THE IMPROVED MATHEMATICAL MODEL FOR CONTINUOUS FORECASTING OF THE EPIDEMIC

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Abstract: COVID-19 began in China in December 2019. As of January 2021, over a hundred million instances had been reported worldwide, leaving a deep socio-economic impact globally. Current investigation studies determined that artificial intelligence (AI) can play a key role in reducing the effect of the virus spread. The prediction of COVID-19 incidence in different countries and territories is important because it serves as a guide for governments, healthcare providers, and the general public in developing management strategies to battle the disease. The prediction proved beneficial in the early months of 2020 to alert nations and territories in danger of an outbreak, allowing them to take preventative measures. Despite the fact that the COVID-19 outbreak has expanded to practically every location on the planet, the prediction has value in terms of monitoring the intensity of the spread and recovery, as well as determining the likelihood of a sequel or tertiary epidemic. COVID-19, like influenza, could become a seasonal or recurring epidemic in the future. COVID-19 activity must so be predicted and monitored now and in the future.

Key words: Machine Learning, Cloud Computing

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Introduction:

The outbreak of the COVID-19 Coronavirus, often known as SARS-CoV-2, has wreaked havoc around the world. COVID-19's cumulative incidence is quickly increasing day by day. Cloud Computing and Machine Learning (ML) can be used to track the disease, predict epidemic expansion, and develop strategies and policies to control its spread. This effort uses an updated mathematical model to analyze and forecast the epidemic's progression. An enhanced approach based on machine learning has been used to forecast the possible threat of COVID-19 in countries around the world. This study aims to demonstrate how a better fit can be produced for fitting the Generalized Inverse Weibull distribution using iterative weighting in order to construct a prediction framework. This can be used on a cloud computing platform to provide a more precise and real-time prediction of the epidemic's growth behavior. A data-driven approach with improved precision, such as this one, can be very valuable for the government and public to respond in a proactive manner.

COVID-19, a highly contagious illness with devastating clinical signs, was initially identified in late 2019 in China and quickly spread to other nations. The World Health Organization (WHO) designated it a pandemic on March 11, 2020, after declaring it a public health emergency of worldwide concern on January 30, 2020. COVID-19 had been recorded in 215 nations and territories as of August 21, 2020, resulting in 22,876,009 confirmed cases and 797,289 fatalities. Individual nations and territories have varying levels of pandemic intensity. Severe outbreaks occurred in several areas, with case counts taking a long time to decline. It took longer for the disease to spread and afflict individuals in other parts of the world. Even in areas where the spread has been halted, second and third waves of outbreaks have occurred, with varying degrees of morbidity and mortality.

The ability to predict the occurrence of COVID-19 in different nations and territories is critical for governments, health care professionals, and the general public to plan management strategies to battle the disease. Advanced prediction of COVID-19 daily incidence can help policymakers avoid disease transmission, which can have a huge impact on people's lives.

EXISTING SYSTEM

No proper live prediction systems were not available during the Covid-19 pandemic hit happened in 2019. Multiple prediction systems have been introduced all over the world but the accuracy of the proposed systems are still a question mark.

PROPOSED SYSTEM

Machine Learning (ML) and the Data Science community are working hard to enhance epidemiological model forecasts and analyse data streaming over Twitter in order to build management measures and assess the impact regulations aimed at preventing the disease's spread have an impact. the disease. Various datasets in this regard have been made publicly available.

However, there is a need to capture, develop and analyze more data as the COVID-19 grows worldwide. The novel coronavirus is leaving a profound socio-economic impact globally. Due to the ease of virus transmission, When an infected person coughs or sneezes, saliva droplets or nasal discharge are released., countries that are densely populated need to be on a higher alert. To gain more insight into how COVID-19 is impacting the world population and to predict the number of COVID-19 cases and dates when the pandemic may be expected to end in various countries, This proposal is a Machine Learning model (figure 1) that can be run continuously on Cloud Data Centers (CDCs) for accurate spread prediction and proactive development of strategic response by the government and citizens.

