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Artificial Intelligence based Prediction and Detection of Coronavirus

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Abstract

Since the beginning of 2020, the Coronavirus Infection 2019 (COVID-19) has spread significantly around the world. It is highly contagious and, in severe cases, can cause acute breathing difficulties or multiple organ failure. The Ministry Of Health designated the epidemic a "public health emergency of worldwide significance" on January 30, 2020. Reverse transcription reaction (RT-PCR) testing is commonly used to confirm the disease. However, it has been suggested that the sensitivity of RT-PCR is insufficient for the early detection and treatment of patients suspected of having COVID-19. The main reason for spreading this disease was that test kits were not available in huge amounts to diagnose the COVID-19, and no vaccine was available to cure this disease. Many researchers are trying to make a vaccine for the treatment of this disease. It is preferable to prevent than cure. As a result, the best way to avoid mortality from this pandemic disease is to diagnose it early. Then, therapy should be administered to the patient at the right moment. Millions of people were infected with this sickness, and the majority of them died as a result of their illness. This disease diagnosis test, as we all know, is difficult. As a result, various smart apps and digital systems, including Siri, Cova, and Arogya Setu, are utilized to detect and diagnose cases of infected persons. This study outlines the many AI-based corona virus prediction and detection strategies. It also serves as a foundation for developing new models and strategies in this field.

Keywords—Artificial Intelligence, Machine Learning, Deep Learning, Corona Virus, RT-PCR

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1. INTRODUCTION

Covid-19, commonly known as coronavirus, is a twentieth-century pandemic disease. China was the birthplace of this sickness. It has now spread throughout the entire world. Due to the increase in positive cases, Governments of every country have ordered the lockdown, social distancing, curfews, and done work from home to decrease the virus disease rate. The first case of covid-19 was founded in Wuhan city of China. WHO (world health organization) declared on Jan 31, 2020, this covid-19 virus as PHEIC (public health emergency of international concern). Presently, most citizens from several countries in China have shown their serious concerns about the diagnosis, estimate, and rectification of the virus infection. The Wuhan center's Epidemiological investigators exposed the covid-19 to a patient who worked in the local seafood market, admitted to the central hospital on 26 Dec 2019. Investigators suggested that the covid-19 outbreak related is with a seafood market in Wuhan. After further analysis, it was shown that SARS-like COVS are classified into RBD sequences and amino acid sequences. The 3 Bats SARS- with COVS impacted the human body's ACE2 receptor. Authors devised a method to swiftly screen ancestral B beta coronaviruses, such as SARS-COVS and the current SARS-COV-2 after SARS-COVS was identified in animal marketplaces. It initially showed up in humans in 2003, and then spread to animals in China's open-air marketplaces. Following that, numerous genetically related viruses were discovered in Chinese horseshoe bats, which then spread to wild animals all over the world. An extent of grave respirational sickness in humans of Wuhan, China, has been accredited and classified the covid-19, which began on December 12, 2019, and had caused 2,794 laboratory-confirmed instances with 80 deaths by January 26, 2020.

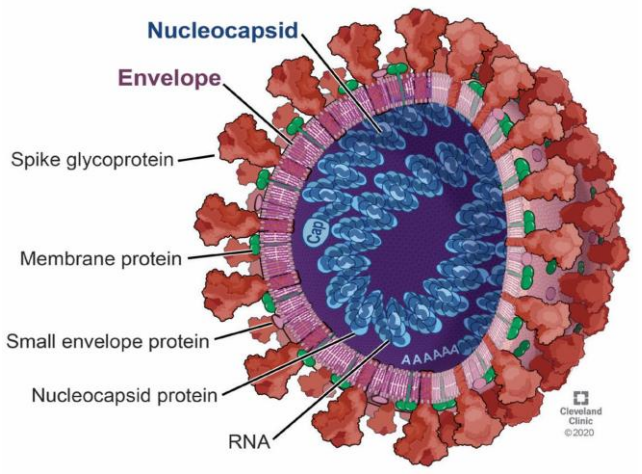

Fig. 1. Structure of Coronavirus (Source: Cleveland Clinic Journal of Medicine)

This virus belongs to the SARSr-CoV family, as evidenced by a pairwise protein system analysis of seven preserved nonstructural proteins as shown in Fig.1. "It was isolated from a critically ill patient's bronchoalveolar lavage liquid, could be deactivated by sera from numerous patients, and it was also discovered that 2019-nCoV uses the same cell entry receptor ACE2 (angiotensin-converting enzyme II) as SARS-CoV". Medical tests for covid-19 are now unavailable on a large scale due to a lack of time, health care specialists, and testing kits. This systematic review addresses the recent AI-based COVID-19 forecasting and detection techniques. It comprises discussions of impact and various techniques involved in the detection and forecasting of this acute disease.
The remaining paper consists of subsections involving related theory, Comparison of various AI-ML models, Impact and effect of COVID-19 on the world and various industries, COVID-19 trend analysis based on Time-series, Bitcoin value expectations in the time of COVID, AI system for early detection of covid-19, Deep leaning framework for screening of covid-19 from chest x-ray images, Prediction of covid-19 pandemic based on regression, Covid-19 forecasting using Arima model, Covid-
19 detection in x-ray images, Advanced CRISPR technology for detection of sars-cov-2 virus, Covid-19 spreading function with seir model, Integration of CNN and cbmir techniques for the diagnosis of covid19 diseases.

