Time Series Data based COVID-19 Prognostic using Support Vector Machine

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Abstract: In recent days, estimation of the likelihood of CORONA virus outbreak has been discussed, but multiple model comparisons or a statistical uncertainty analysis are scarcely available for public literature. The main factors affecting infectious diseases such as Severe Acute Respiratory Syndrome (SARS) and influenza are time series parameters. The forecast for COVID-19 in real-time is critical as a global pandemic is inevitable. This paper is aimed at generating a real-time forecast using the Support Vector Machine Model. This research aims to examine the prediction of confirmed, deceased and recuperated cases of Corona Virus Disease 2019 (COVID-19) and it would help to prepare the resources, identify government strategies, and include resistant passports to survivors, and use the same plasma for therapy. In this study, worldwide data were obtained from March 2020 to 02January 2021 with attributes such as location-wise confirmed, dead, recovered COVID-19, longitude, and latitude. The Support Vector Machine has been used to investigate the impact on identification, deceased, and recovery status cases of corona virus and this model used to forecast the confirmed cases of the COVID-19 in worldwide for the upcoming fifteen days based on previously confirmed case.

Keywords: Pandemic, CORONA virus, Support Vector Machine, Machine Learning

1. INTRODUCTION:

On 31 December 2019, the World Health Organization (WHO) in Wuhan, Hubei Province, China – China's 7th largest city with over 10 million residents - announced an outbreak of "unknown cause pneumonia”. As of January 01, 2021,covid 19 confirmed more than 84,382,650 cases and 1,835,391 deaths and 59,642,271 patients, of which 218 countries and territories worldwide, are either recovering or discharged internationally [1]. Coronavirus, related to severe outbreaks, compounds global public health challenges through its accelerated transnational growth, fuelled by growing commerce and worldwide travel [2]. Coronavirus transmission risks must be accurately mapped to establish public health plans and disease prevention measures that are especially relevant in areas lacking in medical facilities. In December 2019 Wuhan, China, announced a new Coronavirus (COVID-19) outbreak caused by acute respiratory syndrome Coronavirus 2 extremity (SARS-CoV-2) [3]. Covid-19 was stated to be transmissible to people that then generated strong interest not only in China but also throughout the world [4].

The new coronavirus may live for a few days (in stainless steel or plastic) and a few hours on a different surface (cardboard, and copper). However, the number of viable viruses reduces with time and may not always be enough present to induce an outbreak. In humans, the symptoms of this virus will occur within 1 to 14 days of infection day. From then on, it spread at knots speed and was no longer able to brace for an airborne and infectious newly discovered virus, which prompted the WHO to label COVID-19 a pandemic as a result of its quickly circulating to the human being and infecting people on every continent and taking too many lives already [5]. Coronavirus signs range in severity from no (asymptomatic) symptoms to weariness, to cough, to fever and general fatigue, sore throat, muscle, and in the worst cases, sepsis, extreme pneumonia, acute respiratory failure, and septic shock. Medical degradation, frequently over 14 days of illness, can be illustrated easily in studies. Late in the day, it was noted that anosmia's lack of smell was one of the coronavirus disease signs. Many regions like Italy, China, and South Korea have also reported that anosmia/hyposmia has formed in patients with committed SARS-CoV-2 infection, even with no other symptoms. However, coronavirus disease treatments and vaccines have not been properly treated [6]. In the paper [7] a feasibility study on COVID-19 was carried out in isolation and quarantine control. A model for parameterizing COVID-19 is developed. To tackle this pandemic, this model is used to test touch detection effectiveness and case insulation. In certain potential situations, transmission cannot be controlled by isolation alone. Isolation was more effective where no transmission and short delays occurred before the symptoms began from initiation to isolation.