ADVANTAGES

- Cloud Computing and Machine Learning (ML) can be used to track and forecast disease progression to analyze the spread of the disease and design strategy and policies to prevent it.
- ML-based improved mathematical model - Robust Weibull model based on iterative weighting

- This has been hosted on a cloud computing platform in order to provide a more precise and real-time prediction of the epidemic's growth pattern.
- A data-driven approach with higher accuracy as here can be very useful for a proactive response from the government and citizens

SYSTEM ARCHITECTURE

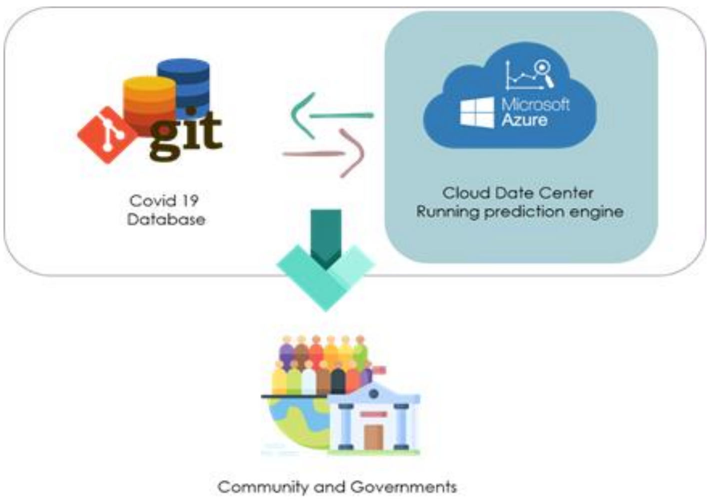

Figure 1 Proposed Cloud based AI framework for COVID-19 related analytics

CLOUD FRAMEWORK

The machine learning models are designed to make greatly advanced predictions of the number of new cases and the end dates of the epidemic. This project presents a framework for deploying these models on cloud data centers, as shown in, to provide fail-safe computation and rapid data processing. Government hospitals and commercial health centers regularly communicate their positive patient count in a cloud-based environment. To improve the accuracy of the projections, data such as population density, average and median age, weather conditions, health facilities, and so on will be included. This project used three instances of single-core Azure B1s virtual machines with 1-GiB RAM, SSD Storage, and 64-bit Microsoft Windows Server 20164.The HealthFog system uses the FogBus to deploy several analysis jobs in an ensemble learning fashion to predict various metrics, such as the expected number of patient-management facilities and hospitals. The cost of daily patient tracking, amortized CPU utilization, and Cloud execution was calculated to be 37 percent and only ~3 INR per hour. As the size of the dataset grows, more powerful computer resources will be required.

MACHINE LEARNING MODEL

Many recent studies have revealed that the COVID-19 spread is distributed exponentially. Many sources have revealed that data relating to new cases with time contains many outliers, and the distribution may or may not be Gaussian or Exponential, according to empirical evaluations of earlier datasets on the SARS-CoV-2 virus pandemic. The regression curves were created using the Susceptible-Infected-Recovered model, and Gaussian distribution was used to estimate the number of cases with time in a recent study by Data-Driven Innovation Laboratory, Singapore University of Technology and Design (SUTD)5. However, data from prior investigations on an earlier form of the virus, SARA-CoV-1, followed a Generalized Inverse Weibull (GIW) distribution rather than a Gaussian distribution.

Weibull Distribution

$$f(x) = k \cdot \gamma \cdot \beta \cdot \alpha^{\beta} \cdot x^{-1-\beta} \cdot \exp\left(-\gamma(\frac{\alpha}{x})^{\beta}\right)$$

This is to give low weightage to outliers for curve fitting. The iterative loop of robust curve fitting is shown below.