2. COVID-19 DETECTION USING AI-ML APPROACHES OVER TIME

Methods and algorithmic techniques used to anticipate and detect COVID-19 are compared in this table. Most of the reviews focus on highlighting the model and algorithm used.

TABLE 1: Methods and Algorithm techniques used to detect COVID-19 (Part;1)

Author	Year	Method	Algorithm	Result
[30]	2020	Supervised Learning with classification model	Shallow Single-Layer Perceptron Neural Network (SSLPNN) and Gaussian Process Regression (GPR) model	Used binary classification and regression. The binary classification model was more accurate than regression analysis, with a root mean square error of 0.91.
[31]	2021	Supervised Learning with regression model	Linear regression, multi-layer preceptor and vector auto regression	Using WEKA and Orange, this forecasting model said that by comparing forecasted values to cases from John Hopkins University11data, The MLP technique gives better prediction outcomes than the LR and VAR methods.
[32]	2021	Artificial Neural network with recurrent neural networks	Adaptive Neuro Fuzzy inference system and long short term memory network	The ANFIS and LSTM-based prediction model were used to forecast the COVID-19 pandemic's spread in Bangladesh. LSTM has delivered more satisfying findings in predicting pandemic.

TABLE 2: Methods and algorithm used to detect COVID-19 (Part:2)

Author	Year	Method	Algorithm	Result
[33]	2021	Supervised learning in classification	BayesNet, Logistic, IBK,CR	This study examines 114 instances from China's Zhejiang Province's Taizhou Hospital. With an accuracy of 84.21 percent, the CR (classification via regression) meta-classifier was shown to be the most accurate classifier for predicting positive and negative COVID-19 cases.
[36]	2020	Supervised Learning with classification and regression	Support vector machine, ARIMA Model, CUBIST and RF models	Machine Learning techniques were used in this study to make precise predictions using models such as RF, ARIMA, SVR, CUBIST, and Gradient Boosting.
[37]	2021	Analyzing CT scans	2D and 3D deep learning models.	A total of 157 patients were tested On datasets of infected patients, the classification findings for Coronavirus versus Non-coronavirus cases per thoracic CT studies were 0.996 AUC (95 percent CI: 0.989-1.00).

3. AI AND ML IN COVID-19

Artificial intelligence (AI) has been used in the health-care system at several levels, including diagnosis, public health, clinical decision-making, and treatments [1] [2]. During the present epidemic, AI algorithms play a critical role in the rapid diagnosis of COVID-19 patients [3]. In 2020, the number of studies applying AI approaches to diagnose COVID-19 skyrocketed [4] . AI has a lot of potential in terms of analysing massive amounts of data quickly. It played a critical part in the COVID-19 outbreak prevention [5]. When it comes to diagnosing COVID-19, AI models may be as accurate as expert radiologists [6][10]. Despite the fact that some COVID-19 infected patients are asymptomatic, they have the potential to become virus transmitters [7][8] [9]. COVID-19 patients with pneumonia symptoms may have a pattern on chest X-ray or CT imaging that is only marginally characteristic for the clinicians 40, despite the fact that the infection can be confirmed by a polymerase chain reaction [11].