Patients who have fulfilled the concept of a clinical case and who have been epidemiologically connected to a travelrecord in the City of Wuhan over the last 14 days or who have been in touch with a reported case (RT)-PCR or with a patient who has received a SARS-COV-2 investigation over the same time are deemed to be COVID-19 [8]. As the asymptomatic spread of the virus is determined, individuals with exposure to epidemiological danger should strictly comply with normal protections and monitor contact-based transmission [9, 10]. Respiratory droplets and touch are used to disperse SAR S-CoV-2. Precautionary precautions are necessary if the transmission is to be avoided. The usual precautions consist of hand-hygiene, the use of PPEs, and labels for breathing and cough. Hygiene of the hand is expected to be accomplished with 60-80% ethanol-based hand rubs (ABHRs) [11]. Hand washing with water and soap should be appropriate following the proper steps. Cloth towels and plastic tissue papers should be used if dried hands need to be prevented. PPE includes surgical masks with breathing debris, facial shields or socks, gowns, gloves, and shoe coverings [12]. Health masks or treatment masks with head straps should be appropriate for droplet and contact-based transmission. This should be worn when entering the patient area and replaced after leaving the patient area. In the population, symptomatic people must still wear surgical masks and be appropriately disposed of, accompanied by hand hygiene, and suspected cases of COVID-19 with minor air symptoms and health staff (as they are extremely at risk for exposure) [13].

The global reaction to the SARS-COV-2 challenge gathered many lessons. Most responses were reactive with weak health system preparedness investments and a lack of participation and empowerment from the community [14]. However, the focus on data exchange, the fast creation, and dissemination by the WHO of interim recommendations, and the open-access preprint sharing of increasingly evolving data show a paradigmatic change to global disease data [15]. This extraordinary attempt to provide global practitioners with intelligence contributed to a coordinated response that helped to mount multinational, multi-country, mitigation measures [16]. However, travel limits and the red-lining of impacted countries have been enforced and have long-term implications on industries like finance, agriculture, or mental health. In this way, we have not concentrated on ways to improve health services and neighborhood sustainability through people-centered interventions in creating technical and medical strategies for another PHEIC. The risks to infectious diseases of our days are far from over and if they are to be minimized, then we have to engage in developing people's health networks that prevent feedback loops guided by human suffering instead of operating in reactive systems [17].

In short, there are various researches to estimate the spread of COVID-19 in China. Extended diseases have reached the world, though. The Effective Mortality Rate is being raised because of increased infection. Analyzing the situation with the COVID-19 pandemic and forecasting the trend is therefore important. This document predicts the occurrence, with the virus spreading rapidly and causing tragic results, of COVID-19 in different countries.

The rest of this study is organized as follows. The preliminaries challenges are described in Section 2. Section 3 presents the proposed SVM model, and Section 4 presents the Results and Discussion. Further conclude this study in Section 5.

2. LITERATURE SURVEY:

Rajesh Singh R. Adhikari [18] researched the age-structured social gaped effect and social contact structure and age between Chinese, Indians, and Italians. To measure the effectiveness of social distancing they built a statistical model. They conclude that a lockdown of three weeks was not enough, but an extended lockdown would reduce covid-19 cases in India. This lets governments and health authorities devote plenty of time to coping with the crisis in the days and weeks ahead, particularly physicians. However, it had an appropriate cost function.

Zhang et al [19] Echinococcosis had become the endemic of the Xinjiang Uygur Autonomous Region of China and was expected to cause significant harm to human health and livestock development. In addition to multiplicative, short-term, seasonal ARIMA(0,1,0,1)(1,1,1,0)4 models, three grey models were implemented in this short-term prediction analysis to investigate an efficient human Echinococcus prediction model in the Xinjiang region. The model includes conventional grey GM (1,1), the Grey-Period Extension Combinatorial Model (PECGM(1,1,1)), and an Updated Gray Model using Fourier (FGM(1,1). It was also tested the exactness of the various grey versions. Elimination is, however, a daunting task to accomplish, largely because of the limitations on disease transmission and surveillance practices.

