



IJIRCCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 8, August 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.542



9940 572 462



6381 907 438



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Mortality Prediction for Covid-19 Patients Using Artificial Intelligence

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ABSTRACT: Human has prioritized the use of artificial intelligence in almost every field. In recent years, with the emergence of the concepts of artificial intelligence and machine learning there have been more advances in this field, because the use of these algorithms can make decisions on the ground with greater precision. Artificial intelligence (AI) and Machine learning (ML) has been developed in recent years to develop prognostic classification models that can be used to predict the outcome of individual Covid-19 patients. Coronavirus outbreaks lead to a significant increase in the demand for hospital beds and a lack of medical equipment, as well as the possibility of infection among medical personnel. The main goal of predictive models is to support individual patient's medical decisions. [2] When the system is overloaded by overcrowding, an Artificial Intelligence-based prediction model can help hospitals and medical institutions decide who requires treatment first and who has the highest priority to be hospitalized, classifies patients, and eliminates delays in providing necessary care. [4] Here we have shown two supervised machine learning algorithm namely Random forest and Artificial neural network. The goal of supervised machine learning is to develop an algorithm that is capable of predicting a unique output when given a particular input. [1]. The RF and ANN models have great potential in predicting the mortality of Covid-19 patients in the ICU. A prospective study is needed to evaluate the clinical utility of the RF and ANN models. [3]

KEYWORDS: Artificial Intelligence, Artificial Neural Network, Covid-19, Intensive care unit, Mortality Prediction, Random Forest

I. INTRODUCTION

The Covid-19 epidemic has brought enormous challenges to the global health system and one of them is the managing and controlling of Covid-19 patients. As a response to this problem Artificial Intelligence based model can be carried out to determine the severity and improve the condition of critical care patients. The use of artificial intelligence in medical diagnosis is becoming more and more popular and has been widely used ranging from diagnosis to prediction. The primary concern of machine learning which is subset of Artificial Intelligence in medicine is construction of artificial intelligent systems that can assist a medical doctor in performing expert diagnosis. [11]. The death toll of Covid-19 is dreadful and therefore to predict the survival of Covid-19 patients through Artificial intelligence can be beneficial to improve the Intensive care unit. This facility to predict the risk of the Covid-19 patient in the future will bring helpful information for improving patient care.

By obtaining new and important information from the vast amounts of data generated, technologies based on artificial intelligence have the potential to transform healthcare. [1]

II. RELATED WORK

Several authors have advocated use of Artificial Intelligence techniques for predicting ICU mortality. Clinical Decision Support System (CDSS) is one of the first successful applications of AI for , which focuses on diagnosing the patient's condition based on the patient's symptoms, Demographic information. [9] There are many machine learning algorithms including Support Vector Machine (SVM), Artificial Neural Networks (ANN), Random Forest (RF), Logistic Regression, Decision Tree, and K-Nearest Neighbor (KNN) to predict the mortality rate in patients with COVID-19. Here, we have reviewed some papers related to the prediction of mortality. Research in [8] found that deep neural network offer unique advantage over logistic regression or multivariate model. In [15] it is seen that predictive models based on data mining method including Naive Bayes classifier and simple logistic shows good outcomes.

With hospitals facing the strain of a global pandemic, the use of bedside AI technology can change the face of healthcare, allowing patients to be treated in a more detailed way and to save time. ICU is a highly complex healthcare

field that relies heavily on the continuous monitoring of various data points to sustain the lives of patients. Therefore, the medical community is looking for a solution to this problem and artificial intelligence and virtual assistants can help to solve these challenges and make the ICU work more efficiently. Mona (virtual assistant) is a unique artificial intelligence system specially designed for intensive care unit applications. It collects patient data and uses artificial intelligence to support clinical decision-making and responsively deliver aggregated data, immediately accelerating today's lengthy process of querying computer systems or physical files. [7]

ML methods are used to estimate the mortality rate of epidemic diseases in advance, which aids public health authorities in developing and designing an effective response. To reduce mortality, we need a plan that is both effective and efficient. [14]

III. METHODOLOGY

The crucial area within the field of clinical prediction involves the evaluation of patient mortality risk. The death prediction models produces probability of death during hospitalization.