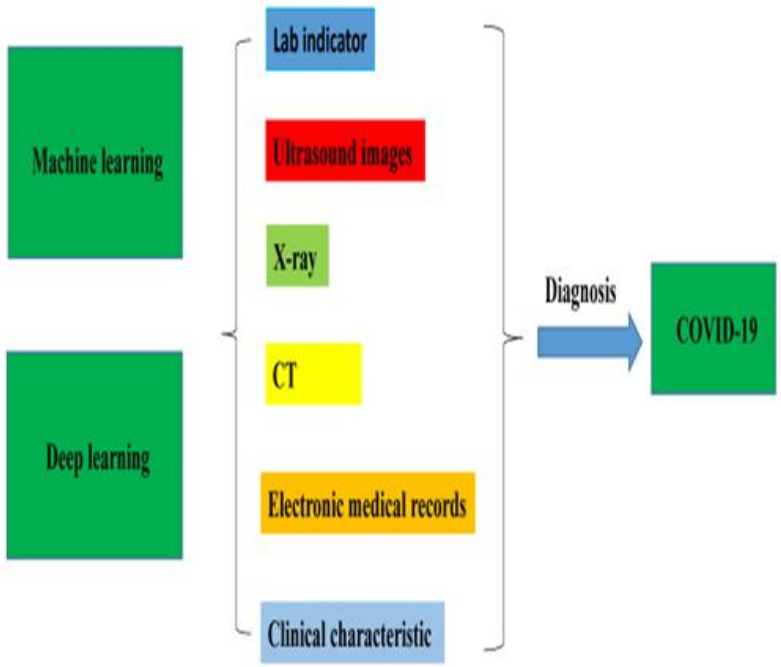

Fig. 2. Use of AI and ML in COVID-19 Diagnosis

It's common knowledge that AI-based biological image detection has had a lot of success [12]. ML and DL approaches have proven to be useful in the discovery of a variety of disorders [13 -15]. Even though some individuals have already been infected with SARS-Cov-2, their chest CT pictures are normal. As a result, chest CT images have a limited negative predictive value and do not totally rule out infection as shown in Fig.2.. The accuracy of a single AI diagnosis is still being questioned. As a result, AI algorithms are required to integrate

chest imaging with clinical signs, exposures history, and lab tests in the diagnosis of COVID-19 in order to meet clinical needs.
Laboratory assays, such as nucleoside RT-PCT, have a significant probability of false negatives. When utilized as an assisted testing approach for COVID-19, medical image scanning can provide a simple and reliable diagnosis. The AI model to detect negative susceptibility with CT has been employed in the early stages of infection in various epidemic countries, such as China and the United States.

4. IMPACT OF COVID-19 ON THE WORLD

Covid-19, commonly known as Acute Respiratory Syndrome (SARS, is the recently discovered coronavirus. In a few countries, the link between air pollution and the spread of infection is being thoroughly investigated in Table 3.. It demonstrates that places with high levels of pollution are the most affected by the disease as shown in Fig.3.. The coronavirus Covid-19 can take anything from 1 to 14 days to infect you. After developing the disease, 20% of patients remain in the hospital, and 5% require admission to critical care.

TABLE 3: Effect of COVID-19 World Wide

Countries	Number of deaths
Asia	~4800
America	~1000
Europe	~600
Africa	~1300
World	~7700

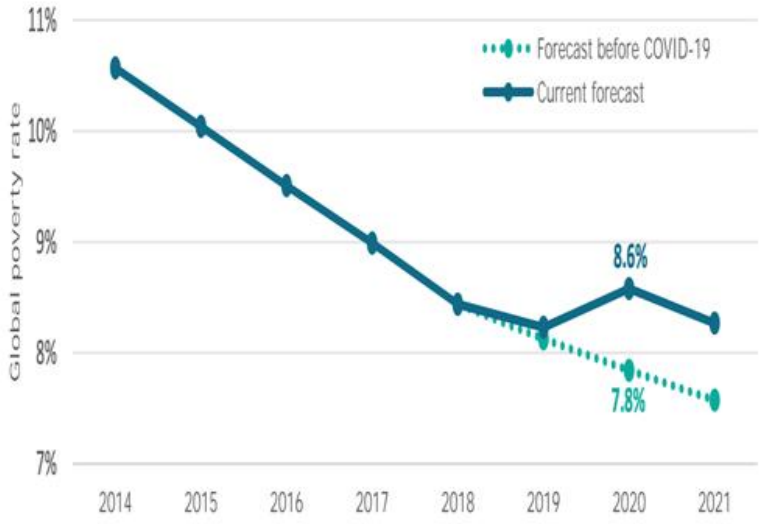

Fig. 3. Impact of COVID-19 on poverty

Exposure to air pollution can cause short-term health effects such as ear, nose, and throat irritation or long-term diseases like diabetes, stroke, and lung cancer. The sources of ambient air pollution are human activities including, industrial facilities and fuel combustion from motor vehicles. Nitrogen dioxide (NO2), ozone (O3), particulate matter (PM2.5), and SO2 are among the pollutants that strongly influence our health [16].

5. EFFECT OF COVID-19 ON THE SERVICE INDUSTRY

The Fama and French five-factor framework was used to examine the assistance business expo before and after the COVID-19 flare-up with reference to Fig.4.. The findings revealed that within the period, each of the five components of market, size, worth, value, and endeavor was demonstrably important. The Fama and French three-factor models were successful in capturing the cross-section of stock returns in the United States. SMB and HML, two more components added to the model, resolve previous contradictions (outflanking period examination). In many firms, the sudden lockdown and working remotely mode have been successful.

