A Systematic Review and Analysis on Deep Learning Techniques Used in Diagnosis of Various Categories of Lung Diseases (Supplemental Material)

Table 7: Dataset details

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.No** | **Image Type** | **Data set classes** | **Dataset** | **Training Dataset** | **Test** | **Data Augmentation** | **Dataset source** |
| 1 | CT | Covid-19/ other pneumonia/ Viral pneumonia/ Normal | 5372 images | 4106 | 1266 | NO | Different cities |
| 2 | CT | Covid-19 lesions | 540 | 499 | 131 | Yes | Hospital |
| 3 | CT | Covid-19, Pneumonia | 2724 | 1387 | 1337 | Yes | Multinational, LIDC |
| 4 | X-ray | COVID, Normal, Pneumonia | 1127 | 80% | 20% | NO | Cohen JP |
| 4 | X-ray | COVID, Normal | 1127 | 80% | 20% | NO | Cohen JP |
| 5 | CT | Covid Positive or Negative | Not mentioned | 20 | 80 | NO | Not mentioned |
| 30 | 70 |
| 40 | 60 |
| 50 | 50 |
| 60 | 40 |
| 70 | 30 |
| 80 | 20 |
| 90 | 10 |
| 6 | X-ray | coronavirus, pneumonia, and normal | 458 | 70% | 30% | No | Kaggle |
| 7 | X – Ray | COVID-19, MERS, SARS, Varicella, Streptococcus and Pneumocystis | 1000 |  |  | NO | Dr. Josepth Cohen GitHub repository; Radiopedia; and NIH dataset. |
| 8 | X-Ray | COVID-19/viral pneumonia/ bacterial pneumonia/TB/ Normal | 502 | 354 | Validation/Test= 49/99 | Yes | JSRT / SCR, NLM(MC), CoronaHack, |
| Cohen et al |
| 9 | Lung Ultrasonography | COVID-19 | 277 lung ultrasound (LUS) videos | 70% | 30% | No | Italian COVID-19 Lung Ultrasound Database (ICLUS-DB) |
| 10 | X-Ray | Normal, Pneumonia,  | 2000 |  |  | Yes | LIDC-IDRI |
| 10 | CT Scan | malignant and benign | 1500 |  |  | Yes | LIDC-IDRI  |
| 11 | CT | Malignant | 1018 cases |  |  | Yes | LIDC |
| 12 | X-Ray (Chest Radiograph) | malignant pulmonary nodules | 43292 | 42092 | Tunning dataset 600, internal validation data set 600 | No | South Korean hospitals and one U.S. hospital |
| 13 | CT  | normal, benign and malignant  | 100 | 70 images | 30 images | No |   |
| 14 | CT | benign and malignant |  |  |  | Yes | LIDC-IDRI Dataset |
|  |  |  |  | RIDER DB |
|  |  |  |  | SPIE-challenge Dataset |
|  |  |  |  | LUNA16 Dataset |
|  |  |  |  | Lung CT Diagnosis dataset |
|  |  |  |  | Hospital Dataset Dataset |
| 15 | SOUNDS | normal, coarse crackle, fine crackle, monophonic wheeze, polyphonic wheeze, squawk, and stridor | 50 RECODINGS OF SOUNDS | 70 | 30 | YES | R.A.L.E. (Respiration Acoustics Laboratory Environment) |
| 16 | X-Ray | TB / Normal | 1007 | 68% | Validation- 17.1% | Yes | Montgomery County, Md |
| Test -14.9% | Shenzhen, china |
|  | Belaraus TB Public health program, |
|  | Thomas Jefferson University Hospital |
|  |   |
| 17 | X Ray | benign and malignant | 247 cases |  |  | Yes | JSRT(Japanese Society of Radiological Technology) |
| 18 | CT | benign and malignant | 5024 | 4576 | 448 | YES | LIDC-IDRI |
