Visualization & Prediction of COVID-19 Future Outbreak by Using Machine Learning

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Abstract: Day by day, the accumulative incidence of COVID-19 is rapidly increasing. After the spread of the Corona epidemic and the death of more than a million people around the world countries, scientists and researchers have tended to conduct research and take advantage of modern technologies to learn machine to help the world to get rid of the Coronavirus (COVID-19) epidemic. To track and predict the disease Machine Learning (ML) can be deployed very effectively. ML techniques have been anticipated in areas that need to identify dangerous negative factors and define their priorities. The significance of a proposed system is to find the predict the number of people infected with COVID-19 using ML. Four standard models anticipate COVID-19 prediction, which are Neural Network (NN), Support Vector Machines (SVM), Bayesian Network (BN) and Polynomial Regression (PR). The data utilized to test these models content of number of deaths, newly infected cases, and recoveries in the next 20 days. Five measures parameters were used to evaluate the performance of each model, namely root mean squared error (RMSE), mean squared error (MAE), mean absolute error (MSE), Explained Variance score and r2 score (R²). The significance and value of proposed system auspicious mechanism to anticipate these models for the current scenario of the COVID-19 epidemic. The results showed NN outperformed the other models, while in the available dataset the SVM performs poorly in all the prediction. Reference to our results showed that injuries will increase slightly in the coming days. Also, we find that the results give rise to hope due to the low death rate. For future perspective, case explanation and data amalgamation must be kept up persistently.

Index Terms: COVID-19, Deep Neural Network, Support Vector Machines, Bayesian Network, Polynomial Regression Pandemic.

1. Introduction

There are many epidemics that have invaded humanity throughout history. In December 2019, a disease appeared in Wuhan, China, this disease spread very quickly around the world and countries could not control it, prompting the World Health Organization in March 2020 to declare the COVID-19 epidemic is a global pandemic [1]. The new COVID-19 fulminate in more than 186 countries infecting cases 34.2 million individuals and causing 1.02 million deaths by OCT 02, 2020. COVID 19 causes many effects on the human body, such as influenza symptoms, failure in many organs, and acute respiratory syndrome, which may eventually lead to the death of people, especially the elderly and Patient with chronic diseases [2].

ML has imposed itself as a science capable of solving very complex real-world problems of past years. Machine learning and artificial intelligence have been used in most areas of life such as medicine [3], autonomous cars, robotics, weather forecasting [4], image processing, natural language, [5], UAV... etc. [6]. ML algorithms surpass traditional algorithms in that they use the method of learning from experiences and correcting errors based on these experiences as a human being. Prediction is one of the most important areas of ML. ML has been used to predict diseases.

The major objectives of this research to contribute to getting rid of the virus and help save humanity. We will develop a predictive model that predicts the spread of the Coronavirus using ML. Our methodology consider three cases
predicted within the next 20 days, the number of confirmed, deaths, and recovery cases. The ML algorithms used are NN, SVM, Bayesian Network, PR [7, 8]. The ML models used in this study are trained using a set of statistical data for daily cases of COVID-19 patients provided by a which are continuously updated. This data is processed and divided into a training data set (85%) and a test data set (15%).

In the absence of any medical advices, the only solution to stop the spread by training social distancing and cleanliness. This up normal of behavior of COVID-19 requires evolving method for tracking its prevalence and automation of the tracking tools for dynamic decision making.

We know that the ML can be utilized to handle large data and intelligently predict the next step of any model such as spreading any dangers disease. The Motivation and our contributions of this paper has findings the prediction model using ML algorithms can be profitable for decision-makers to restrain COVID-19 pandemics. This manuscript, provide a prediction model deployed using for precise prediction of the number of COVID-19 cases: confirmed, deaths and recoveries in near future. Furthermore, provide a detailed of model comparison based on MSE, RMSE, MAE and $R^2$ parameters. Finally, we summarize this work and present various research directions.

2. Related Work

There are many studies conducted to predict future diseases using regression and artificial intelligence networks. ML techniques have been used to predict chronic diseases [9], diabetes [10], heart disease [11], Breast Cancer [12] and other diseases to help the doctor make the right decision.