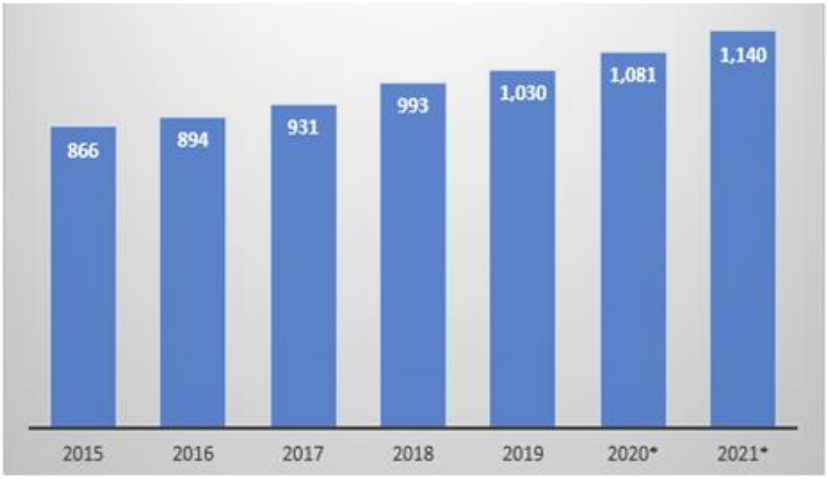

Fig. 4. Effect of COVID-19 on the service sector

In the United States, individual and clothing administrations were particularly heavily damaged. All things considered, the unpleasant impacts on the help companies will continue for a long time due to the fear of "getting in touch with." The goal was to apply the Fama and French five-factor model to administration firms in the United States and to think about the help enterprise exhibitions before and after COVID-19, and to share bits of information and venture techniques. Following the COVID-19 flare-up, each of the five variables proved to be enormous [16]. The administration industry accounted for a significant portion of the US economy. Because of the chapter proportion premium, the HML factor depicts the total development of the r stock.

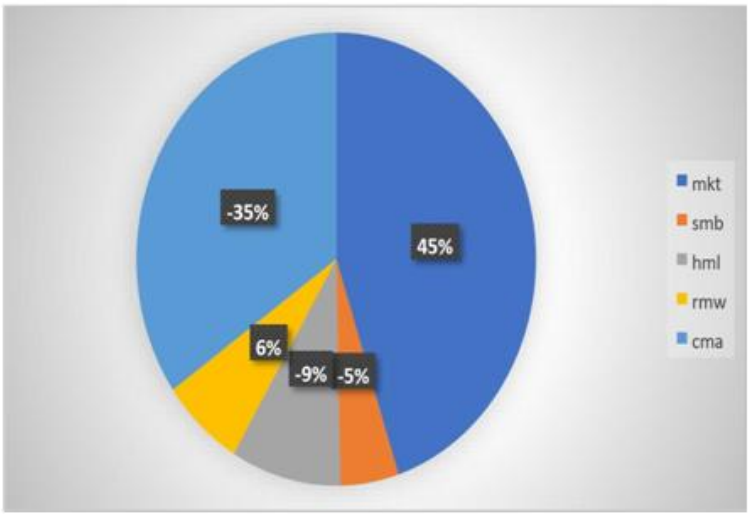

Fig. 5. The estimates after COVID-19

Phone connection frameworks, information on the boards, and training are well-known topics that have garnered a lot of attention in our administration industry. The CMA factor depicts the stock's overall performance about the venture premium (in reference to Fig.5.). The RMW calculate expands extent and becomes huge during the pandemic. It mirrors the troublesome effect COVID-19 brought to the business and makes sure that the speculations are less forceful [17].

6. COVID-19 TREND ANALYSIS BASED ON TIME SERIES

The Covid-19 pneumonia pandemic has already spread to seven continents, with the original Corona infection killing over 2.1 million people. The study forecasts the spread of the epidemic in terms of both confirmed cases and the number of deaths in major countries. Coronavirus has been widely used for disease transmission and testing.

Some AI-based and deep learning-based half-breed estimation are also used. The ensuing four models are mostly used in this study to address the subject of time series analysis as shown in Fig.6.[18].

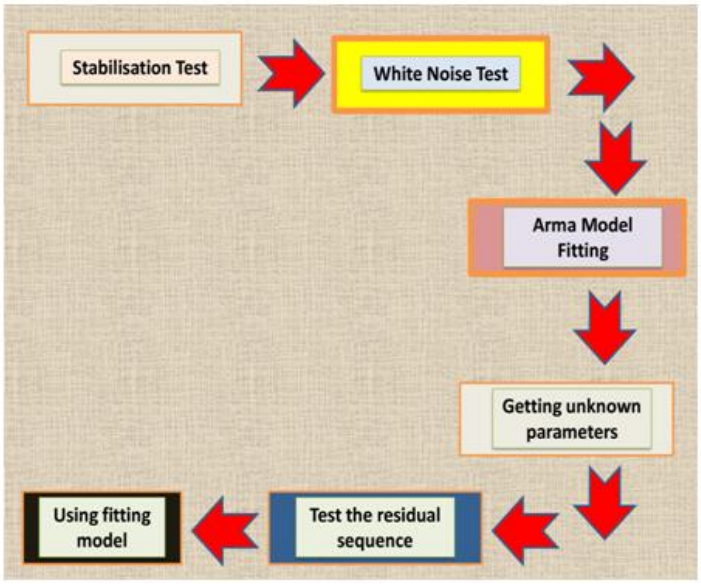

Fig. 6. COVID-19 Time series analysis

7. BITCOIN VALUE EXPECTATIONS IN THE HOUR OF COVID-19

It mentions the display of four different AI models for predicting Bitcoin's return rate and value trend. From January to July 2020, it is based on Bitcoin transaction data, COVID-19 data (recuperation, affirmed, passing), and Twitter data. Bitcoin, among the many different cryptographic forms of money, is the most well-known of them all.