Liu et al [20] the rational allocation of health services the forecast of seasonality and pattern of pulmonary tuberculosis were important; however, this foresting was often obstructed by improper prediction procedures. This report conducted validation research in the southeastern Chinese province by comparing the accuracy of a model for an autoregressive integrated moving means (ARIMA) and a model for the BPNN. To modulate and build the ARIMA and BPNN models used the details from 462214 pulmonary tuberculosis cases reported in the Jiangsu Province from January 2005 to December 2015. The prediction of models was analyzed using cases reported in 2016. However, Seasonal variations can be triggered by disruptions in the method of tracking.

Orbann et al [21] the study of infectious disease in the human population's computational simulations had proved helpful. These models were used by a wider study base and it had become particularly important to ensure that model construction descriptions and data analyses were transparent and convey important model structure characteristics. Papers explaining infectious disease computer models also didn't offer a straightforward explanation of how the results were aggregated and whether or not non-epidemic runs were omitted. As the disease was unrecognized in the public health literature, a technique to classify epidemics during simulation runs must be determined by each modeling model. Here, an SEIR model had been used for the study of the results of the difference in the cutoff to render a run an outbreak. The decline in the number of dead and timed factors ranging from 0 to 15 percent of the model population had ever been afflicted with the disease.

Al-Qanesset al [22] presented a forecasting model to predict and forecast the number of cases of COVID-19 that have been confirmed in China for the next 10 days. The suggested model was an improved adaptive Neuro-fuzzy inference method (ANFIS) using the salp swarm algorithm for an enhanced flower pollination algorithm (FPA) (SSA). SSA was typically used to boost FPA to eliminate its inconveniences (i.e., getting trapped at the local optima). ANFIS was planned to enhance the efficiency of ANFIS with the aid of FPASSA in the key concept of the proposed model, called FPASSA-ANFIS. To predict the reported cases over ten days, the FPASSA-ANFIS was analyzed using the official World Health Organization (WHO) data from the COVID 19 epidemic. However, the computational; time of the method requires more improvements.

In [18] had an appropriate cost function, [19] Elimination is a daunting task to accomplish, largely because of the limitations on disease transmission and surveillance practices. [20] Seasonal variations can be triggered by disruptions in the method of tracking, and [22] the computational; time of the method requires more improvements.

3. PREDICTION USING SVM MODEL:

The advent of a new coronavirus (SARS-CoV-2) has contributed to the contamination of over 80 million people worldwide. This positive-beach RNA virus will cause extreme human breathing distress syndrome (COVID-19). Between December 2019 and Jan 02, 2021, more than 1.8 million deaths are recorded. The WHO directs global efforts on surveillance, epidemiology, statistical modeling, diagnostics, care, and monitoring to tackle this pandemic and has provided interim guidelines to countries. This is a complicated problem, though, and worldwide the number of cases is rising exponentially. This virus also has significant questions about the potential traverse path of the disease, owing to the temporal developments and spatial distribution. Durable identification and forecasting are critical to public health preparation and management during the ongoing outbreak period as the number of cases identified in COVID-19 increases almost exponentially. The probability is high that the regional epidemic could become a global pandemic due to high population connectivity. A world pandemic prediction framework is required therefore as a matter of urgency to provide the WHO and local governments with essential scientific evidence to facilitate public policymaking and medical services allocation.A significant aspect of current epidemiological responses is the use of all available resources to provide information on real-time responses. Although a detailed epidemiological model representing the distribution of a pandemic is difficult to construct, actual global pandemic data contain solutions for the mathematical equations incorporated in epidemiological models. Generate a real-time prognosis based on the SVM model and review the outlook for confirmation and death of Corona Virus Disease 2019 and recoveries (COVID-19). The methodology layout used and assessed in the current analysis as seen in Figure 1.