| 19 | CT | benign and malignant | 1010 |  |  | NO | Lung Image Database Consortium dataset |
| 20 | X-Ray | COVID-19, normal (healthy), viral pneumonia and bacterial pneumonia | Dataset-1 – 3141 | 80% | 20% | No | Git Hub Repository, Kaggle |
| Dataset-2- 1834 |
| Dataset-3 3113 |
| 21 | X-Ray | Covid19/SARS/Pneumonia | 196 | 80 | 20 | YES | JSRT |
| 22 | X-Ray | Covid-19 , Normal | 5000 | 2000 | 3000 | No | Cohen, ChexPert |
| 23 | X-Ray | Covid-19/ Normal/ community-acquired pneumonia (CAP) | 4352 | 90% | 10% | Yes | Six medical centers |
| 24 | CT | influenza-A viral pneumonia (IAVP) | 618 | 85.4 | 14.6 | Yes | three COVID-19-designated hospitals in Zhejiang Province, China |
| 25 | CT | Covid-19/ Viral Pneumonia | 1065 |  |  | NO | Xi’an Jiaotong University First Affiliated Hospital (center 1), Nanchang University First Hospital (center 2), and Xi’an No.8 Hospital of Xi’an Medical College (center 3) |
| 26 | CT | Malignant | 1010 patients | 825 nodules | 275 nodules | Yes | LIDC-IDRI |
| 2618 nodules |
| 28 | X-Ray | COVID ,Pneumonia bacterial, pneumonia viral, normal | 1300 images |  |  | No | Github repository by Joseph, Radiological Society of North America (RSNA) |
| 29 | X-RAY | normal and COVID-19 pneumonia | 3487 images | 80% | 20% | Yes | Kaggle databases, Italian Society of Medical and Interventional Radiology (SIRM) , Github, RSNA |
| normal, viral and COVID-19 pneumonia |
| 30 | CT | Lung Cancer nodule ( Solid, Calcified, Part-solid, Non-solid, Perifissural, Spiculated) | 943 patients (1,352 nodules) | 75% | 25% | Yes | Multicentric Italian Lung Detection (MILD) for Training |
| 468 patients (639 nodules) | Danish Lung Cancer Screening Trial (DLCST) for testing |
| 31 | CT | Pulmonary Nodule | 1018 |  |  | Yes | LIDC-IDRI |
| 32 | X- Ray | COVID-19, pneumonia, Normal | Dataset1- 1427 |  |  | No | Github-(Cohen), RSNA, Radiopaedia, Italian Society of Medical and Interventional Radiology (SIRM) |
| Dataset 2- 1442 |
| 33 |  |  |  |  |  |  |   |
| 34 | X Ray | COVID-19, bacterial pneumonia, Viral Pneumonia Normal | 5232 | 5232 | 624 | Yes | Guangzhou Women and Children’s Medical Center |
| 35 | X-Ray | Covid-19 , Normal | 1124 images | 932 | 192 | Yes | IEEE Covid Chest X-ray dataset [23] 2) COVID-19 Radiography Database [24] and 3) COVID-19 Chest X-ray Dataset Initiative |
| 36 | X Ray | Pneumonia, Normal | 5856 | 3722 | 2134 | yes |   |
| 37 | X-Ray | Tuberculosis | 1104 |  |  | Yes | e U.S. National Institute of Health (NIH) , Belarus dataset |
| 38 | CT | Covid-19, Pneumonia | 46096 | 35355 | 13911 | NO | Renmin Hospital of Wuhan University. |
| 39 | CT | Covid-19 |  |  |  |  |   |
| 40 | CT | Covid-19, Pneumonia | 1020 | 816 | 102 | No |   |
| 41 | CT | Covid-19 | 126 Patients |   |   |   |   |