COVID-19 spreads very quickly between people, through air or physical contact, or by touching surfaces contaminated with the virus, so it poses a great danger to humanity [13, 14]. Doctors, scientists, and researchers in various parts of the world are making efforts to provide the appropriate treatment and vaccine to get rid of COVID-19. Unfortunately, now there is no suitable vaccine for this disease. Limiting the spread of the virus in the coming days is very important, and therefore the governments of the world have taken strict measures such as closing airports and imposing a complete or partial ban. Technology helps limit the spread of the virus by predicting new cases [15]. ML algorithms are evaluated with the following measures parameters MSE, RMSE, MAE and $R^2$ [16].

3. Materials and Methods

ML and Data Science community are hardly work to improve the estimates of epidemiological models and analyze the generation information. This article proposes a ML model that can be run continuously on Python platform to obtain the most accurate result of the development of the spread of the epidemic and to develop a strategy to avoid the spreading by the government and the citizen. Prediction of COVID-19 using ML in Python language is a technique implemented with the help of processing tool following:

- **Jupyter** Notebook environment: It is used to generate a single web document by merging executable code, text, formulas into. This is useful for many purposes such as debug, and so forth.
- **library NumPy**: Foundation library used for scientific computing in Python since. It offers data structures and high-performing purposes. It defines a precise data structure that is an N-dimensional array defined as ndarray. This library utilized in this article for element-wise computation and Reading-writing datasets.
- **Pandas**: this package is core of data analysis in Python and provides complex data structures to make the work easy, fast, and effective. Its work with NumPy library to manipulation of data in spreadsheets or in relational databases (SQL databases).
- **Matplotlib**: it used to generate the plots and other data visualizations in 2D.

*Data Set*: In this paper, COVID-19 dispersal predicts in the future using ML algorithms to taking into consideration the number of confirmed cases, recoveries and deaths. The ML models were constructed using the datasets from the GitHub repository provided by the Center for System Science and Engineering, Johns Hopkins University [17]. Datasets are included in the folder on the GitHub under the name (csse_covid_19_time_series). These Dataset files consist of daily time series tables, inclusive the number of recoveries cases, deaths cases, and confirmed cases. All data are from the daily case report and the update frequency of data is one day, Table 1, Table 2 and Table 3 are displayed the country, latitude, longitude and interval range (1/22/2020 to 04/10/2020) for recovery, death and new confirmed, respectively. The selection of MATERIALS AND METHODS facilitates to achieve research objectives was the assistance of experts in the field of ML and scientific papers.
ML PREDICTION MODEL:

Four regression models have been used to predict the COVID-19: NN, SVM, BR and PR. In this paper, to denote the NN we used the ML Perceptron regressor (MLP) [18]. MLP model using LBFGS or stochastic gradient descent to optimizes the squared-loss. MLP regressor trains iteratively since at each time step the partial derivatives of the loss function with respect to the model parameters are computed to update the parameters. To update the parameters of MLP always use concept of iterative to obtain the partial derivatives of the loss function with respect to parameters of the model to compute the new value of parameters [19-22]. In our model, we used parameters as follow:

a) in case of recoveries

*alpha=0.0001, hidden layer sizes= (30, 30), random state=35, learning rate='constant, solver='lbfgs', activation='relu'.*

b) in case of confirmed

*alpha=0.001, hidden layer sizes= (100, 60), random state=25, learning rate='constant, solver='lbfgs', activation='relu'.*

c) in case of deaths

*alpha=0.001, hidden layer sizes= (500, 120), random state=25, learning rate='constant, solver='adaptive', activation='relu'.*

Secondly, SVM [23] use a mechanism called kernels. This mechanism converts the input data into the required output. SVM solves the regression problems using a linear function but in our case we map the input (x) to a feature space (z) (i.e, n-dimensional space) because our it has non-linearity behavior. In this paper, we used parameter as follow:

a) in case of recoveries

*shrinking=True, kernel='poly',gamma=0.01,epsilon=1,degree=4, C=1*

b) in case of confirmed

*(shrinking=False, kernel='poly',gamma=0.01,epsilon=0.01,degree=3, C=0.1)*

c) in case of deaths

*(shrinking=True, kernel='poly',gamma=0.1,epsilon=0.01,degree=2, C=0.01)*

Table 1. Sample data of new recovery cases worldwide

| COUNTRY /REGION | LAT     | LONG    | 1/22/20 0  | 1/23/20   | 9/30/2020 | 10/1/2020 | 10/2/2020 | 10/3/2020 | 10/4/2020 |
|-----------------|---------|---------|------------|------------|-----------|------------|------------|------------|------------|
| 0               | Afghanistan | 33.93911 | 67.709953  | 0          | 0         | ...        | 32789      | 32842      | 32842      | 32842      |
| 1               | Albania  | 41.1533 | 20.1683    | 0          | 0         | ...        | 7847       | 8077       | 8342        | 8536        | 8675       |
| 2               | Algeria  | 28.0339 | 1.6596     | 0          | 0         | ...        | 36174      | 36282      | 36385       | 36482       | 36578      |
| 3               | Andorra  | 42.5063 | 1.5218     | 0          | 0         | ...        | 1432       | 1432       | 1540        | 1540        | 1540       |
| 4               | Angola   | -11.2027 | 17.8739    | 0          | 0         | ...        | 1941       | 2082       | 2215        | 2436        | 2377       |

Table 2. Sample data of new death cases worldwide

| COUNTRY /REGION | LAT     | LONG    | 1/22/20 0  | 1/23/20   | 9/30/2020 | 10/1/2020 | 10/2/2020 | 10/3/2020 | 10/4/2020 |
|-----------------|---------|---------|------------|------------|-----------|------------|------------|------------|------------|
| 0               | Afghanistan | 33.93911 | 67.709953  | 0          | 0         | ...        | 1458       | 1458       | 1458       | 1462        | 1462       |
| 1               | Albania  | 41.1533 | 20.1683    | 0          | 0         | ...        | 378        | 388        | 389        | 392         | 396        |
| 2               | Algeria  | 28.0339 | 1.6596     | 0          | 0         | ...        | 1736       | 1741       | 1749       | 1756        | 1760       |
| 3               | Andorra  | 42.5063 | 1.5218     | 0          | 0         | ...        | 53         | 53         | 53         | 53          | 53         |
| 4               | Angola   | -11.2027 | 17.8739    | 0          | 0         | ...        | 183        | 185        | 189        | 193         | 195        |

Table 3. Sample data of New Confirmed Cases in Worldwide

| COUNTRY /REGION | LAT     | LONG    | 1/22/20 0  | 1/23/20   | 9/30/2020 | 10/1/2020 | 10/2/2020 | 10/3/2020 | 10/4/2020 |
|-----------------|---------|---------|------------|------------|-----------|------------|------------|------------|------------|
| 0               | Afghanistan | 33.93911 | 67.709953  | 0          | 0         | ...        | 39268      | 39285      | 39290      | 39297      | 39341      |
| 1               | Albania  | 41.1533 | 20.1683    | 0          | 0         | ...        | 13649      | 13806      | 13965      | 14117      | 14266      |
| 2               | Algeria  | 28.0339 | 1.6596     | 0          | 0         | ...        | 51530      | 51690      | 51847      | 51995      | 52136      |
| 3               | Andorra  | 42.5063 | 1.5218     | 0          | 0         | ...        | 2050       | 2050       | 2110       | 2110        | 2110       |
| 4               | Angola   | -11.2027 | 17.8739    | 0          | 0         | ...        | 4972       | 5114       | 5211       | 5370        | 5402       |
Thirdly, the utilization of Bayesian inference [24] was used to construct the models where the update of the parameters using Sparse Bayesian Learning and the Relevance Vector Machine [25]. When talking about hierarchical data structure the Bayesian modeling framework has been praised for its capability to deal with it [26].

Furthermore, Polynomial Regression is a form of regression analysis in which the relationship between the independent variable \((x)\) and the dependent variable \((y)\) are modeled as \((n^{th})\) degree polynomial in \((x)\).

4. Methodology

The study is aimed to finding a new way to limit the spread of the Coronavirus due to the threat to human life. It causes the death rate is increasing day by day throughout the globe. To add to this pandemic situation control, this study effort to achieve number of confirmed cases, recoveries and deaths in the upcoming 20 days. In the study, the dataset used holds regular time series, containing the number of confirmed cases, deaths, and recoveries in the past number of days from which the pandemic started until 4 October 2020.