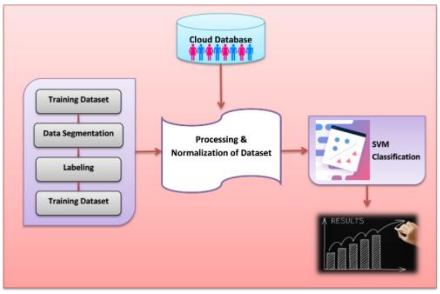


Figure 1: Research Process Flow

Figure 1 shows the process flow of the proposed method. This paper predicts COVID-19 in the individual countries, which rapidly spreads the virus and yields disastrous effects. The study covers information investigated between March 2020 and 02 January 2021. The main sources include the following: (a) a prediction model is proposed in this paper for forecasting the reported cases of COVID-19 (b) SVM machine learning technique for prediction is taken into account. Data from the cloud database is taken as an input to the model and in processing and normalization stage, the input data is trained, segmented and labeled. Trained data to SVM is equivalent for solving linear programming problem. SVM performs classification by finding the hyperplane that maximizes the margin between the two classes. Results are generated by the machine training method and Hyperplane evaluated in conjunction with the theory of support vector algorithms. SVM learning algorithm foreseen for COVID-19 proved case pandemics and calls for successful disease control and surveillance methods.

3.1 SVM Separation:

The differentiated linearly separable data as seen in figure 3 can be mathematically used with a graph. Line equation 1 is as follows.

$$a = n * b + d \quad (1)$$

Renaming b with φ_1 and a with φ_2, the equation will change too $n * \varphi_1 - \varphi_2 + d = 0$, If $b = (\varphi_1, \varphi_2)$ and $\varpi = (n, -1)$, then equation 2 of hyperplane is

$$\varpi * b + d = 0 \quad (2)$$

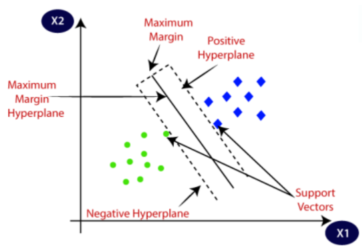


Figure 2: SVM Coordinate

A SVM is a (controlled) ML approach to seeking a decision limit for data classification. The SVM Training Algorithm is used on a training data set containing class information that contains each data (or vector) and thus a hyperplane (i.e., distance or geometric border) that is separated between the two classes. The SVM aims to optimize the gap width (i.e. the maximum margin hyperplane) between classes during this model learning process. The resulting model can then be used to determine whether a (new) data vector is a member of a class (or not). Once the SVM separation is processed, it performs classification by finding the hyperplane that maximizes the margin between the two classes.

3.2 SVM Classifier:

Hyperplane prediction is characterized by hypothesis function s_0 as shown in equation3

$$s_0(b_u)=\begin{cases}+1, if\ \varpi * b + d \geq 0\\ -1, otherwise\end{cases} \quad (3)$$

The hyperplane would be classified as class +1, class -1 as indicated above. The trained data is classified and the

3.3 Derivation of SVM amendment problem:

The SVM learning algorithm generates a high-level hyperplane that separates the data. The following equation has to be maximized to measure ϖ and d of the hyperplane.

$$\max_{\varpi,d} P\ subject\ to\ \delta_u \geq P, i=1\ldots z \quad (4)$$

Where $\delta\ and\ P$ are defined as,

$$\delta = a * \left(\frac{\varpi}{\|\varpi\|} * \frac{d}{\|\varpi\|}\right)$$

$$P = \min_{u=1\ldots z} a_u \left(\frac{\varpi}{\|\varpi\|} * b + \frac{d}{\|\varpi\|}\right)$$

It is also Know that,

$P = \frac{G}{\|\varpi\|}$, the above amendment equation can be re-defined as,

$$\max_{\varpi,d} P\ subject\ to\ \chi_u \geq P, i=1\ldots z \quad (5)$$

Maximizing P does not change the optimized result, therefore by putting F=1, the above equation can be defined as

$$\max_{\varpi,d} \frac{1}{\|\varpi\|}\ subject\ to\ \chi_u \geq P, i=1\ldots z \quad (6)$$