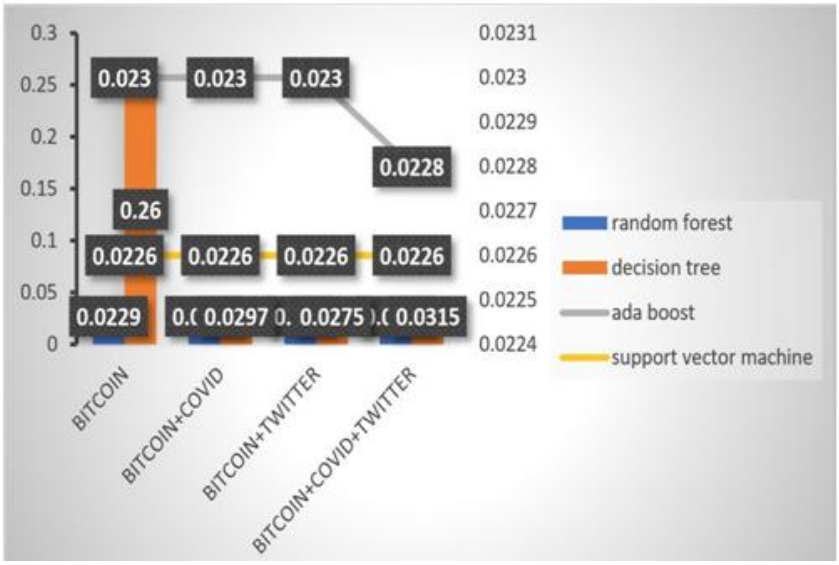

Fig. 7. Bitcoin Value expectations

Because Bitcoin's price is so volatile, many people are interested in learning how to predict its future value as shown in Fig.7. Forecasting methodologies range from time models to artificial intelligence models and deep learning algorithms.

Bitcoin's value trend and return rate are predicted and based on four different AI algorithms. Model exhibitions can benefit from Twitter information. Support vector machines, on the other hand, aren't very good at predicting Bitcoin's comeback. When making business decisions, people consider data within five days [19].

8. AI SYSTEM FOR EARLY DETECTION OF COVID-19 MODELS

Artificial intelligence (AI) aids in the diagnosis of Covid-19 disease and other lung diseases [20]. The suggested AI framework is split into two sections. Patients with normal (sound) and pneumonia-affected chest X-rays are ordered in stage 1, and pneumonia-affected patients are ordered in stage 2. From X-beam volumes, the CovAI-Net architecture recognizes positive patients. The overall framework is divided into three parts: The three streams are: 1) the passage stream, 2) the center stream, and 3) the exit stream.

A section stream of 56x56x256 X-beams is processed by the center stream, with each beam volume of 224x224x3 as shown in Fig.8.. Three best-in-class structures - Inception, DenseNet, and Xception - drive the suggested design developed on the Keras system with Tensorflow as the backend. To arrange the info X-beam into required classes, the CovAINet framework is measured freshly for steps 1 and 2 [21].

