Predicating & Forecasting of Coronavirus Disease 2019 (COVID-19) using Machine Learning Approach

Vaishali P.Latke, Anuja T.Bhondave, Shweta A. Koparde
Assistant professor, Computer engg Dept,
PCCOER, Ravet.
vaishali.latke@pccoer.in

Abstract

By extensive researches on the Machine Learning or ML, it has been established that they would play an important role in future to correctly predict the prognostic values of different decisions during operative procedures. This will hence help in decision making. These Machine Learning models are not new. They have been used previously in many of the application areas which required to identify and rank different unfavorable components for a danger. To deal with the different forecasting issues, there are many different famous prediction techniques under employment. This research is also based on the efficiency of such Machine Learning or ML models. It shows what these models are capable of in regard to correctly predicting the total number of patients suffering from the disease that is posing serious threats to mankind, i.e. corona virus disease 2019. Specifically, we use four predicting Machine Learning models to predict the endangering models of corona virus disease 2019. These models include the support vector machine (SVM), least absolute shrinkage and selection operator (LASSO), exponential smoothing (ES) and the linear regression (LR).

Keywords: ML, COVID, forecasting, ML Algorithms.

1. Introduction

Coronavirus belongs to a family of viruses which have been known to infect many different animals and humans in the past. The latter usually suffer from the respiratory infections. These infections are usually mild eliciting common cold. But sometimes, they also cause severe diseases. Famous examples of such serious diseases from recent past include the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS).

Coronavirus disease 2019 (COVID-19) is an infection caused by a coronavirus as the name indicates. The new virus has been termed as the severe acute respiratory syndrome coronavirus 2 by the scientists. The first confirmed case was from China in the city of Wuhan detected in Dec, 2019. Within six months, in the mid of June, the virus has been reported from the total of one hundred and eighty-eight countries along with the account of almost half a million deaths. At the same time, almost 4 million people were also reported to be recovered from this disease. Most common symptoms reported by the patients were fever, shortness of breath, dry cough, fatigue, etc. This gives rise to the fact that majority of cases were mild and resulted in complete recoveries. But few of them also developed the more severe form, especially the immune compromised patients. A cytokine storm usually resulting into Acute Respiratory Distress Syndrome was very common among critical patients. Multi-organ failure and septic shock are other serious conditions in such patients. The WHO set the incubation period range from 2 to 14 days with an average of 5 days.

Coronavirus is a droplet-borne infection meaning it could be transmitted with close contact. On sneezing, talking or coughing droplets are produced which spread to all the nearby surfaces. Touching such an infected surface and then touching your own eyes, nose or mouth can also result in infection from spreading. Infected person is most contagious in the first 3 days of

starting of symptoms and it is said that an asymptomatic patient can also transmit the infection. The suspected patients are usually diagnosed with the real-time reverse transcription PCR machines. The sample is usually through a nasopharyngeal or oropharyngeal swab. In a patient with high suspicion of infection, chest CT can also be used to establish the diagnosis. Although, this method is not recommended for routine.

1.1 Types Coronaviruses

The coronavirus comes under the subfamily Coronavirinae of the family Coronaviridae. The coronaviruses infecting the humans are distinguished on the basis of the severity of disease they cause and their mode of spread. At present, scientists have listed 7 sorts of coronavirus that can cause infections in humans.

Common types

1. 229E (alpha coronavirus)
2. NL63 (alpha coronavirus)
3. OC43 (beta coronavirus)
4. HKU1 (beta coronavirus)

Signs and symptoms

The most common symptom recorded in the patients of coronavirus disease 2019 was fever. But the severity of fever was found to be very inconsistent. Many of the immune-compromised patients were sometimes presented with no fever.[5]According to a research, forty-four per cent of the corona patients presented to hospital came with the complaint of fever and eighty-nine per cent of patients developed fever during their time in hospital. So, we establish that having no fever does not necessarily mean no disease.

