International Journal of Engineering Trends and Technology
ISSN: 2231 – 5381 / https://doi.org/10.14445/22315381/IJETT-V70I7P245
Volume 70 Issue 7, 438-448, July 2022

Original Article

Analyze the Spread of Coronavirus in the World to Predict New Cases Under Machine Learning Techniques

Margarita Giraldo-Retuerto[1], Lilian Ocares-Cunyarachi[2], Alexandra Santisteban-Santisteban[3], Brian Malaver-Tuero[4], Erick Canova-Rosales[5], Alexis Delgado[6], Enrique Lee Huamaní[7]

[1,2,3,4,5] *Faculty of Engineering, University of Science and Humanities, Lima, Perú.*
[6]*Mining Engineering Section, Pontificia Universidad Católica del Perú, Lima-Perú*
[7]*Image Processing Research Laboratory, Universidad de Ciencias y Humanidades, Lima-Perú*
[1]margiraldor@uch.pe

Received: 11 May 2022 Revised: 15 July 2022 Accepted: 17 July 2022 Published: 27 July 2022

Abstract *- Coronavirus is a worldwide pandemic disease. At the same time, it is making unexpected changes in different countries of the World, with new variants in each region due to their autonomous climates. That is why the coronavirus is mutating, and there is a massive contagion that causes death. Consequently, it is necessary to analyze and identify where the new cases occurred and where is the possible area of attack of the new variant of covid 19. It is also necessary to know the characteristics and the stage of infection of patients with covid 19. This research method is based on a branch of artificial intelligence, machine learning; the idea is to use artificial intelligence techniques to analyze and predict new coronavirus cases, using classification models, decision trees, and the Bernoulli model. The case study was used to input a real-time database with a systematic record of covid-19 from 2020 to the present. Accordingly, the data and properties for implementing the model and training were defined to make the corresponding predictions of new cases of covid 19. Finally, as a final result, predictions of the number of new cases and total deaths of covid 19 in the World were made. Finally, this research aims to analyze the data on the spread of Covid-19 in the World to predict new cases and help society prevent new variants of Covid 19 by using artificial intelligence to provide various related solutions.*

Keywords *– Covid-19, Coronavirus, Contagion, Data, Machine learning.*

1. Introduction

Coronavirus worldwide is recognized as an infectious pathology caused by a virus that was first derived in the metropolis found in Wuhan city, Hubei provinces of China [1]. This virus severely causes a respiratory problem classified as severe acute. The virus is transmitted primarily by respiratory droplets when sneezing or coughing so that they interact with each other over time. These droplets can be inhaled and spread when they come into contact with the eyes, mouth, or nose [2].

The initial clinical sign of coronavirus pathology is related to SARS - COV - 2, which allows the detection of cases such as pneumonia. The most current statistics describe gastrointestinal signs such as asymptomatic infections, especially among young children. So far, research reported that it occurs in the middle of one and a half incubation lapse and 5 days in an incubation period. During the 3 days, the range would reach 0-24 days [3].

The exact number of people infected with coronavirus Covid-19 is unknown, and some cases are asymptomatic throughout the infection. Asymptomatic persons and clinical manifestations of the pathology begin in less than a week, consisting of fever, cough, nasal congestion, and fatigue, among other signs of respiratory tract infections. The infection can progress severely, causing dyspnea and thoracic sequelae corresponding to pneumonia in about 75% of patients. This is why most people ignore this warning, as seen on a CT scan on admission [4].

Pneumonia passes primarily in approximately 2 to 3 weeks from the onset of symptomatic infection. Signs of viral pneumonia are integrated as decreased oxygen saturation and blood gas deviations, showing visible changes by chest radiographs, with ground-glass abnormalities in which occasionally deterioration in the lungs arises [5].

Covid-19 can live in different areas such as stainless steel, plastic, cardboard, and copper for many hours. However, the proportion of viruses. In humans, signs of this virus can experience between 1 and 14 days from the day of infection. After that, it has been expanding to the rapidity of knots. According to the World Health Organization, it was reported that all countries worldwide are trying to maintain control and block all places where there are crowds to prevent contagion [6].

The importance of the research work is the contribution to the scientific community. A detailed analysis of the spread of the coronavirus was carried out to predict new cases of contagion and applied to Machine Learning techniques to help society through a comprehensive analysis based on Covid-19.

The research aims to analyze the data on the spread of Covid-19 to predict the new cases using Machine Learning techniques.

This paper is structured as follows; section 2 will describe in detail the methodology. Section 3 will show the case study, section 4 will show the results and discussion, and finally, section 5 will present the conclusions.

2. Methodology

The technique used is Machine Learning, a data analysis method that automates the construction of analytical models. The subfield of Artificial Intelligence called Machine Learning is an area of study that provides tools that allow using a large amount of data to select different sampling similarities from the collected [7]. Such tools, such as support vector machines triggered by an interpolation polynomial, can make predictions and give us numbers to control decision-making. This paper presents this vision, applying an algorithm to the data based on the COVID-19 pandemic [8].

2.1. Machine Learning Phases

2.1.1. Collect Data and Process Data

In the first phase, you can define the amount and type of data. Here we collect all the necessary data and information to process all the data obtained and convert the data in ways that can get better results [9].

2.1.2. Create Model

The second phase is where you can create a model according to your objective; you will use all the information of the data and algorithms and thus be able to reach an idea of the model [10].

2.13. Training Model

The third phase is dedicated to the model's training; all the data will be used to run the model; in this phase, all the data must be correctly verified to obtain correct answers [10].