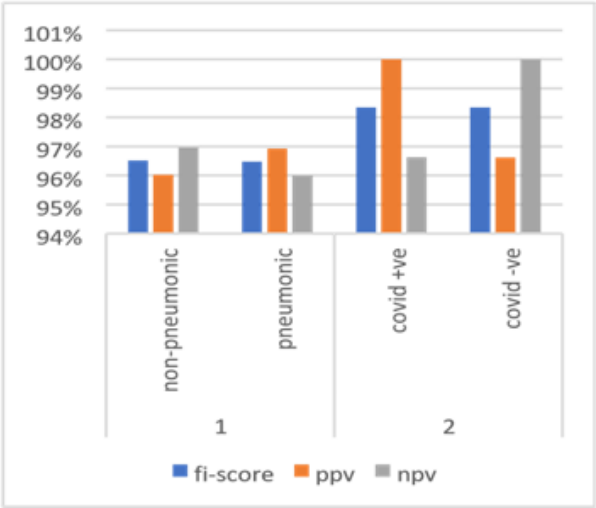

Fig. 8. a) Stage 1: Detection of Covid-19

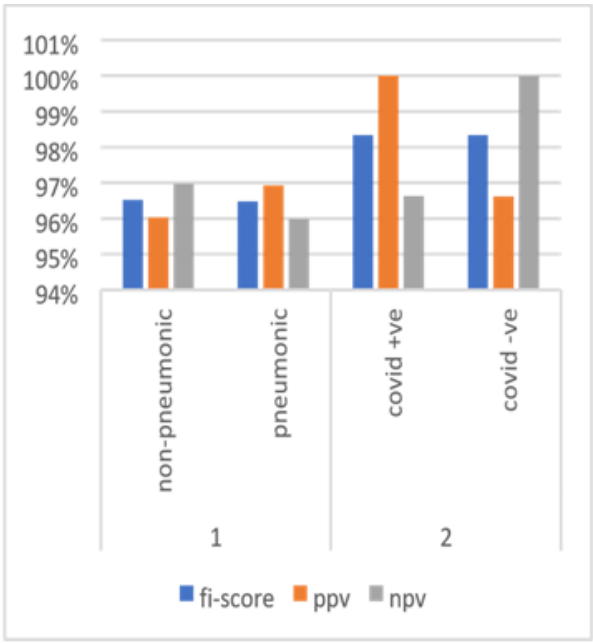

Fig.8. b) Stage 2: Generation of X beam

9. DEEP LEARNING FRAMEWORK FOR SCREENING OF COVID-19 FROM CHEST X-RAY IMAGES

A neural organization model to aid radiologists in identifying pneumonia pictures is presented. COVID-GATNet has an optimum precision of 94.1 percent and an ideal F-1 score of 95.2 percent. CoV placement is influenced by instructions for preventing and controlling COVID-19 disorders. The most prevalent adverse effects are respiratory difficulties, which might vary from normal cold to asthma. X-ray imaging of the chest to

look for atypical anomalies is another screening tool. The suggested COVID-GATNet model shows that RT-PCR test strip discovery is preferable over the order execution with reference to Fig.9. PC vision and deep learning are used to detect a variety of illnesses and injuries, including lung, brain, and skin lesions.

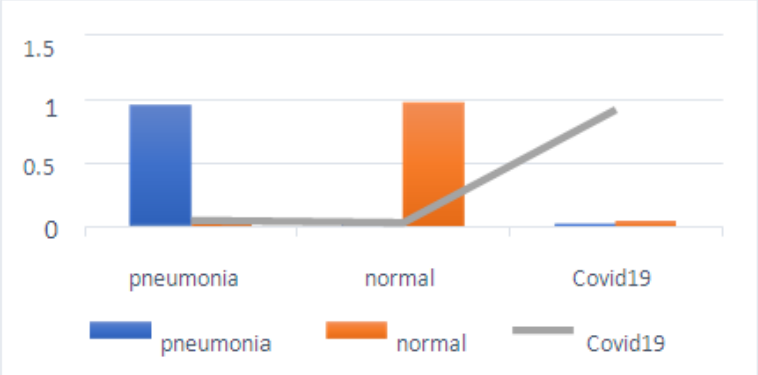

Fig. 9. Screening of COVID-19 from X-ray images

Furthermore, the COVID-GATNet.neural network model is explained and can screen out certain patients from CXR pictures of sound lungs. An additional inspection of how the informational index is made from the combination is also done [22].

10. PREDICTION OF COVID-19 BASED ON REGRESSION

COVID-19 spread estimations are calculated using a variety of methods. Regardless, the majority of the estimates are incorrect since the COVID-19 is influenced by a variety of factors, including geographic location, financial status, and government plans.

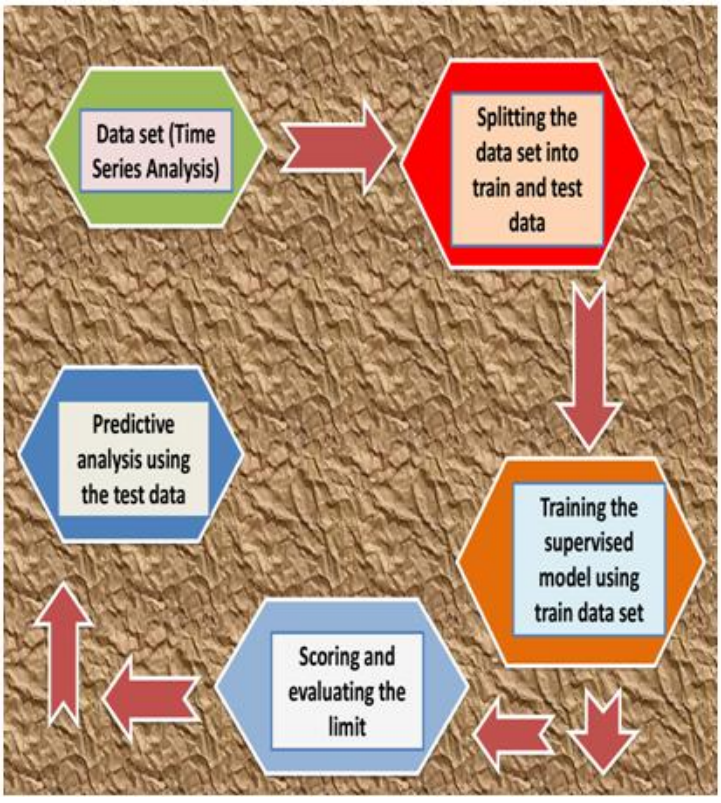

Fig. 10. Block diagram of the proposed framework

To meet this test, this document gives a situation-based forecast to predict COVID-19 distribution in Indonesia (as shown in Fig.10). The Susceptible-Infectious-Recovered (SIR) Model and Support Vector Regression (SVR) were used in this study. The ideal scenario is analyzed, as well as hypothetical forecasts. The circumstance is utilized as the best case in the current step-by-step case, while the worst result imaginable is used as the best case in the direst outcome possible [23].