As mentioned before, dry cough, shortness of breath and body pains were also reported as symptoms. Non common but associated symptoms also include the diarrhea, loss of senses of smell and taste, vomiting or nausea, runny nose, sore throat, etc. In China, few cases came with the only presenting complaints of palpitations and chest tightness. Anosmia was found in almost thirty per cent of the confirmed coronavirus cases in South Korea [9].

Like other common infections, there is also a reported incubation period of the disease which on average is 5 days. The range of incubation period according to WHO is 2 to 14 days and about 10% of the cases usually require longer time.

To form an early diagnosis, disease should be monitored closely. There is a vast variability in early symptoms. Shortness of breath in early days is very rare and developed over days. A sudden onset of shortness of breath is usually due to an anxiety attack being afraid of the coronavirus disease. The disease become critical after the starting of shortness of breath and then requires additional care [10].

Few of the cases remain asymptomatic and hence are not tested. There is a lot of doubt among the specialists about such asymptomatic cases that whether they transmit the disease or not. But the primary researches recommended that there might be a chance of transmission from such cases. It was claimed by WHO that the transmission from such cases is very rare but no further proof of this claim was provided later. On the upcoming day, it was cleared by the WHO that they caused a misconception. They said that it was possible that transmission occurs by asymptomatic.

The complications of coronavirus do not develop in every person. Rather, they tend to occur in special groups having certain characteristics such as being immune-compromised according to the National Institutes of Health (NIH).

These groups include:
1. Young children
2. People aged 65 years or older
3. Women who are pregnant

It is predicted that most of the people in the world will be affected by this virus one way or the other. This virus has the ability to mutate and hence this makes them heavily transmissible.

1.2 Causes of COVID

Small droplets are released in the air whenever there is a sneeze, cough or loud talking. These can be visualized by Tyndall scattering. These droplets contain the viruses which can transmit to nearby people. Due to this, WHO has suggested to maintain social distancing of at least one meter or three feet. The US Centers for Disease Control suggests double the distance, i.e. 2 meters. According to a study, approximately forty per cent of the affected people are asymptomatic. It is still under study that what is the role of these asymptomatic people in transmission [10].

The rate of transmission is at its peak when the symptomatic phase of the disease starts. There is also proof of pre symptomatic transmission present.[21] Patients usually can transmit the disease for approximately 7 to 12 days in moderate cases. However, in severe cases, estimated period of being infectious is 2 weeks.

As mentioned before, the droplets produced by infected people contain viruses. These droplets then tend to fall on all the nearby surfaces hence contaminating them. Touching such a surface and then touching the eyes, mouth or nose can also transmit the disease unless the hands are completely sanitized after touching the surface. Although, the researches have shown evidence that this mode of spread is rather uncommon as the viruses die with time on the non-living surfaces. It is still a matter of debate that how many particles of virus are required on a surface to successfully transmit the disease. It was found out that the virus has the ability to stay on the copper surface for approximately 4 hours, cardboard 24 hours and plastic and stainless steel up to 3 days. But this does not pose a serious threat as virus can be easily destroyed from these surfaces by using the disinfectants. Care should be taken while using theses disinfectants as they are not the treatment for this disease and pose serious health threats if not used properly, for example, using inside our bodies [9].

There is a huge load of virus in our saliva and sputum. This is the reason that the virus can also transmit through intimate contact including kissing and feaco-oral routes. It is confirmed that it cannot be transmitted sexually. There is also an increased risk of transmission during certain aerosol producing medical techniques.

COVID-19 is being studied widely as only limited knowledge is present about it. It is a new disease which spread too quickly than it could be managed. Its transmission is better than influenza but not as good as measles. The number of people which can be infected by a single infected person is labelled as R0. The R0 of COVID-19 has been found out to be different in different studies. WHO initially predicted it to be on average of 1.95 but recent studies reveal it to be more than the median value of 2.79. Moreover, there is a good chance that this virus is present in breast milk. But it's not sure that this virus is transmittable through this route or not.

1.3 Protection from Covid-19

All the up-to-date information is available for public on the WHO website. It's better to stay aware of all the updates and adjust accordingly specifically following your local public health authorities. Most of the world has been affected by this disease suffering from severe outbursts. Few countries including China, have however managed to control these outbursts. Still, the situation remains unreliable and it's better to continuously follow the guidelines from health authorities and remain up to date[10].