2.1.4. Evaluate Model

In this phase, the chosen model is evaluated, where it is divided into two parts, the one hand data sample and, on other hand, the training data source, for which all the data of the chosen model are attached to predict new results [9].

2.1.5. Results

In this last phase, all the results from the model based on machine learning techniques will be obtained in detail [11].

Fig. 1 shows the 5 phases implemented based on Machine Learning: Collect and Process Data, Create Model, Data Management, Train the Model, Evaluate the model, and finally, the results.

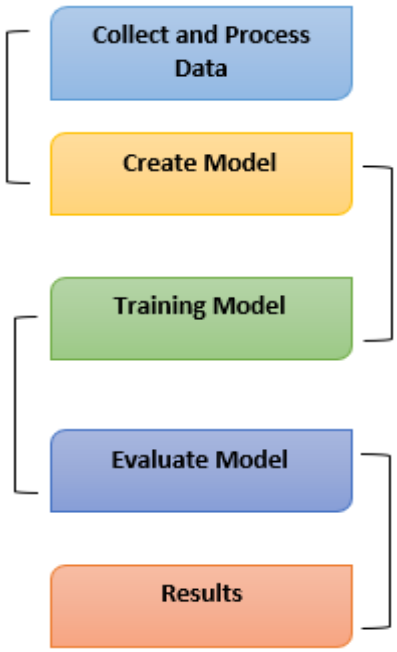

Fig. 1 Phases of machine learning

3. Case study

With the methodology mentioned below, the detailed processes will be explained according to the phases to analyze the propagation of Covid-19 using Machine Learning.

3.1. Collect and process data

As a first step, the problem will be identified by adding the real fact that worldwide there are new variants of covid-19. The virus that causes COVID-19 is transmitted mainly through droplets generated when an infected person coughs, sneezes or spits. Saliva droplets contain a high viral load transmitted from an infected person to a healthy person, which is why there is a higher chance of infection. That is why the responsible entities have recommended using more than two masks to avoid the spread of droplets in order not to be carriers of COVID 19 [12].

In Fig. 2, we show the collected data sets, such as global cases, deaths, and total results of coronavirus cases in the World, as they are the main data to create the model of the mentioned data, which was obtained from the real-time data and shows how the data are processed in detail so that from there we can process them [13].