This maximization equation can be written as the minimization equation:

$$\min_{\varpi,d} \|\varpi\|\ subject\ to\ \chi_u \geq P, i=1\ldots z \quad (7)$$

As we know that $l2$ optimization is more stable than $l1$, so again above-mentioned equation can be re-written as

$$\min_{\varpi,d} \frac{1}{2}\|\varpi\|^2\ subject\ to\ a_u(n*b+d)-1, i=1\ldots z \quad (8)$$

The above equation s is defined as the SVM amendment equation. This document adopts the principle of Support Vector Machine (SVM), which is likely to be an effective methodology for the global population for time series data. Input data from the cloud is processed and the normalized. Data is plotted and training and testing the dataset makes the model to measure the accuracy of the model. SVM machine learning algorithm is expected to predict COVID-19 confirmed pandemic events. Efficient methods are expected to deter and control the transmission of the disease.SVM uses the upper-limit error technique, by decreasing the boundary gap from conventional means for eliminating observational testing errors between the training data and hyperplane. Trains to SVM are equivalent to solving a linear programming problem when teaching other networks that have nonlinear optimization with the possibility of being trapped in local minima. In SVM, the problem-solving method relies only on several training data called a support vector. The data is plotted into train and test set for train and test the model to assess the model's accuracy. The support vector model will be used for data sets and the SVM model has been used to forecast the confirmation, death, and rehabilitation of the patient. The SVM kernel is a tuning parameter, which takes low input space and makes it a larger space, which is a dilemma that cannot be isolated. Here, the problem is linear: 'poly,' 'sigmoid' and 'RBF.'The Result section produces the real times forecast using the SVM model.

4. RESULTS AND DISCUSSION:

The prediction of COVID-19 expected patients depends on using SVM calculations on the numbers given in these attributes. Furthermore, an optimal hyperplane can be identified using RBF and C. It helped us compare the parameters for the hyperplane to better look at support vectors. At the same time, statistical analysis by bar charts is done to classify categories. To forecast the COVID-19 cases predictable with kernel function, SVM generates optimized output values.

4.1 Data Collection:

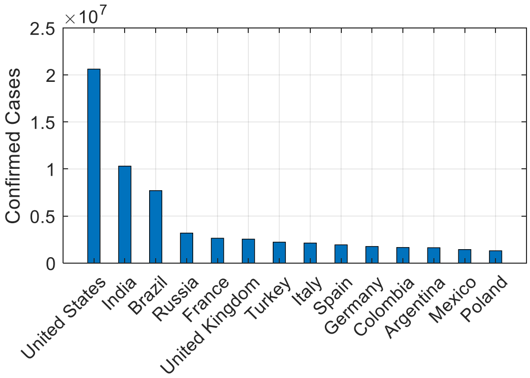
Worldwide statistics from March 2020 to 02 January 2021 are obtained, including the annual confirmations, cases that have died, and cases restored. COVID-19 data from the https://www.worldometers.info/coronavira/country-where-coronavirus-spread/represented were received and regularly updated.

4.2 Statistical Analysis:

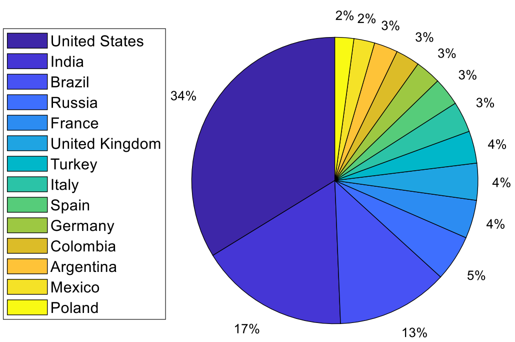
Ongoing coronavirus has been halted on the earth, and the cumulative mortality rate of 2003 extreme acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) have been surpassed. The current public health burden of 2019 coronavirus disease (COVID-19) should rise and immediate decisions need to be taken. Calculate the mortality rate by dividing the total death by the world's total confirmed deaths. Date Cases Wise are represented by a list of world cases in every region.

$$MortalityRate = \frac{Total\ Deaths\ till\ date}{Total\ confirmed\ cases\ in\ the\ world}$$

The number of patients reported, missing, and recovered so far helps estimate COVID-19 death rates. About 80 million cases are registered on 02 January 2021, 1.8million deaths are reported and approximately 60 million patients recovered.