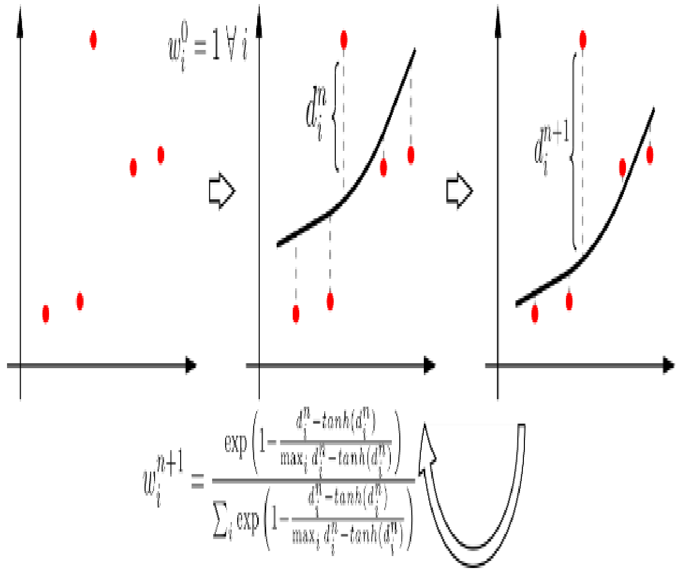

Figure 2 Outliers for Curve Fitting

PREDICTION MODEL ALGORITHM

Algorithm 1 Robust Curve Fitting using Iterative weighting.

Require:

x : Input sequence of days from first case
y : Number of cases for each day in x
ϵ : Threshold parameter

procedure ROBUST CURVE FITTING
  $w^0 \leftarrow$ Unit vector $[1] \times size(x)$
  for iteration n from 0, step 1 **do**
    $f \leftarrow$ LM(input = x, target = y, weights = w^n)
    $d_i \leftarrow |f(x_i) - y_i| \; \forall i$

$$w_i^{n+1} \leftarrow \frac{\exp\left(1 - \frac{d_i^n - \tanh(d_i^n)}{\max_i d_i^n - \tanh(d_i^n)}\right)}{\sum_i \exp\left(1 - \frac{d_i^n - \tanh(d_i^n)}{\max_i d_i^n - \tanh(d_i^n)}\right)}$$

    if $\sum_i |w_i^n - w_i^{n+1}| < \epsilon$ **then**
      break
  end for
end procedure

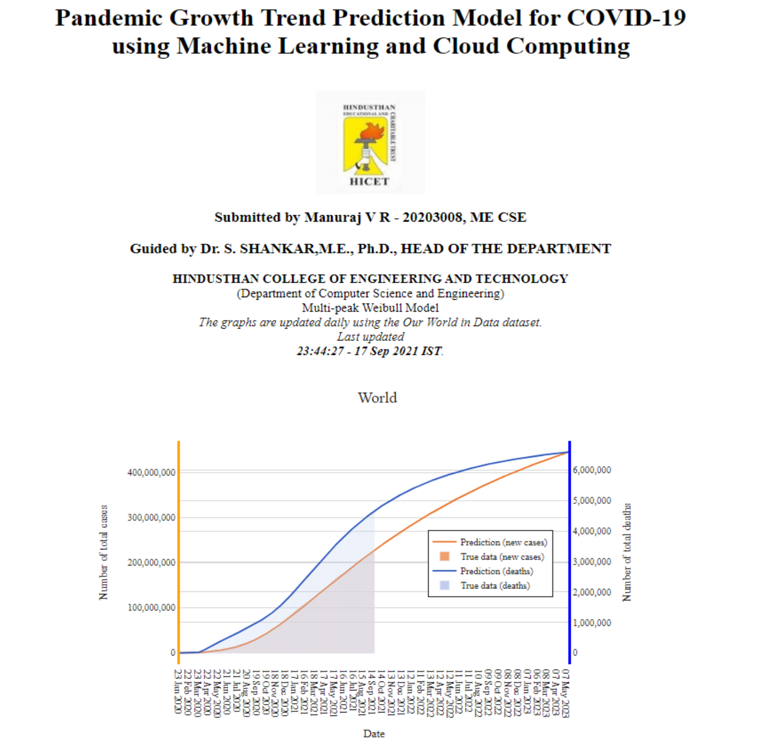

FIGURE 3 SAMPLE SNAPSHOT OF THE WEBAPP

CONCLUSION AND FUTURE ENHANCEMENTS

This paper looked at how better mathematical modeling, machine learning, and cloud computing may be used to forecast the spread of the pandemic in advance. The suggested Robust Weibull model, based on iterative weighting, makes statistically superior predictions than the baseline model. The COVID-19 scenario is overly optimistic in the baseline Gaussian model. A model that isn't well-fitting could lead to poor decision-making, exacerbating the public health crisis.