We will predict the number of confirmed cases, recoveries and deaths. The first step is to process the data. In next step, the dataset (259) split into two subsets: a training set (220 days) and testing set (39 days). The ML models used in this paper are NN, SVM, BR and PR. These models trained on the days confirmed cases, recovery, and death patterns. The evaluating matrix consist of number of parameters such as MSE, RMSE, and MAE and \(R^2\). The proposed approach used in this article has been illustrated in Fig. 1 block diagram.

![Block Diagram of Methodology](image)

4.1. Covid 19 Data Visualization

All data until 4 October 2020 has been used to generate the prediction results as in Fig. 2,3,4 and 5 where the log figures are shown from Fig. 6 to Fig. 9. The world daily cases presented from Fig. 10 to Fig. 12.

The figures displayed the data on moving average for 10 days which can be calculate at time period \((t)\) as in equation:

\[
\frac{\left(x_t + x_{t-1} + x_{t-2} + \ldots + x_{t-(M-1)}\right)}{M}
\]

where \((M)\) represents the sliding window, it depends on the amount of smoothing desired since increasing the value of \((M)\) improves the smoothing at the expense of accuracy.
Fig. 2. Number of confirmed cases in worldwide

Fig. 3. Number of deaths cases in worldwide

Fig. 4. Number of recoveries cases in worldwide

Fig. 5. Number of active cases in worldwide
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Fig. 6. Log of COVID-19 cases in worldwide

Fig. 7. Log of deaths cases in worldwide

Fig. 8. Log of recoveries cases in worldwide

Fig. 9. Log of confirmed cases in worldwide
5. Results and Discussion:

The number of people infected with COVID-19 is unknown in the world. In this paper, we are trying to know the numbers of infected cases and death cases, in addition to the cases of recovery affected by COVID-19 in the next 20 days. Four machine learning models MLP, PR, SVM, and BR have been used to forecast the number of confirmed cases, the deaths, and recoveries. Four measures have been used to evaluate the four algorithms and choose the best algorithm that predicts the number of COVID-19 cases.

5.1. Prediction of New Confirmed Cases

In the following, figures are presented the performance graphs of SVM, PR, MLP, BR and linear regression models respectively. All Graphs in all figures predict that the new confirmed case will increase in upcoming days which is a not good sign expect, the results of MLP give us the hopefulness. We can observe clearly from Fig. 18, the MLP curve (B), outperform other algorithms as in curve (A).
Fig. 13. SVM prediction for the upcoming 20 days (New confirm cases).

Fig. 14. PR prediction by for the upcoming 20 days (New confirm cases).

Fig. 15. NN (i.e. MLP) prediction for the upcoming 20 days (New confirm cases).

Fig. 16. B. R. prediction for the upcoming 20 days (New confirm cases).
The algorithm NN (i.e. MLP) achieved the best prediction performance for new cases as in curve (B) in Fig. 18. While the algorithm SVM was performing poorly. The performance of the algorithms PR and BR was good and comparable in performance. As for the linear algorithms, they were not able to predict the states and the values were very far from reality. The study performs predictions on confirmed case and according to results MLP performs better among all the models, while PR and BR perform equally well and achieve almost the same $R^2$ as shown in Table 4. The predicted number of confirmed cases over the worldwide are list in Table 5.

Table 4. Evaluate Metrics to Confirmed Cases Prediction

|                | SVM      | PR        | BR          | NN (i.e. MLP) |
|----------------|----------|-----------|-------------|---------------|
| MAE            | 3350432.468 | 888352.8451 | 906398.9479 | 268264.6905   |
| MSE            | 14851309552451.30 | 7.90834E+11 | 8.23477E+11 | 1.62164E+11   |
| $R^2$         | 0.593436004 | 0.953576088 | 0.95153218 | 0.989086182   |
| Explained Variance | 0.900738369 | 0.999902393 | 0.99987051 | 0.993298691   |
| RMSE           | 1830.418659 | 942.5247186 | 952.0498663 | 517.9427483   |
Table 5. Predicted of Confirmed Cases Worldwide