Table 8: Dataset classes referred in different articles

|  |  |  |
| --- | --- | --- |
| **Data set Classes** | **No of Classes** | **No of Articles** |
| COVID-19 Lesions/ Normal | 2 | 1 |
| Covid-19, Bacterial Pneumonia, Mycoplasma Pneumonia, Viral Pneumonia, Fungal Pneumonia | 5 | 1 |
| COVID-19, CAP, Normal | 3 | 1 |
| COVID-19, normal (healthy), viral pneumonia and bacterial pneumonia | 4 | 3 |
| COVID-19, Viral Pneumonia | 2 | 1 |
| COVID-19, Normal | 2 | 7 |
| COVID-19, Pneumonia | 2 | 1 |
| COVID-19, Pneumonia, Normal | 3 | 3 |
| COVID-19, viral pneumonia, bacterial pneumonia, TB, Normal | 5 | 1 |
| influenza-A viral pneumonia (IAVP), Normal | 2 | 1 |
| Lung Cancer nodule (Solid, Calcified, Part-solid, Non-solid, Perifissural, Spiculated) | 6 | 1 |
| Lung Pneumonia, Cancer | 2 | 1 |
| Malignant, benign | 2 | 6 |
| normal and COVID-19 pneumonia | 2 | 3 |
| normal, benign and malignant | 3 | 1 |
| normal, coarse crackle, fine crackle, monophonic wheeze, polyphonic wheeze, squawk, and stridor | 7 | 1 |
| normal, viral and COVID-19 pneumonia | 3 | 1 |
| Pneumonia, Normal | 2 | 1 |
| Pulmonary Nodules, Normal | 2 | 1 |
| TB , Normal | 2 | 2 |

Table 11: Metrics of DL algorithms

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ref. No | Deep Learning | Accuracy | Precision | Recall | F1- Score | Sensitivity | Specificity | AUC |
| 1 | Covid-19Net | 81.24 |  |  | 86.92 | 78.93 | 89.93 |  |
| 2 | DeCoVNet | 90.1 |  |  |  |  |  | 0.959 |
| 3 | Hybrid 3D | 90.5 |  |  |  | 75 | 95 | 0.938 |
| 3 | 3D | 93.9 |  |  |  | 84.5 | 91.6 | 0.941 |
| 4 | DarkCovidNet | 87.02 |  |  | 87.37 | 85.35 | 92.18 |  |
| 5 | MODE-based CNN | 1.9789 |  |  | 2.0928 | 1.8262 | 1.6827 |  |
| 6 | MobileNetV2 (COVID-19) | 96.28 | 99.32 |  | 98.81 | 98.31 | 98.69 |  |
|  | SqueezeNet (COVID-19) | 95.85 | 98.65 |  | 98.82 | 98.98 | 97.35 |  |
| 7 |  |  |  |  | 0.65 |  |  |  |
| 8 | Patch-Based Classification Network | 88.9 | 83.4 | 85.9 | 84.4 |  | 96.4 |  |
| 9 | CNN+Reg-STN+SORD | 96 | 70% | 60% | 61% |  |  |  |
| 10 | MAN | X-Ray images >96%,CT – 86.47 | 96.58, 92.20 |  | 96.97, 88.06 | 96.63, 82.78 | 96.78, 99.08 |  |
| 11 | HSCNN | 84.2 |  |  |  | 0.705 | 0.889 | 0.856 |
| 12 | DLAD |  |  |  | 87.0 | 79.0 | 95 | 0.92 |
| 13 | ODNN | 96.2 |  |  |  | 95.26 | 96.2 |  |
| 14 | DFCNET algorithm for different datasets algorithm for different datasets- LIDC-IDRI Dataset | 86.02 |  |  |  | 83.91 | 89.32 |  |
| RIDER DB | 80.64 |  |  |  | 74.58 | 86.54 |  |
| SPIE-challenge Dataset | 84.87 |  |  |  | 81.22 | 82.97 |  |
| LUNA16 Dataset | 80.12 |  |  |  | 73.14 | 81.95 |  |
| Lung CT Diagnosis dataset | 89.52 |  |  |  | 82.54 | 93.60 |  |
| Hospital Dataset Data set | 86.32 |  |  |  | 83.67 | 96.17 |  |
| 16 | AlexNet | 93.3 |  |  |  | 92.0 | 94.7 |  |
| GoogLeNet | 95.3 |  |  |  | 92.0 | 98.7 |  |