Only via comprehensive and organized testing will we be able to reduce the negative consequences of the disease's spread. Government entities can use cloud services to deploy such frameworks, inputting data from tracking sensors and estimating the number of cases shortly. Furthermore, updating the information regularly and incorporating other demographic characteristics into the proposed model, such as population density, temperature, and age distribution, can result in more reliable and accurate forecasts for the last expected instance. This allows authorities to immediately release the lockdown, limiting the post-lockdown increase in cases.

REFERENCES

1. C. Wang, P.W. Horby, F.G. Hayden, G.F. Gao, A novel coronavirus outbreak of global health concern, The Lancet 395 (10223) (2020) 470–473.
2. Coronavirus-worldometer,link: https://www.worldometers.info/coronavirus/, [online accessed]
3. G. Li, E. De Clercq, Therapeutic options for the 2019 novel coronavirus (2019-ncov), 2020.
4. S. Mallapaty, What the cruise-ship outbreaks reveal about COVID-19, Nature 580 (7801) (2020). 18–18
5. K. Liu, Y. Chen, R. Lin, K. Han, Clinical features of COVID-19 in elderly patients: a comparison with young and middle-aged patients, J. Infect. (2020)
6. S. Zhao, Q. Lin, J. Ran, S.S. Musa, G. Yang, W. Wang, Y. Lou, D. Gao, L. Yang, D. He, et al., Preliminary estimation of the basic reproduction number of novel coronavirus (2019-ncov) in china, from 2019 to 2020: adata-driven analysis in the early phase of the outbreak, Int. J. Infect. Dis. 92 (2020) 214–217
7. S. Tuli, S. Tuli, G. Wander, P. Wander, S.S. Gill, S. Dustdar, R. Sakellariou, O. Rana, Next generation technologies for smart healthcare: challenges, vision, model, trends and future directions, Internet Technol. Lett.e145
8. Karthick, R., Senthilselvi, A., Meenalochini, P. et al. Design and Analysis of Linear Phase Finite Impulse Response Filter Using Water Strider Optimization Algorithm in FPGA. Circuits Syst Signal Process (2022). https://doi.org/10.1007/s00034-022-02034-2
9. Meenalochini, P., and E. Sakthivel. "An efficient GBDTRSO control strategy for PV connected H-Bridge Nine Level MLI System with quasi-Z-source inverter." Applied Soft Computing 113 (2021): 108026.N. C. Mediaite. Harvard educator sounds caution on 'probable' Covid p
10. andemic: 40% to 70% of world could be tainted for the current year. Gotten to on 2020.02.18. [Online]. Accessible: https://www.mediaite.com/news/harvardprofessor-sounds-alert on-possible Covid pandemic-40-to-70-ofworld-could-be-contaminated for this present year/.
11. Punarselvam, E., Suresh, P., & Parthasarathy, R. (2013). Segmentation of CT scan lumbar spine image using median filter and canny edge detection algorithm. Int J Comput Sci Eng, 5, 806-814.
12. Punarselvam, E., et al. "Segmentation of Lumbar spine image using Watershed Algorithm." International Journal of Engineering Research and Applications, ISSN (2013): 2248-962
13. Punarselvam, E., et al. "Segmentation Analysis Techniques and Identifying Stress Ratio of Human Lumbar Spine Using ANSYS." Journal of Medical Imaging and Health Informatics 10.10 (2020): 2308-2315.