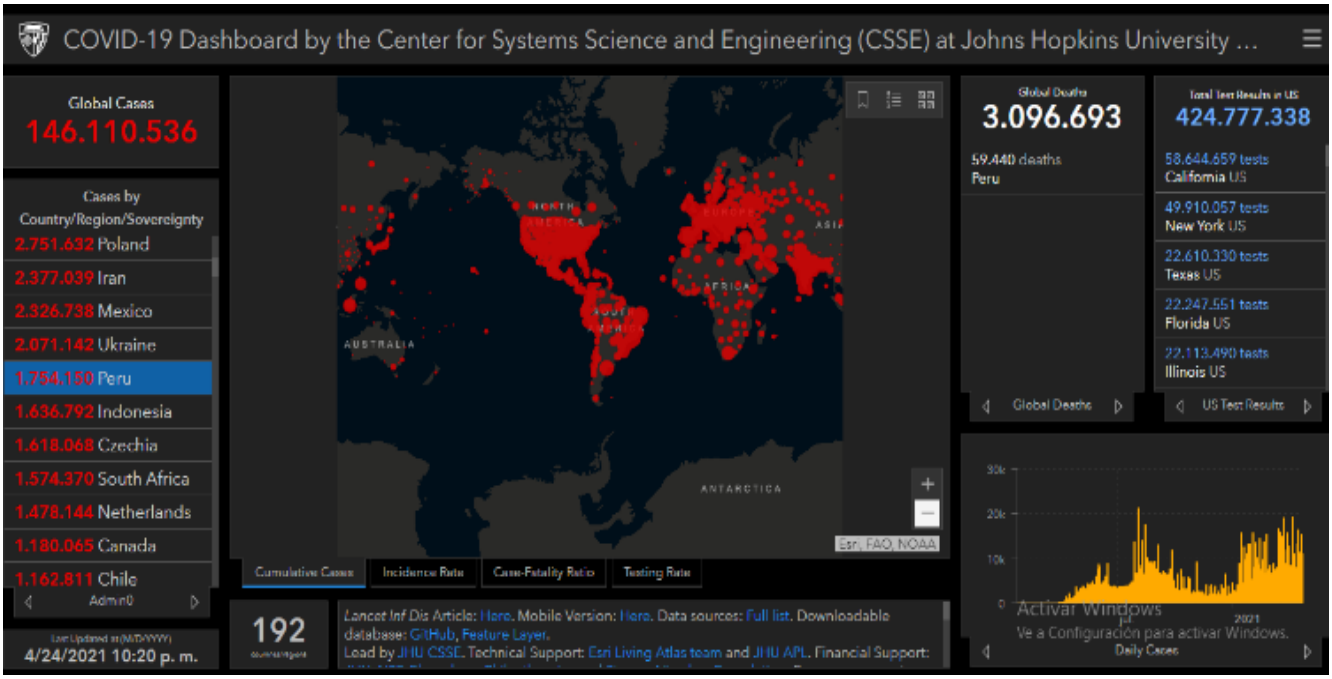

Fig. 2 Real-time data on Covid-19

Fig. 3 shows the columns to evaluate the content of all the data collected to identify the data that will be valuable for our model.

```
datos.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 83862 entries, 0 to 83861
Data columns (total 59 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   iso_code                              83862 non-null  object
 1   continent                             79805 non-null  object
 2   location                              83862 non-null  object
 3   date                                  83862 non-null  object
 4   total_cases                           81878 non-null  float64
 5   new_cases                             81876 non-null  float64
 6   new_cases_smoothed                    80875 non-null  float64
 7   total_deaths                          72262 non-null  float64
 8   new_deaths                            72420 non-null  float64
 9   new_deaths_smoothed                   80875 non-null  float64
 10  total_cases_per_million               81435 non-null  float64
 11  new_cases_per_million                 81433 non-null  float64
 12  new_cases_smoothed_per_million        80437 non-null  float64
 13  total_deaths_per_million              71832 non-null  float64
 14  new_deaths_per_million                71990 non-null  float64
 15  new_deaths_smoothed_per_million       80437 non-null  float64
 16  reproduction_rate                     67668 non-null  float64
 17  icu_patients                          8760 non-null   float64
 18  icu_patients_per_million              8760 non-null   float64
 19  hosp_patients                         10574 non-null  float64
 20  hosp_patients_per_million             10574 non-null  float64
 21  weekly_icu_admissions                 774 non-null    float64
 22  weekly_icu_admissions_per_million     774 non-null    float64
 23  weekly_hosp_admissions                1273 non-null   float64
 24  weekly_hosp_admissions_per_million    1273 non-null   float64
 25  new_tests                             38228 non-null  float64
 26  total_tests                           37944 non-null  float64
 27  total_tests_per_thousand              37944 non-null  float64
 28  new_tests_per_thousand                38228 non-null  float64
```

Fig. 3 Data collection en base al Covid-19

In Fig. 4, each column's data types are shown to observe the data in detail and process the data.

```
datos.columns
```

```
Index(['iso_code', 'continent', 'location', 'date', 'total_cases', 'new_cases',
       'new_cases_smoothed', 'total_deaths', 'new_deaths',
       'new_deaths_smoothed', 'total_cases_per_million',
       'new_cases_per_million', 'new_cases_smoothed_per_million',
       'total_deaths_per_million', 'new_deaths_per_million',
       'new_deaths_smoothed_per_million', 'reproduction_rate', 'icu_patients',
       'icu_patients_per_million', 'hosp_patients',
       'hosp_patients_per_million', 'weekly_icu_admissions',
       'weekly_icu_admissions_per_million', 'weekly_hosp_admissions',
       'weekly_hosp_admissions_per_million', 'new_tests', 'total_tests',
       'total_tests_per_thousand', 'new_tests_per_thousand',
       'new_tests_smoothed', 'new_tests_smoothed_per_thousand',
       'positive_rate', 'tests_per_case', 'tests_units', 'total_vaccinations',
       'people_vaccinated', 'people_fully_vaccinated', 'new_vaccinations',
       'new_vaccinations_smoothed', 'total_vaccinations_per_hundred',
       'people_vaccinated_per_hundred', 'people_fully_vaccinated_per_hundred',
       'new_vaccinations_smoothed_per_million', 'stringency_index',
       'population', 'population_density', 'median_age', 'aged_65_older',
       'aged_70_older', 'gdp_per_capita', 'extreme_poverty',
       'cardiovasc_death_rate', 'diabetes_prevalence', 'female_smokers',
       'male_smokers', 'handwashing_facilities', 'hospital_beds_per_thousand',
       'life_expectancy', 'human_development_index'],
      dtype='object')
```

Fig. 4 To process data related to the pandemic To Process Data

3.2. Create model

Fig. 5 shows the machine learning steps to be developed for creating the model with the respective descriptions and occupations.

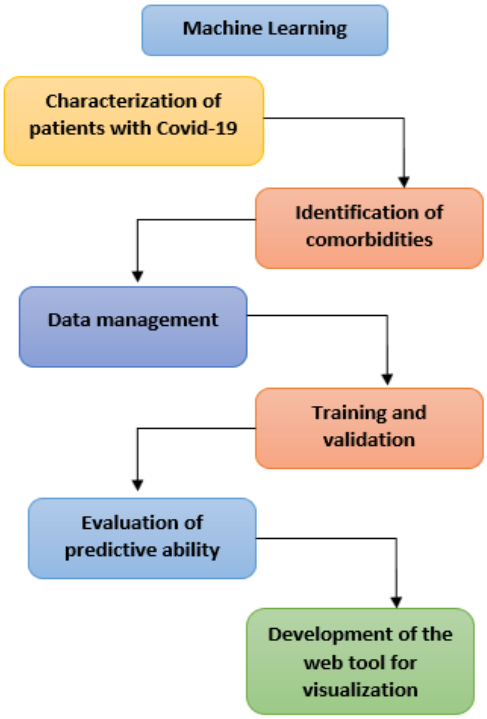

Fig. 5 Data processing

The main data and information related to the propagation of the new covid 19 variants were collected and processed under the machine learning techniques, showing the results and thus developing with the required phases to obtain the required objective of the work [14].

3.2.1. Characterization of Patients with Covid 19

The characteristics of a patient with covid 19 are almost the same as a cold and flu; the difference is in the dry cough; as time goes by, it is more frequent accompanied by fever. There is also an increase in sore throat and loss of taste and smell. It is also presented with back and chest pain that gives to understanding that the patient is getting complicated and losing appetite, tiredness, and shortness of breath. Similarly, the patient already requires oxygen. If treated early, the patient with covid may require an ICU bed or even die. Covid patients are divided into three percentage groups: 80% of patients do not require any medical attention (asymptomatic), 15% of patients require moderate medical attention, and 5% of patients are those who become complicated and die. A pulse oximeter accompanies all this treatment to measure saturation every 2 hours.