Case A



Case B

Figure 3: Top 14 affected countries of the world a) Bar graph b) Pie chart

The research suggested forecasts worldwide confirmation, mortality, and rehabilitation events. The tools can be organized weekly accordingly and the next week's data can help to make the forecast more reliable, as this generalizes the model and extracts the data from the archive. Nation smart data assists you in finding the corona hot spot and in submitting or locking it down. China moves from 1st spot in December to 15th position. As seen in Figure 3, the USA is battling in 1st place with 34% of confirmed cases and India in second spot with 17% of corona virus confirmed cases followed by Brazil has 13%, Russia has 5%, France, UK, and Turkey has 4% of confirmed cases till date. Similarly Italy, Spain, Germany, Columbia and Argentina have 30% of confirmed cases and Mexico and Poland has 2% of the confirmed cases of COVID-19. The majority of the countries has a troubling situation and is following stringent and necessary health policy.

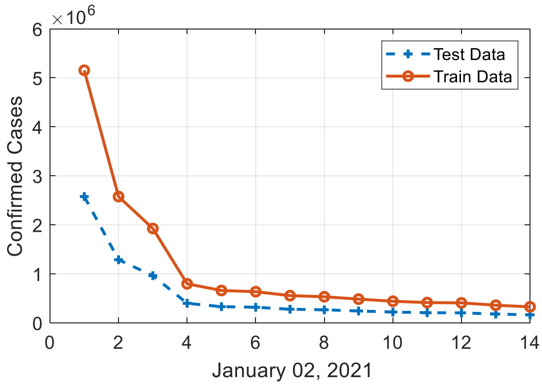


Figure 4: Test the SVM trained model

Figure 4, shows the graph of the test and trained data of the proposed model. The data is plotted into train and test set for train and test the model to assess the model's accuracy. The support vector model will be used for data sets and the SVM model has been used to forecast the confirmation, death, and rehabilitation of the patient.

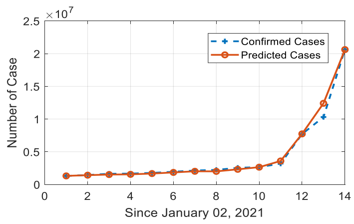
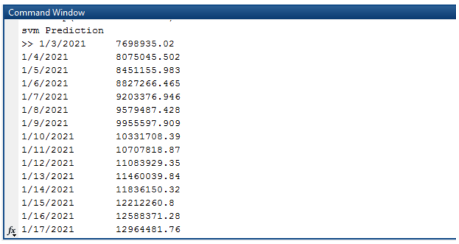


Figure 5: Confirmed versus predicted cases using SVM Model

The test data set was used to quantify the errors following the training of the model. The two lines seen in Figure 4 are parallel. Confirmed cases and forecasted SVM cases largely co-exist. SVM prediction still prevails over the confirmed available evidence, seen in Figure 5, up to 02 January 2021. Number of cases is increasing day by day due to effect of the virus spreading. Initially, the confirmed and the SVM predicted cases are similar with limited cases. Then it get rise and the SVM prediction is ahead of confirmed cases with 2.5million cases.