| Date    | Polynomial Predicted # of Confirmed Cases Worldwide | SVM Predicted # of Confirmed Cases Worldwide | Bayesian Predicted # of Confirmed Cases Worldwide | NN (i.e. MLP) # of Confirmed Cases Worldwide |
|---------|----------------------------------------------------|---------------------------------------------|-------------------------------------------------|--------------------------------------------|
| 0       | 34925200                                           | 43048934                                   | 34895230                                        | 34755613                                   |
| 1       | 35237460                                           | 43549854                                   | 35206971                                        | 35012449                                   |
| 2       | 35551106                                           | 44053750                                   | 35520094                                        | 35269286                                   |
| 3       | 35866137                                           | 44561537                                   | 35834599                                        | 35526123                                   |
| 4       | 36182555                                           | 45073220                                   | 36150485                                        | 35782960                                   |
| 5       | 36500357                                           | 45588844                                   | 36467754                                        | 36039796                                   |
| 6       | 36819546                                           | 46108393                                   | 36786404                                        | 36296633                                   |
| 7       | 37140120                                           | 46631894                                   | 37106436                                        | 36553470                                   |
| 8       | 37462080                                           | 47159361                                   | 37427850                                        | 36810307                                   |
| 9       | 37785426                                           | 47690809                                   | 37750646                                        | 37067143                                   |
| 10      | 38110157                                           | 48226252                                   | 38074824                                        | 37323980                                   |
| 11      | 38436274                                           | 48765706                                   | 38400383                                        | 37580817                                   |
| 12      | 38763776                                           | 49309186                                   | 38727325                                        | 37837269                                   |
| 13      | 39092665                                           | 49856707                                   | 39055648                                        | 38091178                                   |
| 14      | 39422938                                           | 50408283                                   | 39385353                                        | 38345087                                   |
| 15      | 39754598                                           | 50963930                                   | 39716440                                        | 38598996                                   |
| 16      | 40087643                                           | 51523663                                   | 40048908                                        | 38852905                                   |
| 17      | 40422074                                           | 52087496                                   | 40382759                                        | 39106814                                   |
| 18      | 40757891                                           | 52655445                                   | 40717991                                        | 39360724                                   |
| 19      | 41095093                                           | 53227524                                   | 41054605                                        | 39614633                                   |

5.2. Prediction of New Recoveries Cases

The recovery cases of COVID-19 increase day by day. Graphs in figures 19, 20, 21, 22 and 23 are illustrates the predictions of learning models. Table 6 shows the estimating results to recovery cases of the models used in this study. Table 7 provides the predicted of recovered cases over the worldwide. We found that, the results also proved the superiority of MLP over the rest of the models, and both BR and PR were equal.

Fig.19. SVM prediction for the upcoming 20 days (New recoveries cases).

Fig.20. PR prediction for the upcoming 20 days (New recoveries cases).
Fig. 21. MLP prediction for the upcoming 20 days (New recoveries cases).

Fig. 22. B.R. prediction for the upcoming 20 days (New recoveries cases).

Fig. 23. LR prediction by for the upcoming 20 days (New recoveries cases).

Fig. 24 ML algorithm prediction by for the upcoming 20 days (New recoveries cases).

Table 6. Evaluate Metrics to recoveries Cases Prediction

|       | SVM        | PR         | BR         | NN (i.e. MLP) |
|-------|------------|------------|------------|---------------|
| MAE   | 4271162.927| 1318443.424| 261822.89  | 246086.8444   |
| MSE   | 2516169191032.50 | 2.94424E+12  | 2.72036E+12 | 1.04288E+11   |
| R^2   | 0.286567242 | 0.849124653 | 0.85858648 | 0.989356735   |
| Explained Variance | 0.803824055 | 0.937260783 | 0.939929732 | 0.995537118   |
| RMSE  | 2066.679203 | 1148.234917 | 1123.308902 | 496.0714106   |
### Predicted of recovered Cases Worldwide:

| Date       | Polynomial Predicted # of recovered Cases Worldwide | SVM Predicted # of recovered Cases Worldwide | Bayesian Predicted # of recovered Cases Worldwide | Predicted # NN (i.e. MLP) of recovered Cases Worldwide |
|------------|------------------------------------------------------|--------------------------------------------|--------------------------------------------------|------------------------------------------------------|
| 0 10/7/2020 | 29170602                                             | 35417364                                   | 29144438                                         | 2578393                                             |
| 1 10/8/2020 | 29549772                                             | 35966719                                   | 29522921                                         | 26022671                                             |
| 2 10/9/2020 | 29932228                                             | 36522449                                   | 29904679                                         | 26261409                                             |
| 3 10/10/2020| 30317984                                             | 37084604                                   | 30289727                                         | 26500146                                             |
| 4 10/11/2020| 30707055                                             | 37653233                                   | 30678078                                         | 26738884                                             |
| 5 10/12/2020| 31099455                                             | 38228385                                   | 31069748                                         | 26977622                                             |
| 6 10/13/2020| 31495198                                             | 38810110                                   | 31464749                                         | 27216360                                             |
| 7 10/14/2020| 31894298                                             | 39398459                                   | 31863097                                         | 27455097                                             |
| 8 10/15/2020| 32296769                                             | 39993480                                   | 32264805                                         | 27693835                                             |
| 9 10/16/2020| 32702626                                             | 40595225                                   | 32669887                                         | 27932573                                             |
| 10 10/17/2020| 33111883                                            | 41203743                                   | 33078359                                         | 28171310                                             |
| 11 10/18/2020| 33524555                                            | 41819086                                   | 33490233                                         | 28410048                                             |
| 12 10/19/2020| 33940654                                            | 42441304                                   | 33905523                                         | 28648786                                             |
| 13 10/20/2020| 34360197                                            | 43070448                                   | 34324245                                         | 28891115                                             |
| 14 10/21/2020| 34783196                                            | 43706570                                   | 34764613                                         | 29135897                                             |
| 15 10/22/2020| 35209666                                            | 44349721                                   | 35172039                                         | 29382680                                             |
| 16 10/23/2020| 35639621                                            | 44999952                                   | 35601140                                         | 29629462                                             |
| 17 10/24/2020| 36073076                                            | 45657316                                   | 36033727                                         | 29876245                                             |
| 18 10/25/2020| 36510044                                            | 46321863                                   | 36469817                                         | 30123027                                             |
| 19 10/26/2020| 36950541                                            | 46993648                                   | 36909423                                         | 30369810                                             |

5.3. Prediction of New Deaths Cases

The performance of the NN (i.e. MLP), PR, SVM, and BR models are illustrated in Fig. 25, 26, 27, 28 and 29 respectively. All figures are predicting that the death rate will be growing in upcoming days, which are a very worrying marking. Through this sign, new precautionary precautions must be taken or an algorithm for life must be created in a different way in order to come with this virus. From Table 8 we can observe that the MLP outperform other approach in $R^2$ parameter. The Predicted of Deaths Cases Worldwide provide in Table 9.
Fig. 27. NN (i.e. MLP) prediction for the upcoming 20 days (New Deaths cases).

Fig. 28. B.R. prediction for the upcoming 20 days (New Deaths cases).

Fig. 29. LR prediction for the upcoming 20 days (New Deaths cases).

Fig. 30. ML algorithm prediction for the upcoming 20 days (New Deaths cases).

Table 8. Evaluate Metrics to Deaths Cases Prediction

|          | SVM        | PR          | BR           | NN (i.e. MLP) |
|----------|------------|-------------|--------------|---------------|
| MAE      | 55870.28183| 56511.30021 | 112902.4181  | 19754.56174   |
| MSE      | 4323906787.89 | 5930203438  | 14845929533  | 406564135.9   |
| $R^2$    | 0.67934414  | 0.6711188   | 0.083891571  | 0.932880987   |
| Explained Variance | 0.910830061 | 0.839648927 | 0.870477134  | 0.997305522   |
| RMSE     | 236.3689528 | 237.7210555 | 336.0095505  | 140.5509222   |
### Predicted # of death Cases Worldwide