3.2.2. Identification of comorbidities in patients with Covid 19.

In this phase, the probability of complications is accompanied by the causes that one carries with oneself, such as arterial hypertension (high and low blood pressure), obesity, diabetes, and other diseases. People with the disease, as mentioned earlier, indicators after 7 days have the first symptoms, such as a sore throat. As shown in Fig. 6, with each passing day, the symptoms increase; the 11 and 12 days are complications for vulnerable people who already require oxygen. From 15 days onwards, patients start a mild recovery, and after a few days, they are out of danger.

- High danger, in which patients who died between 0 and 14 days from the beginning of the evidence are ordered.

- Low danger, in which the deceased who remained 15 days or more between the beginning of signs and death is ordered.

As shown in Fig. 6, the data are divided into 2 parts of risk (high and low) that define the number of deceased days that remain from the onset of symptoms until death. Between 15 days and more are high risk, and 0 to 14 days is low risk.

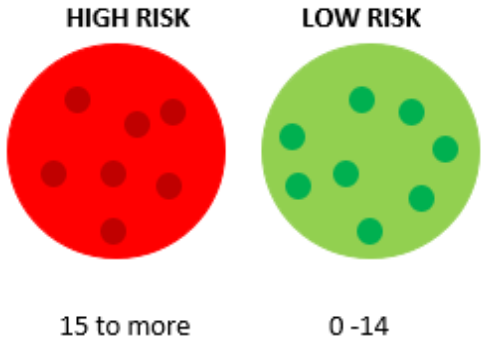

Fig. 6 Data schematic

3.3. Data Management

According to WHO, reports of new variants and total death caused by covid 19 have been identified. Table 1 shows the signs of covid 19, such as the usual signs (fever, dry cough, fatigue), as well as more frequent signs (diarrhea, sore throat, conjunctivitis, headache, loss of sense of smell) and severe signs (rash, difficulty breathing, chest pain or pressure, inability to speak and move). In Fig. 7, total cases, new cases in one day, new cases in the last 60 days, and cases per 1,000 people of coronavirus worldwide are shown. In addition, in Fig. 8, the statistics of coronavirus cases until April 1, 2021, in all countries of the World are shown. And finally, in Fig. 9, the update of covid-19 deaths in detail in all countries of the World is shown.

Cases | Vaccines

Location	Total cases	New cases (1 day *)	New cases (last 60 days)	Cases per 1 million people	Deaths
All the countries	**146,576,428**	*No data*		**18,850**	**3,101,896**
USA	32,070,058	50,575		97,313	571,471
India	16,960,172	349,691		12,466	192,311
Brazil	14,308,215	71,137		67,703	389,492
France	5,432,085	32,485		80,984	102,046
Russia	4,699,988	8,698		32,028	106,108
Turkey	4,591,416	40,596		55,215	38,011
UK	4,403,170	2,061		66,277	127,417
Italy	3,949,517	13,814		65,559	119,021
Spain	3,468,617	0		73,643	77,591