14. Karthick, R., et al. “Overcome the challenges in bio-medical instruments using IOT–A review.”; Materials Today: Proceedings 45 (2021): 1614-1619.
15. Suresh, Helina Rajini, et al. “Suppression of four wave mixing effect in DWDM system.” Materials Today: Proceedings 45 (2021): 2707-2712.
16. Soundari, D. V., et al.”Enhancing network-on-chip performance by 32-bit RISC processor based on power and area efficiency.” Materials Today: Proceedings 45 (2021): 2713-2720.
17. Sabarish, P., et al., Investigation on performance of solar photovoltaic fed hybrid semi impedance source converters." Materials Today: Proceedings 45 (2021): 1597-1602.
18. Karthick, R., and M. Sundararajan. “SPIDER-based out-of-order execution scheme for HtMPSOC “; International Journal of Advanced Intelligence paradigms 19.1 (2021): 28-41.
19. Karthick, R., and P. Meenalochini. “Implementation of data cache block (DCB) in shared processor using field-programmable gate array (FPGA).” Journal of the National Science Foundation of Sri Lanka 48.4 (2020).
20. Sabarish, P., et al., “An Energy Efficient Microwave Based Wireless Solar Power Transmission System” IOP Conference Series: Materials Science and Engineering. Vol. 937.No. 1. IOP Publishing, 2020.
21. Vijayalakshmi, S., et al. ”Implementation of a new Bi-Directional Switch multilevel Inverter for the reduction of harmonics” IOP Conference Series: Materials Science and Engineering. Vol.937. No. 1. IOP Publishing, 2020.
22. Karthick, R., and M. Sundararajan. “Design and implementation of low power testing using advanced razor based processor” International Journal of Applied Engineering Research 12.17 (2017): 6384-6390. 23. Punarselvam, E., and P. Suresh. "Non-Linear Filtering Technique Used for Testing the Human Lumbar Spine FEA Model." Journal of medical systems 43, no. 2 (2019): 1-13.
24. Punarselvam, E., Hemalatha, E., Dhivahar, J., Gowtham, V., Hari, V., & Thamaraikannan, R. PREDICTING WIRELESS CHANNELS FOR ULTRA-RELIABLE LOW-LATENCY COMMUNICATIONS.
25. Punarselvam, E., et al. "Segmentation of Lumbar spine image using Watershed Algorithm." International Journal of Engineering Research and Applications, ISSN (2013): 2248-9622.
26. Punarselvam, E., and P. Suresh. "Edge detection of CT scan spine disc image using canny edge detection algorithm based on magnitude and edge length." 3rd International Conference on Trendz in Information Sciences & Computing (TISC2011). IEEE, 2011. (2021): 4991-5004.
27. Punarselvam, Dr E., and S. Gopi. "Effective and Efficient Traffic Scrutiny in Sweet Server with Data Privacy." International Journal on Applications in Information and Communication Engineering 5.2 (2019): 1-5
28. Punarselvam, E., and P. Suresh. "Investigation on human lumbar spine MRI image using finite element method and soft computing techniques." Cluster Computing 22, no. 6 (2019): 13591-13607.

29. Karthick, R., and M. Sundararajan. “A Reconfigurable Method for Time Correlated Mimo Channels with a Decision Feedback Receiver” International Journal of Applied Engineering Research 12.15 (2017): 5234-5241.
30. Karthick, R., and M. Sundararajan. “A novel 3-D-IC test architecture-a review” International Journal of Engineering and Technology (UAE) 7.1.1 (2018): 582-586.
31. Karthick, R., and M. Sundararajan.,”PSO based out-of-order (ooo) execution scheme for HTMPSOC” Journal of Advanced Research in Dynamical and Control Systems 9 (2017): 1969.
32. Punarselvam, Dr E., and S. Gopi. "Effective and Efficient Traffic Scrutiny in Sweet Server with Data Privacy." International Journal on Applications in Information and Communication Engineering 5.2 (2019): 1-5.
33. Punarselvam, E., et al. "Different loading condition and angle measurement of human lumbar spine MRI image using ANSYS." Journal of Ambient Intelligence and Humanized Computing 12.5
34. Punarselvam, E., and P. Suresh. "Non-Linear Filtering Technique Used for Testing the Human Lumbar Spine FEA Model." Journal of medical systems 43, no. 2 (2019): 1-13.
35. Punarselvam, E., Hemalatha, E., Dhivahar, J., Gowtham, V., Hari, V., & Thamaraikannan, R. PREDICTING WIRELESS CHANNELS FOR ULTRA-RELIABLE LOW-LATENCY COMMUNICATIONS.