By following some easy safety measures, we can significantly decrease the probability to get infected or transmit this disease:

- It is recommended to at least follow the protocol of maintaining social distance of one meter to avoid contracting the disease.
- Do not touch your mouth, eyes or nose before sanitizing them because they can transmit the viruses from infected surfaces.
- Make the habit of washing your hands using a sanitizer or simple soap and water.
- Do not go to places which are crowded to avoid close contact with someone who has COVID-19 as it is very much difficult to maintain social distancing in such places.
- If you face symptoms then isolate yourself in your rooms even though they are mild in character. Stay there until the symptoms completely subside. Do not leave your quarantine for any purpose and take help from friends and families for bringing supplies. In severe case of emergency, leave with a proper mask to avoid the spread of disease to others.
- Always cover your nose and mouth with some handkerchief or your elbow whenever coughing or sneezing. Discard the handkerchief or wash it along with your hands immediately to avoid spreading the infection to others. Following good respiratory hygiene will help you avoid contracting the disease and prevent its spread.
- Try to keep up to date with all the latest statistics and guidelines issued by the health authorities and make sure that all the information you get is from trusted sources as fake news have become very common these days.
- Do not panic if you have symptoms and find medical assistance if you have difficulty in breathing, cough and fever. Get in touch to a doctor through a phone call or internet before deciding to leave for the hospital. Hospital are very dangerous places these days as you can contract the disease from there if you did not already have it. So, it's better to get all the necessary information beforehand.

1.4 Use of Machine learning in Covid-19:

COVID-19 has become a world-wide problem causing immense damage everywhere. To tackle this pandemic, innovations in technology has been playing an important role. Machine learning and artificial intelligence (AI) are the epicenters of these technological advances and helping the world to understand and deal with this disaster. The technology of machine learning helps the computers to process like humans. The computers are fed with huge amount of data which is utilized to find the patterns and insights faster than humans.

Many organizations have hurried to use their machine learning knowledge in various domains to tackle the COVID-19. The domains include the understanding of the transmission patterns of COVID-19, increasing customer communications, and acceleration of research work and treatment finding efforts.

All the organizations are now adopting new ways to work proficiently while maintaining the social distancing and quarantine protocols and also keeping in view the requirements of their employees and customers. This include both the small and large organizations, irrespective of public or private owners. This major change in work habits is supported by the machine learning technology. It provides them with the tools that are required for this sort of functioning for example enabling the telemedicine, supporting remote communication, and protecting the food security[4].

Many of the government institutions and healthcare facilities are also taking help from machine learning technology. One example is the use of ML-enables chatbots which helps to screen the COVID-19 cases without any sort of contact. They are also used to answer public questions hence raising awareness. Clevy.io is a French startup and AWS customer. They have also launched a chatbot similar to the idea given before. The chatbot helps people by making it easy for them to find certified public communications about the COVID-19.

1.5 Objective:

- Study of covid disease & their preventive measures by using Machin learning.
- Design an algorithm for automated detection & predication of disease.
- Design model for sending automated notification for detecting the disease and indicating their preventive measures.

2. Literature Review:

Addda Jin et al. [1] researched on the COVID-19. Their focus was on the important findings on CT chest. They explained the findings in very detail dividing them into 5 distinct stages depending on the time. The first stage was labelled as ultra-early stage which is in asymptomatic patients. The CT of such cases might present with one or more focal GGO along with patchy consolidative opacities. GGO encircling the pulmonary nodules and air bronchograms might also be present. The second stage was labelled as early stage occurring in the cases with early symptoms. They might also show the one or more GGOs similar to the ultra-early stage. But they might also have interlobular septa; thickenings in addition to GGOs. The third stage is the rapid progression stage which is in cases with three to seven days of symptomatic presentation. The findings include the light but large consolidative opacities along with air bronchograms. The fourth stage or consolidation stage consists of cases with 2nd week of symptoms. The CT might show decrease in the size and density of the consolidative opacities. After about two to three weeks of onset, the consolidative opacities might become dispersed and patchy on CT. Also, strip-like opacities (or reticular opacities), interlobular septal thickening, and bronchial wall thickening might be present.