Fig. 7 Cases of Covid-19 in the Countries

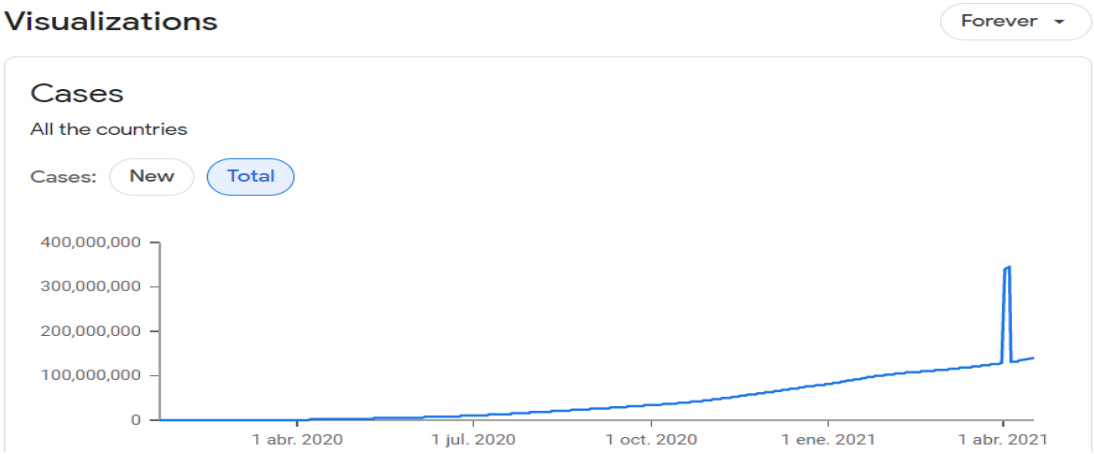

Fig. 8 Coronavirus Cases in the World

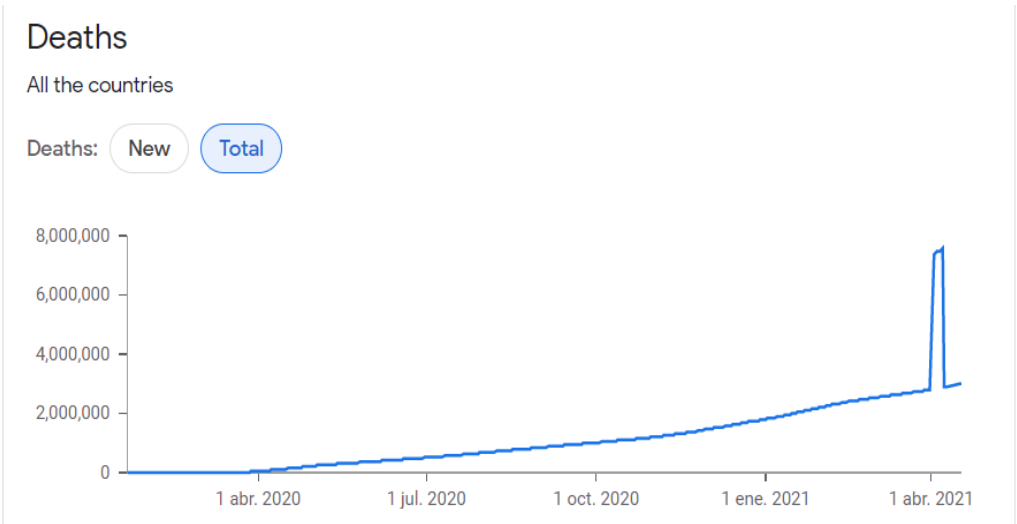

Fig. 9 Coronavirus Deaths in the World

Table 1. Symptoms Of Covid-19

Symtoms Of Covid-19	
The most common symptoms	-Fever -Dry cough -Fatigue
Other less common symptoms	-Aches and pains -Sore throat -Diarrhea -Conjunctivitis -Headache -Loss of sense of smell or taste -Skin rashes or loss of color in the fingers or toes
Severe symptoms	-Shortness of breath or feeling short of breath -Chest pain or pressure -Inability to speak or move

3.4. Train Model

Once the dataset is defined, it is prepared for use, linked to the selection phase that applies the Machine Learning technique, for the investigation of comorbidities in covid-19 patients; therefore, the consistency of the data was analyzed in detail, such as the number of variables related to the samples. As mentioned above, the data set was subdivided so that a data set was obtained through training, which obtained 80% of the data, while the test data set had only 20%. It should be noted that it was essential to balance the data since the number of data duplicates the same number of the class; as shown in Fig. 10, 5 techniques based on Machine Learning were implemented and were duly supervised with the classification listed below with each of its characteristics [15].

- In the Nearest Population Model: It should be noted that the limits of the number of neighbors and weight functionality are specified to be able to observe the data.
- Bernoulli model: No code or parameter was modified in this model, so all the data collected was implemented.
- Decision tree: Most of the collected and processed data samples were viewed to divide the number of tests.
- Gradient Boosting Model: Different data were implemented for the model.
- Vector model machine: This model vector machine is characterized by performing different regulated parameters added to the different data in Python, as shown in Fig. 10.

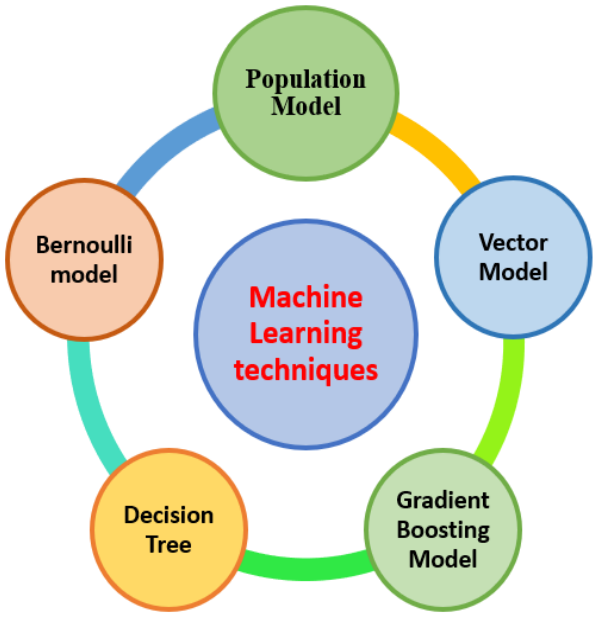

Fig. 10 Machine Learning Algorithms

3.5. Evaluate model

All the data obtained from the covid 19 cases, published by the health organization, allowed us to evaluate the first prediction of the model, with a new set of data already standardized, which with the different cases obtained allowed us to know that the current pandemic will not have a quick solution, so the information of the cases will be continuous.

3.6. Results

Subsequently, the following results were obtained according to the earlier methodology listed and described below.

3.6.1. Description of covid-19 patients

Since the data provided by the Peruvian Ministry of Health does not have the necessary information related to all the diseases of the diagnosed cases, it was essential to use the data obtained from the daily report of the deaths caused by covid-19 from the magazine Sumana [16], which does contain the necessary information on the diseases or causes of the deaths caused by the coronavirus. Therefore, in the present project, only the data of the people who died due to covid-19 were considered. As shown in Fig. 11, we created the model, applying Machine Learning techniques to train it and obtain good results.

```
datosnew = datosfil[['location','new_cases','total_deaths','aged_65_older','population','handwashing_facilities']]

datosnew
```

	location	new_cases	total_deaths	aged_65_older	population	handwashing_facilities
425	0	188	2572	2.581	188	37.746
1712	1	174	3198	6.211	174	83.741
2532	2	213	577	2.405	213	26.664
3908	3	764	4001	11.232	764	94.043
5694	4	1676	4342	6.018	1676	83.241
...	...	...	...	...	...	...
77290	61	2229	10231	8.001	2229	78.687
82218	62	3	35	7.150	3	85.847
83057	63	49	1175	2.922	49	49.542
83460	64	66	1245	2.480	66	13.938
83861	65	19	1556	2.822	19	36.791