11. PREDICTION OF COVID-19 SPREADING USING SUPPORT VECTOR MACHINE

Various strategies are utilized to accomplish COVID-19 spread estimates. Be that as it may, most of the forecasts are inaccurate since different elements impact the COVID-19, like geographic area, financial status, and government strategies [24].

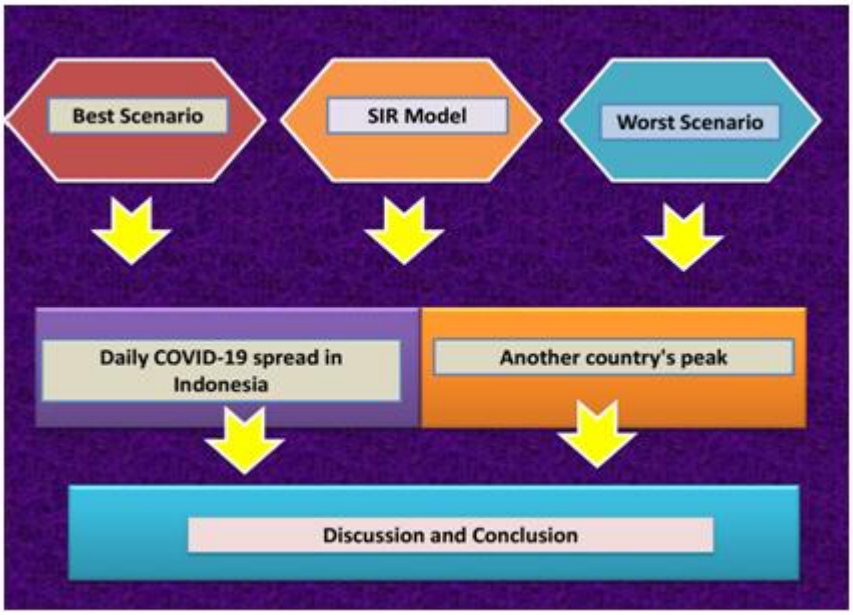

Fig. 11. Prediction of COVID-19 using support vector machine algorithm

A situation based forecast to anticipate COVID-19 dispersion in Indonesia is proposed to address this test. Support Vector Regression (SVR) and the Susceptible-Infectious-Recovered (SIR) Model are utilized in this examination as shown in Fig.11. The ideal situation and hypothetical forecasts are examined. The circumstance is used in the current step-by-step case as the best case however the direst result possible used the immediate result possible as the best case [25].

12. COVID19 FORECASTING USING ARIMA MODEL

The flare-up of the Coronavirus epidemic prompted widespread warnings around the world. The mathematical foundation for developing decision models that seek to predict how many future infections would cost is currently viewed as critical [26].

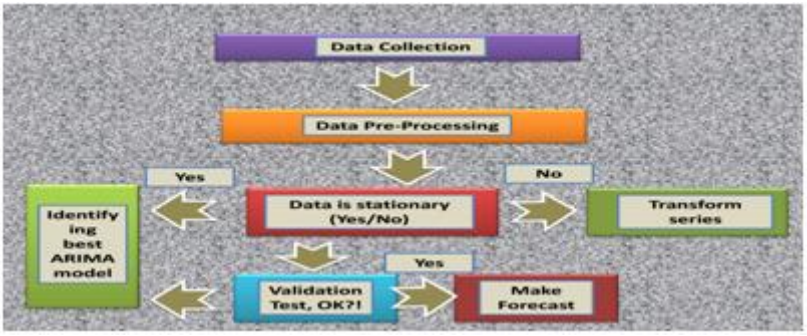

Fig. 12. COVID-19 forecasting using ARIMA Model

The goal of this study is to use the Box-Jenkins process (Diagnostic, Estimate, and Forecasting) to determine the best ARIMA model (Autoregressive Integrated Moving Average) for estimating the number of Covid-19-infected patients in Iraq. Between the first of March and the last day of July, data is gathered. The results revealed that ARIMA is the most accurate estimating model as shown in Fig.12.[27].