| Ensemble (AlexNet, GoogLeNet, DCNN) | 98.7 |  |  |  | 97.3 | 100 | 0.99 |
| 17 | deep feature fusion |  |  |  |  | 69.3 | 96.2 |  |
| 18 | CNN | 84.15 |  |  |  | 83.96 | 84.32 | 0.916 |
| DNN | 82.37 |  |  |  | 80.66 | 83.9 | 0.877 |
| SAE | 82.59 |  |  |  | 83.96 | 81.35 | 0.884 |
| 19 | DBN |  |  |  |  | 73.4 | 82.2 |  |
| CNN |  |  |  |  | 73.3 | 78.7 |  |
| 20 | ResNet50 | 99.5 | 98 | 99.4 | 98.7 |   | 99.5 |  |
|  ResNet101  | 97.1 | 95.6 | 88.3 | 91.8 |   | 99.1 |  |
| ResNet152 | 97.5 | 95.7 | 90.9 | 93.2 |   | 99.1 |  |
| Inception-ResNetV2 | 94.4 | 80.5 | 92.1 | 85.9 |   | 94.9 |  |
| Inception V3 | 98.6 | 93.2 | 99.7 | 96.3 |   | 98.3 |  |
| ResNet50 | 99.5 | 98 | 99.4 | 98.7 |   | 99.5 |  |
| 21 | DeTraC | 93.1 |  |  |  | 100 |  |  |
| 22 | ResNet18 | 98.0 |   |   |   | 98 | 90.7 |  |
| ResNet50 | 98.0 |   |   |   | 98 | 89.6 |  |
| SqueezeNet | 98.0 |   |   |   | 98 | 89.6 |  |
|  DenseNet-121 | 98.0 |   |   |   | 98 | 75.1 |  |
| ResNet18 | 98.0 |   |   |   | 98 | 90.7 |  |
| 23 | 3D DL framework |  |  |  |  | 90 | 96 | 0.96 |
| 24 | 3D DL | 86.7 | 0.813 | 0.867 | 0.839 |  |  |  |
| 25 | GoogLeNet, Inception V3 | 89.5 |  |  | 0.77 | 0.87 | 0.88 |  |
| 26 | MC-CNN | 87.14 |  |  |  | 0.77 | 0.93 | 0.93 |
| 28 | CoroNet | 89.6 | 90 | 89.92 |  |  | 96.4 |  |
| 29 | SqueezeNet | 95.10 | 95.18 |  | 95.14 | 95.10 | 97.17 |  |
| MobileNetv2 | 96.22 | 96.25 |  | 96.23 | 96.22 | 97.80 |  |
| ResNet18 | 96.44 | 96.48 |  | 96.46 | 96.44 | 97.91 |  |
| InceptionV3 | 86.20 | 97.00 |  | 96.60 | 96.40 | 97.50 |  |
| ResNet101 | 96.22 | 96.24 |  | 96.23 | 96.22 | 97.80 |  |
| CheXNet | 96.94 | 96.43 |  | 96.42 | 96.42 | 97.29 |  |
| DenseNet201 | 97.94 | 97.95 |  | 97.94 | 97.94 | 98.80 |  |
| VGG19 | 96.00 | 96.50 |  | 96.38 | 96.25 | 97.52 |  |
| 30 | ConvNets | 79.5 |  |  |  |  |  |  |
| 32 | Transfer Learning with CNN | 96.78 |  |  |  | 98.66 | 96.46 |  |
| 33 |  |  |  |  |  |  |  |  |
| 34 | Transfer Learning usingAlexNet, DenseNet121, InceptionV3, ResNet18, GoogLeNet | 96.39 | 93.28 | 99.62 |  |  |  | 99.34 |
| 35 | CovidGAN | 95% | 0.96 | 0.90 | 0.93 | 90 | 97 |  |
| 36 | CNN | 95 |  |  |  |  |  |  |
| 37 | CNN | 86.2 |  |  |  |  |  | 0.925 |
| 38 | DL Based model, ResNet50 | 96 |  |  |  | 98 | 94 |  |
| 39 | Inf-Net |  |  |  |  | 0.870 | .974 |  |
| 40 | AlexNet | 78.92 |  |  |  | 89.21 | 68.83 | 0.894 |
| VGG16 | 83.33 |  |  |  | 80.39 | 86.27 | 0.926 |
| VGG19 | 85.29 |  |  |  | 92.16 | 78.43 | 0.943 |
| SqueezeNet | 82.84 |  |  |  | 78.43 | 87.25 | 0.899 |
| GoogleNet | 85.29 |  |  |  | 81.37 | 90.20 | 0.927 |
| MobileNet-V2 | 92.16 |  |  |  | 97.06 | 87.25 | 0.982 |
| ResNet-18 | 91.67 |  |  |  | 95.10 | 88.23 | 0.970 |
| ResNet-50 | 94.12 |  |  |  | 90.20 | 100 | 0.990 |
| ResNet-101 | 99.51 |  |  |  | 100 | 99.02 | 0.994 |
| Xception | 99.02 |  |  |  | 98.04 | 100 | 0.994 |