Fig. 11 Creating the model for later training

3.6.1. Training and validation of models

Next, In Fig. 12, we define our target: new cases and their properties location, total deaths, 65 years old hand washing facilities for older people to premiere the model.

```
datosnew = datosnew.dropna(axis=0)

y = datosnew.new_cases

datos_properties = ['location','total_deaths','aged_65_older','population','handwashing_facilities']

x = datosnew[datos_properties]

x.describe()
```

	location	total_deaths	aged_65_older	population	handwashing_facilities
count	66.000000	66.000000	66.000000	66.000000	66.000000
mean	32.500000	11723.318182	5.326742	6592.454545	54.537682
std	19.196354	36374.867197	3.185046	42961.713597	30.747428
min	0.000000	3.000000	0.000000	2.000000	5.818000
25%	16.250000	192.000000	2.940500	49.500000	24.834000
50%	32.500000	1385.500000	4.492000	221.500000	59.578500
75%	48.750000	5367.250000	6.914000	1626.750000	83.616000
max	65.000000	214853.000000	17.366000	349691.000000	98.999000

Fig. 12 Definition of objectives with new cases and Properties

In Fig. 13, the model was implemented and trained with location data, new cases, total deaths, and handwashing facilities for people over 65 to train the working model.

```
from sklearn.tree import DecisionTreeRegressor
datos_model=DecisionTreeRegressor(random_state = 57)
datos_model.fit(x, y)
```

```
DecisionTreeRegressor(ccp_alpha=0.0, criterion='mse', max_depth=None,
                      max_features=None, max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=2,
                      min_weight_fraction_leaf=0.0, presort='deprecated',
                      random_state=57, splitter='best')
```

```
[ ] x.head()
```

	location	total_deaths	aged_65_older	population	handwashing_facilities
425	0	2572	2.581	188	37.746
1712	1	3198	6.211	174	83.741
2532	2	577	2.405	213	26.664
3908	3	4001	11.232	764	94.043
5694	4	4342	6.018	1676	83.241

Fig. 13 Model Implementation

In Fig. 14, the first prediction was made with the location data, new cases, total deaths, and 65 years of facilities for hand washing of older people from the work model.

```
print("Making predictions for the following 5 new cases:")
print(x.head())
print("The predictions are")
print(datos_model.predict(x.head()))
```

```
Making predictions for the following 5 new cases:
      location  total_deaths  aged_65_older  population  handwashing_facilities
425          0          2572          2.581         188                  37.746
1712         1          3198          6.211         174                  83.741
2532         2           577          2.405         213                  26.664
3908         3          4001         11.232         764                  94.043
5694         4          4342          6.018        1676                  83.241
The predictions are
[ 188.  174.  213.  764. 1676.]
```

Fig. 14 First prediction

4. Results And Discussions

4.1. About the case study

For the case study, the analysis of the spread of the coronavirus helps to provide a detailed analysis of what is happening in the World as covid-19 is affecting all countries. To be able to specify the phases one by one will be through the analysis will be carried out to make predictions and thus give us numbers to control the decision-making process. This work presents this vision, applying an algorithm to the data based on the COVID-19 pandemic. In Fig. 15, the statistical table is shown in detail based on the virus called Covid-19 or Coronavirus.

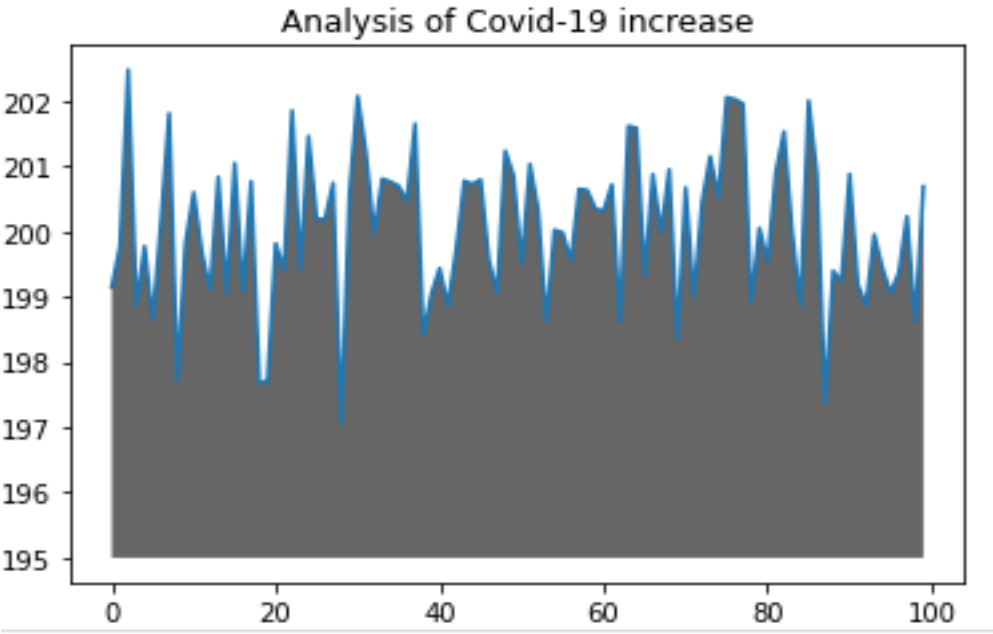

Fig. 15 Analysis of Covid-19 increase

Fig. 16 shows a scattering map applied with the same Seaborn Regplot.