Three step model of Artificial Intelligence in Intensive care unit:-1) Input 2) Process 3) Output

1) INPUT

The algorithm predicts the mortality risks based on patients' physiological conditions, symptoms, clinical, Para clinical and demographic information. [4] Demographic features Such as age, sex, province, country, age, travel historyetc. Symptoms and signs of Covid-19 such as fever, dry cough, tiredness, loss of taste and smell etc.

2) PROCESS

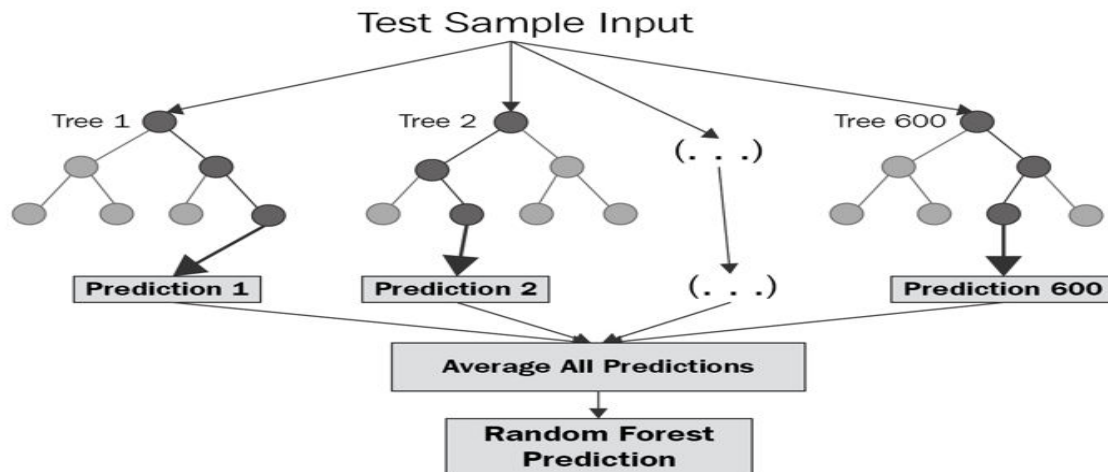
Machine learning combines statistical analysis technology with computer science to create algorithms that allow "statistical learning." In general, there are two types of machine learning structures:supervised and unsupervised.Supervised learning algorithms are very suitablefor two types of problems: classification problems and regression problems. [6]In the next subdivision, we have studied two commonly used supervised machine learning algorithms for predicting mortality.

Random Forest:

Random forest is a supervised machine learning algorithm consisting of many decision trees.

This supervised learning procedures operates according to the simple but effective"divide and conquer" principle. [10]It utilizes ensemble learning, which is a technique that combines many classifiers to provide solutions to complex problems. It establishes the outcome based on the predictions of the decision trees. Then it chooses the classification based on average or mean of the output from several decision trees. [12] Since the RF algorithm considers the results of many different Decision tree, it can reduce the variance caused by considering a single DT from the same data set.[6] A large number of trees operating as a committee will outperform any of the individual constituent models. The intention for this phenomenon is that the tree protects each other from individual errors.The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting.