Command Window

svm Prediction

>> 1/3/2021	7698935.02
1/4/2021	8075045.502
1/5/2021	8451155.983
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1/7/2021	9203376.946
1/8/2021	9579487.428
1/9/2021	9955597.909
1/10/2021	10331708.39
1/11/2021	10707818.87
1/12/2021	11083929.35
1/13/2021	11460039.84
1/14/2021	11836150.32
1/15/2021	12212260.8
1/16/2021	12588371.28
1/17/2021	12964481.76

Figure 6: SVM prediction for next 15days

Figure 6, shows the SVM prediction for the following days. For the next 15 days, the SVM model will predict the COVID-19 cases.SVM model is used to forecast the confirmed cases of the COVID-19 in worldwide for the upcoming fifteen days based on previously confirmed case. For the next day, the predicted confirmed cases is 7.6million and the following day cases is 8million cases which shows 40K of confirmed cases difference perday in worldwide.Also the SVM prediction accuracy is higher than the other ML algorithmsSimilar to the data available in the worldometer.info SVM forecasts the date of confirmation, death, and regeneration. This indicates also that the infection rate would decrease dramatically and steadily for the disease incidence and mortality rate to be significantly decreased.

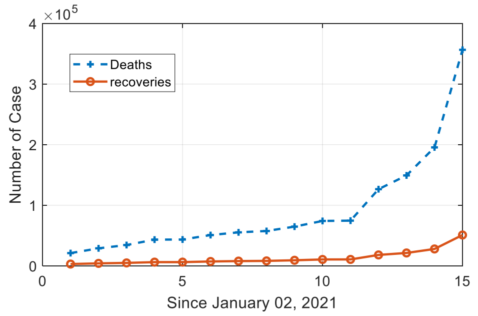

Figure 7: Death and Recovery

Figure 7 shows the graph of death and recovery of COVID-19 patients.Plot shows the initial days death and recovery cases. At beginning, the death rate is higher than the recovered cases due to fewer precautions. The death rate of the affected patients is initially high and it gets increased for further days. Also, the recovered patients increased as per the database. Total death for coronavirus is 1.8 million in worldwide and 60million patients are recovered.

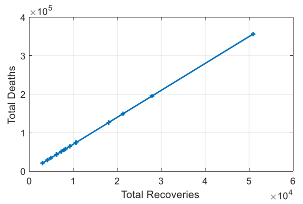

Figure 8: Death per Recovery

Figure 8 shows the number of coronavirus death versus the total number of coronavirus recovery. At certain peaks, the death and recovery cases are increasing due to the increase in coronavirus cases. Initially compared to death and recovery cases, the death rate is higher than the recovered case. Following, the corona virus recovered cases is increasing exponentially by giving precautions and safety measures. 60million patients are recovered worldwide with fewer death rates.

The results generated by the machine training method and Hyperplane are evaluated in conjunction with the theory of support vector algorithms. The SVM learning algorithm foreseen for COVID-19 proved case pandemics. It calls for successful disease control and surveillance methods. For the government to enforce the compulsory allocation of capital in medical equipment, health care services, farming, and industrial operations to support the national economy, it is very necessary. Therefore, it is very important to evolve as an appropriate statistical model that can give the government an edge in deciding on macroeconomic emergency strategies.An SVM model is a simple means of forecasting a high performing machine learning technique. In this study, the actual COVID-19 condition throughout the world is underlined, and the SVM approach measures the ongoing trend and gravitationally of the epidemic. The proposed research aims to incorporate SVM modeling for the worldwide prediction of COVID-19 events.

5. CONCLUSION:

This paper would aim to analyze and predict the confirmed, deceased, deaths, and deaths per reporting case (the mortality rate). The findings show that the normal mortality rate of COVID-19 is correlated positively with the number of cases reported. It can also rely on the diet and immune system of the population. This study indicates that before the correct vaccine is made, the emergency could wake up. Authors, from individual nations, territories, and reported cases, deaths, and recoveries, updates were reviewed regularly as some vital elements. The model can be expanded, to forecast more factors, if more detail is available and can even be applied in individual cities. This model predicts that in the next few weeks, there will be a rise in cases in the UK and Russia, and an outbreak of COVID-19 will begin. Finally, the prediction analysis for COVID 19 indicates the suggestive ways to reduce transmission of COVID 19 among humans by preventing them from migrating to another location and also by restoring various communal communities.

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