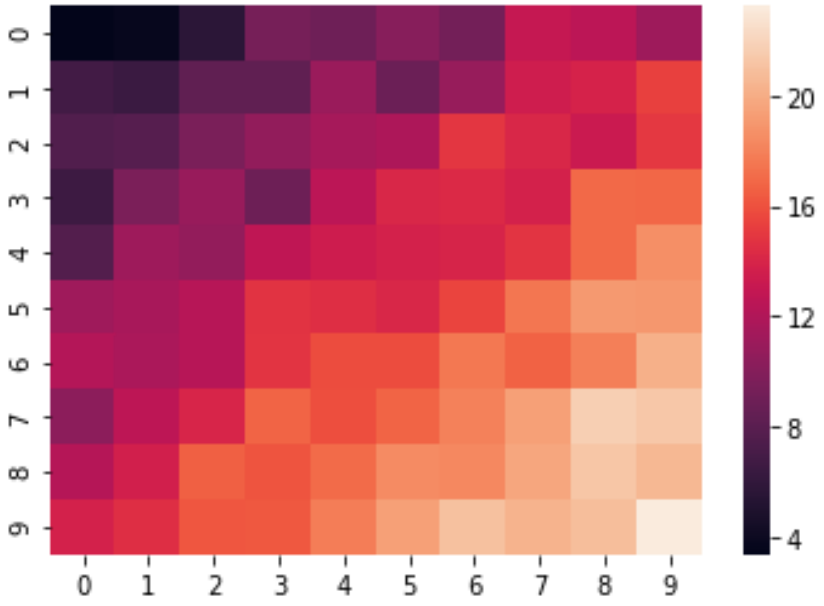

Fig. 16 Regplot de Seaborn.

Fig. 17 shows a scatter plot identifying the points of Covid-19 infection in the countries of Europe, Japan, and the USA.

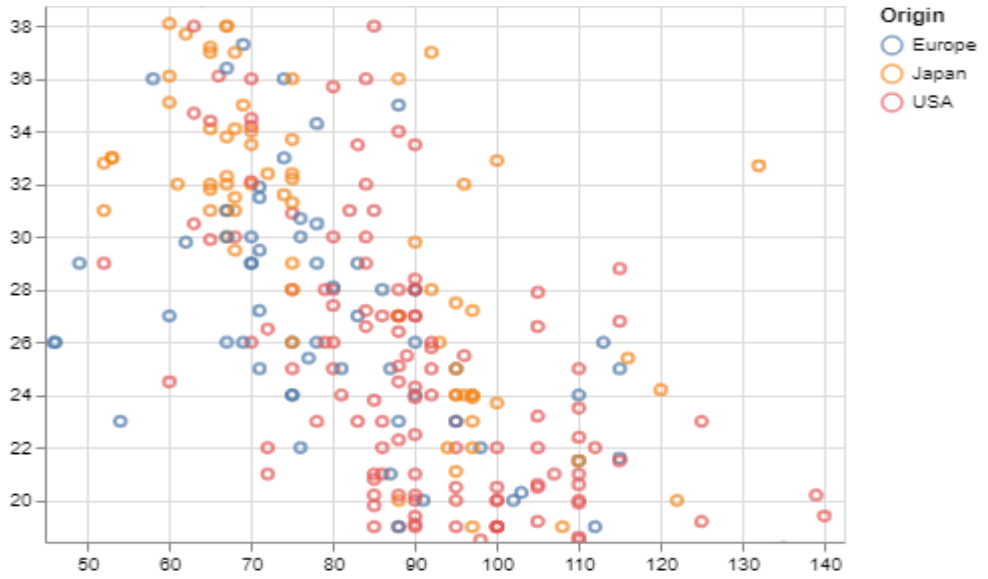

Fig. 17 Interactive scatter plot

4.2. About the methodology

In this environment, Machine Learning is a data analysis method that automates the construction of analytical models. The subfield of Artificial Intelligence called Machine Learning is an area of study that provides tools that allow using a large amount of data to select different sampling similarities from the collected data.

4.2.1. Advantages

One of the advantages of using this Machine Learning methodology is that it is based on the analysis and collection of data, automating the construction of analytical models in a fast and automatic way that can analyze larger and more complex data, can produce faster and more accurate results, which aims to identify patterns in massive data, to make predictions [17]. Machine Learning is a tool that can be applied to those areas where a large amount of data is generated and, above all, in repetitive activities or behaviors that can be optimized through algorithmic techniques [18].

4.2.2. Disadvantages

The main problem of machine learning is that the program must be directed at each stage of the system so that it knows how to detect each category automatically. Therefore, this modality is supervised learning [19]. In other words, it is necessary to reinforce the work of the machine with the human so that the human provides the necessary semantics for the machine to work, apply it in the future to the algorithms and be able to execute them later without the intervention of the human hand [20].

4.2.3. Comparison

Machine Learning methodology is a method of data analysis. It is also a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. Big data analysis involves discovering hidden patterns or extracting information [21]. In simple terms, machine learning teaches a machine how to respond to unknown inputs and thus provide satisfactory results using various models.

