11.88 16.13 13.72 14.2 12.75 22.21 15.91 23.6 | BULANDSHAHR | 7.39 | 8.87 | 19.79 | 11.19 | 7.2 | 14.98 | 9.61 | 13.16 | 11.51 |
| GAR | MUZAFFARNA- | | 16.13 | 13.72 | 14.2 | 12.75 | 22.21 | 15.91 | 23.6 | 21.9 |
| | GAR | | | | | | | | | |

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

| Algorithm | Rank- |
|------------|--------|
| | ing |
| 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 |

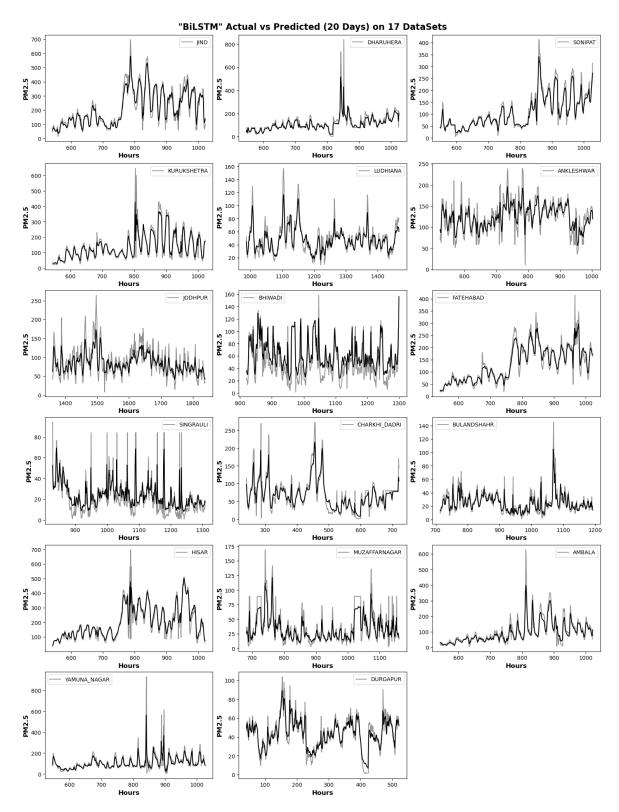


FIGURE 5.1: Actual vs Predicted of BiLSTM for All Datasets

Conclusion

6.1 Conclusion