Song et al. [3] also did a similar research. He associated the findings on CT with the progression of the disease. Pan et al. worked on the follow up CT scans obtained after three to fourteen days of first CT scan. They discovered that about eighty-five per cent of the patients presented with the signs that were associated with the progression of disease. Signs included were consolidative opacities, increase in GGO, and interstitial septal thickening (referred to as "enlarged fibrous stripes"). The patients which showed pulmonary nodules on first CT later showed increased size and number of the nodules or fusion of those nodules. But decrease in those nodules was also observed by them as time passed.

CT changes in twenty-one COVID-19 confirmed cases were studied by Pan et al. in another research. During early phase, most patients had more GGO along with fewer lobes involved. But over time, increasing number of lobes involved, formation of consolidative opacities and more intense paving pattern was observed in most patients. The CT findings were found to be most visible at an average tenth day of the disease. And after the fourteenth day, seventy-five per cent of the patients showed improvement in their CT findings[25].

Sr. No.	Author	Proposed Method	Mechanism
1	Nanning Zheng et al	Hybrid artificial-intelligence (AI) model for COVID-19 prediction	the natural language processing (NLP) module and thelong short-term memory (LSTM) network.
2.	Furqan Rustam et al	Supervised Machine Learning Models for COVID-19 Future Forecasting	linear regression (LR), least absolute shrinkage and selection operator (LASSO), support vector machine (SVM), and exponential smoothing (ES)

Increase in consolidative opacities and the loss of crazy paving pattern were the leading findings on follow up CT chest scans as mentioned in other printed researches. In the early days after the presentation of a symptomatic case, the progression of GGO has been found to be a prominent feature. While in the later disease days (5-7 days), progression to mixed pattern GGO, consolidative opacities and pleural effusion formation have been observed.

3. Problem Definition:

This virus is a droplet-borne infection meaning it could be transmitted with close contact. On sneezing, talking or coughing droplets are produced which spread to all the nearby surfaces. Touching such an infected surface and then touching your own eyes, nose or mouth can also result in infection from spreading. Infected person is most contagious in the first 3 days of starting of symptoms and it is said that an asymptomatic patient can also transmit the infection. Such issue causes the problem in day to day life and increases the economic problems.

4. Motivation:

In almost all the countries, 44 to 50 % of the people belong to a lower middle-class not having permanent jobs. These are the most affected people as they have lost their jobs owing to the difficult times on economies. With the lockdowns and curfews, there is no way for these people to find jobs and support their families. Majority of these don't have any other skills and even the labor work isn't available right now. These problems inspire us to help these people by finding a way to fight this pandemic and make our economy stable.

Summary & Discussion:

➢ There is a good chance that different viruses similar to coronavirus will keep coming infecting both humans and animals hence wreaking havoc to our world. This is due to their capability to get mutations in their DNA and form recombination along with the ability to infect more than one species.

➢ Due to such unrecoverable diseases I am trying work on automated diseases detection/predication system using machine learning approach with some step mention in proposed work.

5. Conclusion

In the last five decades, there have been attacks of almost three different coronaviruses on humans and many attacks on animals too. There is a good chance that different viruses similar to coronavirus will keep coming infecting both humans and animals hence wreaking havoc to our world. This is due to their capability to get mutations in their DNA and form recombination along with the ability to infect more than one species.

Due to such unrecoverable diseases we are trying work on automated diseases detection/predication system using machine learning approach. In our proposed system different approach are going to use to predict the such harmful diseases so in future such a unstability in all nation not going to occurs or help to reduce an economic loss.

Also, number of researchers focus on coronaviruses to investigate many aspects of viral replication and pathogenesis. First, understanding the propensity of these viruses to jump between species, to establish infection in a new host, and to identify significant reservoirs of coronaviruses will dramatically aid in our ability to predict when and where potential epidemics may occur. So, we can also try to work on all this point.

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