Table 9. Predicted of Deaths Cases Worldwide

| Date     | Polynomial Predicted # of deaths Cases Worldwide | SVM Predicted # of deaths Cases Worldwide | Bayesian Predicted # of deaths Cases Worldwide | NN Predicted # of deaths Cases Worldwide |
|----------|--------------------------------------------------|------------------------------------------|-----------------------------------------------|------------------------------------------|
| 0        | 1184576                                          | 1269107                                  | 1250318                                       | 1021946                                  |
| 1        | 1192890                                          | 1278980                                  | 1259753                                       | 1027132                                  |
| 2        | 1201231                                          | 1288890                                  | 1269224                                       | 1032318                                  |
| 3        | 1209600                                          | 1298839                                  | 1278730                                       | 1037503                                  |
| 4        | 1217996                                          | 1308825                                  | 1288272                                       | 1042689                                  |
| 5        | 1226419                                          | 1318850                                  | 1297849                                       | 1047875                                  |
| 6        | 1234870                                          | 1328914                                  | 1307462                                       | 1053060                                  |
| 7        | 1243347                                          | 1339015                                  | 1317110                                       | 1058246                                  |
| 8        | 1251853                                          | 1349155                                  | 1326794                                       | 1063432                                  |
| 9        | 1260385                                          | 1359332                                  | 1336513                                       | 1068618                                  |
| 10       | 1268945                                          | 1369548                                  | 1346267                                       | 1073803                                  |
| 11       | 1277532                                          | 1379802                                  | 1356057                                       | 1078989                                  |
| 12       | 1286146                                          | 1390095                                  | 1365882                                       | 1084175                                  |
| 13       | 1294788                                          | 1400425                                  | 1375743                                       | 1089361                                  |
| 14       | 1303457                                          | 1410794                                  | 1385639                                       | 1094546                                  |
| 15       | 1312153                                          | 1421201                                  | 1395571                                       | 1099732                                  |
| 16       | 1320877                                          | 1431646                                  | 1405538                                       | 1104918                                  |
| 17       | 1329627                                          | 1442129                                  | 1415540                                       | 1110103                                  |
| 18       | 1338406                                          | 1452651                                  | 1425578                                       | 1115289                                  |
| 19       | 1347211                                          | 1463210                                  | 1435652                                       | 1120475                                  |

5.4. Impact of Model Performances with 20 Days Prediction Intervals

To ensure the accuracy and reliability of the results, our model predictions are very auspicious that show in Fig. 31, 32 and 33, because the models predict that in upcoming days’ death rate will be increased and the scheme of mortality rate shows the same pattern. Furthermore, in recovery scenario models predict that recoveries rate will be also increase and in Fig. 32 the recovery scheme follows the same behavior which proves the model predictions correct.

![Mortality Rate of Coronavirus Over Time](image1)

**Fig.31. Mortality rate after 20 days of this paper prediction**

![Recovery Rate of Coronavirus Over Time](image2)

**Fig.32. Recovery rate after 20 days of this paper prediction.**
Fig. 33. Ratio between recovery rate and death rate after 20 days of this paper prediction

Fig. 34. Comparison between death rate, recovery rate and confirm case rate after 5 days of this study prediction

In general, MPL performed best followed by VSM performed followed by PR and then BR and the death has lower values compare to new and recovery case. From Fig. 34, more stringent restrictions must be imposed by governments and the World Health Organization to limit the spread of the Coronavirus.

6. Conclusion

The Coronavirus has caused great economic losses resulting from the imposition of strict measures to confront this virus, including a complete or partial curfew, and the closure of airports and factories, as well as the virus, has caused great loss of life. Scientists and governments fear the second wave of this virus. In this paper, we are building a system to predict the spread of the Coronavirus in the world based on machine learning algorithms. Corona data provided by Johns Hopkins University have been analyzed and predict the spread of the Coronavirus in the coming days to help control this virus. The results showed that smart neural networks outperformed all other algorithms and achieved amazing results with a low error rate. The results showed that injuries will increase slightly in the coming days, and our result deploy the optimism because the deaths will increase. This study will benefit governments in understanding the general situation and taking appropriate measures. The results prove that MLP performs best in the current forecasting domain given the nature and size of the dataset. All algorithms also perform well for forecasting, to some extent, to predict the death rate as in Fig. 30 observe that the situation going to worry marking.

According to the results of all approach, the death rates will increase in upcoming days, and recoveries rate will be slowed down. The poor results clearly have been observed in SVM scenarios because of the ups and downs in the dataset values. This is due to the difficulty of establishing accurate patterns between the given values of the data set. Overall we conclude that model predictions according to the current scenario are correct which may be helpful to understand the upcoming situation.

It is clear that there is a visible effect to the whole world because the Corona virus does not spread to the same extent that it has spread in some countries, due to the exposure of those countries to ultraviolet rays with a value greater than 10 and I think there are other factors. Therefore, the study must be developed to include all natural factors such as relative humidity, solar ultra-violate (UV), erythema dose, UV aerosol index, day light and ozone thick layer.

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