5. Conclusion

In this research article, it is concluded that the use of data processing, data collection, and data cleaning is something very necessary concerning this research because if we worked with the data as it was proposed at the beginning, without the necessary cleaning, we could not obtain data with a higher percentage of accuracy; also the technique that is the subject of the decision tree was used, which helped to make the right decisions. As for the methodology, Machine Learning techniques were used, and one of the branches of artificial intelligence was used to predict the data. It was seen that it was one of the technologies that could adapt much better to the research work and achieve the objective of analyzing and predicting the new COVID-19 cases. For future work, it is suggested to go a little deeper into the topic of data analysis concerning coronavirus cases, using new techniques, such as Breeding Learning and Deep Learning, to detect all the mentioned incidences that occur around the World of Covid-19 cases.

References

[1] N. Zhu, D. Zhang, W. Wang, X. Li, B. Yang, J. Song, X. Zhao, B. Huang, W. Shi, R. Lu, "A Novel Coronavirus From Patients with Pneumonia In China," *New England Journal of Medicine*, 2020.

[2] M. Yadav, M. Perumal, and M. Srinivas, "Analysis on Novel Coronavirus (Covid-19) Using Machine Learning Methods," Chaos, Solitons Fractals, vol. 139, pp.110050, 2020.

[3] A. E. Gorbalenya, S. C. Baker, R. Baric, R. J. D. Groot, C. Drosten, A. A. Gulyaeva, B. L. Haagmans, C. Lauber, A. M. Leontovich, B. W. Neuman, "Severe Acute Respiratory Syndrome-Related Coronavirus: the Species and Its Viruses–A Statement of the Coronavirus Study Group," 2020.

[4] T. P. Velavan and C. G. Meyer, "the Covid-19 Epidemic," *Tropical Medicine & International Health*, vol. 25, no. 3, pp. 278, 2020.

[5] Q. Li, X. Guan, P. Wu, X. Wang, L. Zhou, Y. Tong, R. Ren, K. S. Leung, E. H. Lau, J. Y. Wonget Al, "Early Transmission Dynamics In Wuhan, China, of Novel Coronavirus–Infected Pneumonia," *New England Journalof Medicine*, 2020.

[6] A. E. Gorbalenya, S. C. Baker, R. Baric, R. J. D. Groot C. Drosten, A. A. Gulyaeva, B. L. Haagmans, C. Lauber A. M. Leontovich, B. W. Neuman, "Severe Acute Respiratory Syndrome-Related Coronavirus: the Species and Its Viruses–A Statement of the Coronavirus Study Group," 2020.

[7] L. M. P. Da Silva Francisco, V. D. A. Borges, and D. D.S. V. Neto, "Aplicación De Técnica De Machine Learning Para Previsado Da Curva De Dados Da Covid-19," 2020.

[8] G. Bonaccorso, "Machine Learning Algorithms," 2017.

[9] A. Canabarro, F. F. Fanchini, A. L. Malvezzi, R. Pereira, and R. Chaves, "Unveiling Phase Transitions with Machine Learning," *Physical Review B*, vol. 100, no. 4, P. 045129, 2019.

[10] R. E. Andrade Ramos and J. C. Cañar Zumba, "Procesamiento De Datos Mediante Machine Learning De Matlab," *B.S. Thesis*, 2019.

[11] C. Russo, H. D. Ramon, N. Alonso, L. B. Cicerchia, L. Española, and J. P. Tessore, "Mass Data Processing Using Machine Learning Techniques," *In Xviii Workshop of Researchers In Computer Science (Entre Ríos , Argentina),*2016.

[12] M.I. A. Oyarzabal Alcain Et Al, "Evaluation of the Impact of Containment Measures on the Spread of the Covid-19 Disease Through 'E Machine Learning Techniques A´ Ethical," 2020.

[13] J. Hopkins, "Dashboard By the Center For Systems Science and Engineering University (Jhu)," 2021.

[14] M.I. A. Oyarzabal Alcain Et Al., "Evaluation of the Impact of Containment Measures on the Spread of the Covid-19 Disease Through 'E Machine Learning Techniques A´ Ethical," 2020.

[15] J. Rabbah, M. Ridouani, and L. Hassouni, "A New Classification Model Based on Stacknet and Deep Learning For the Rapid Detection of Covid 19 Through X- Ray Images," *In 2020 Fourth International Conference on Intelligent Computing In Data Sciences (Icds)*, 2020, pp. 1–8.

[16] T. M. Mitchell Et Al., "Machine Learning," 1997.

[17] E. Nazarenko, V. Varkentin, and T. Polyakova, "Features of Application of Machine Learning Methods For Classification of Network Traffic (Features, Advantages, Disadvantages)," *In 2019 International Multi-Conference on Industrial Engineering and Modern Technologies (Fareastcon)*, 2019, pp. 1–5.

[18] A. Valdivieso, C. Díaz, and J. Sarmiento, "Mhealth with Bigdata and Machine Learning As Technological Support For Health In Colombia," *Loginn Magazine: Research*.

[19] D. Liu, L. Clemente, C. Poirier, X. Ding, M. Chinazzi, J. T. Davis, A. Vespignani, and M. Santillana, "A Machine Learning Methodology For Real-Time Forecasting of the 2019-2020 Covid-19 Outbreak Using Internet Searches, News Alerts, and Estimates From Mechanistic Models," Arxiv Preprint Arxiv:2004.04019, 2020.

[20] E. Parra, C. Dimou, J. Llorens, V. Moreno, and A. Fraga, "A Methodology For the Classification of Quality of Requirements Using Machine Learning Techniques," *Information and Software Technology*, vol. 67, pp. 180–195, 2015.

[21] X.-D. Zhang, "Machine Learning," *In A Matrix Algebra Approach To Artificial Intelligence*, Springer, 2020, pp. 223–440.