13. COVID-`9 DETECTION IN X RAY IMAGES

Unique Dependent on the best-distributed exploration from Stanford College, the CheXNet calculation was created to analyze and recognize pneumonia from chest X-beams. To accomplish preferred execution over experienced radiologists from similar colleges, straightforward changes were made to the calculation to analyze obsessive conditions in thechest X-beam with an exhibition that surpasses all recently grown profound learning.

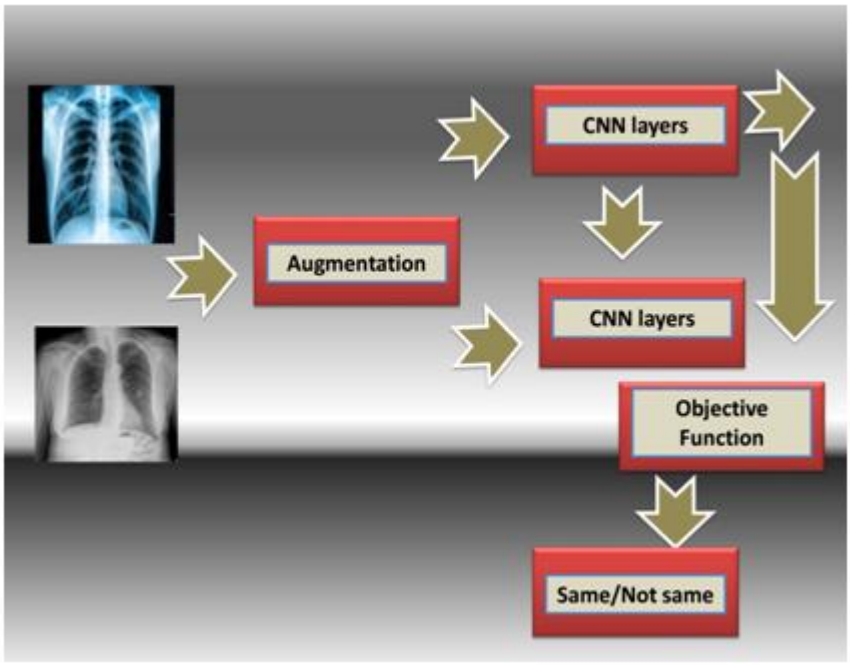

Fig. 13. COVID-19 detection in X ray images

In Different avenues regarding applying a convolutional neural organizations (CNN) calculation were explored along these lines to the instrument of work in CheXNet calculation by utilizing a dataset of 550 Chest X-beam pictures gathered from the Kaggle site, some of them are tainted with Coronavirus infection as shown in Fig.13. There was an adequate forecast precision of89.7% which is shut to the consequences of CheXNet calculation [28].

14. INTEGRATION OF CNN AND CBMIR TECHNIQUES FOR DIAGNOSIS OF COVID-19 DISEASES

When compared to traditional RT-PCT testing, determination methods based on clinical picture modalities have a higher level of affectability.

Two methods for diagnosing COVID-19 illness and distinguishing it from viral pneumonia using X-beam images are suggested. The discovering section employs deep neural networks, and the separation section employs a picture recovery method. As shown in Fig.14. the framework for the proposed model is illustrated.

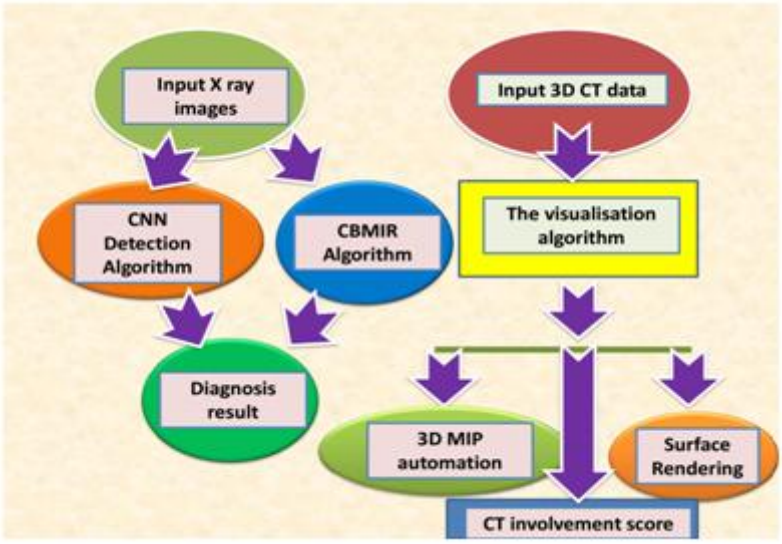

Fig. 14. Overview of the proposed framework

The two units were prepared using solid, pneumonia, and COVID-19 images [29,34, 35].

15. CONCLUSION

Early detection and treatment of COVID-19 are critical steps in preventing disease and pandemic spread. It will be possible to conduct a faster, less expensive, and more secure analysis of this illness sooner rather than later. The use of these processes in COVID-19 quick analytic decision-making can be a valuable asset for radiologists in reducing human error and assisting them in making decisions in both basic and advanced circumstances.

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