Figure 1: RANDOM FOREST TECHNIQUE

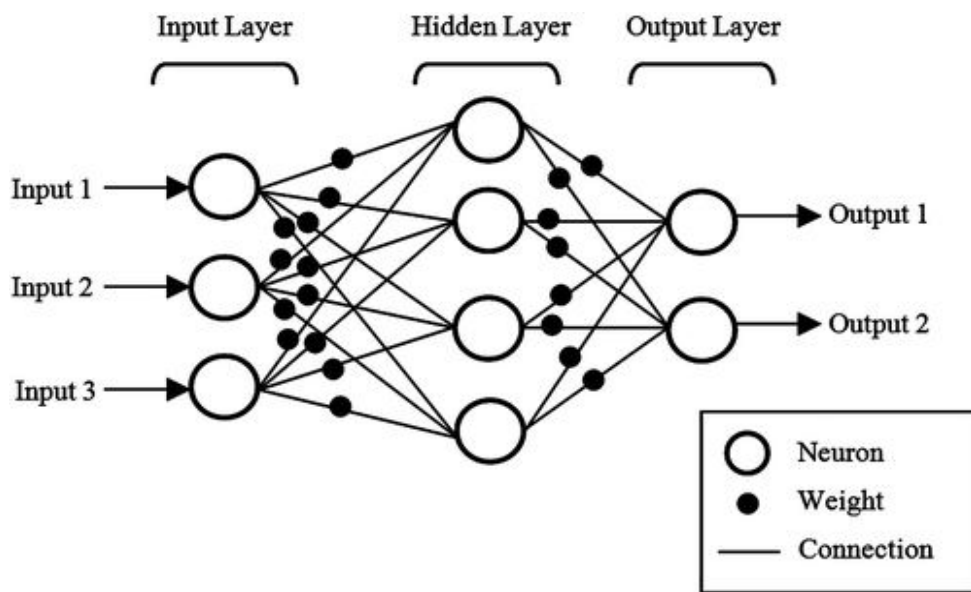


Src: -<https://corporatefinanceinstitute.com/resources/knowledge/other/random-forest/>

Artificial Neural Networks (ANN):-

An artificial neural network is an analytical model that estimates the mapping between input and output. [13] The artificial neural network is a set of machine learning algorithms, which is inspired by the functions of the neural network of the human brain. The neuron layer between the input layer and the output layer is called the hidden layer because they cannot be accessed directly. Each neuron implements a nonlinear function that maps an input set to output activation. The nodes and edges have weights that can adjust the strength of the communication signals, and these signal strengths can be amplified or reduced by repeated training. A well-designed neural network is a trainable adaptive system that can normally "learn" to solve complex problems from a set of examples, generalize the learning learned, and apply the same methods to solve unseen problems of a similar nature. [11].

Figure 2: ARTIFICIAL NEURAL NETWORK



Src:- <https://ascelibrary.org/doi/10.1061/%28ASCE%29EE.1943-7870.0000439>

3) OUTPUT: Mortality Prediction

Predictive model classify the data, predict the medical condition, and calculate the probability and risk of mortality. [4]

Table:-1

<u>Supervised Algorithm</u>	<u>Advantages</u>	<u>Limitations</u>
<u>Artificial neural network(ANN)</u>	<ul style="list-style-type: none"> - Can identify complex nonlinear relationships between dependent and independent variables. - Need less formal statistical training. - Availability of numerous training algorithms. - It can be implemented to classification and regression problems. 	<ul style="list-style-type: none"> - Have features of 'black box' - user can not have access to the exact decision-making process and therefore, - Computationally costly to train the network for a difficult classification problem. - Predictor or Independent variables need pre-processing

Random Forest	<ul style="list-style-type: none"> - Minor chance of variance and over fitting of training data compared to DT, since RF takes the average value from the result of its constituent decision trees. - Empirically, this ensemble-based classifier executes better than its individual base classifiers, i.e., Decision Tree. - Scales well for huge datasets. - It can provide approximations of what variables or attributes are essential in the classification. 	<ul style="list-style-type: none"> - More complex and computationally extortionate. - Number of base classifiers needs to be well-defined. - It approves those variables or attributes that can take high number of different values in estimating variable significance. - Over fitting can take place easily.
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Src: <https://doi.org/10.1186/s12911-019-1004-8>

IV. CONCLUSION

This study attempts to use artificial intelligence to study the prediction of mortality in patients with Covid-19. Artificial Intelligence based prediction model can help hospitals and medical institutions decide who needs treatment first who has the highest priority to be hospitalized, classifies patients when the system is overwhelmed by overcrowding, and eliminate delays in providing the essential care.[4] Due to a slew of contradictory result on the performance of various prediction tools, no single algorithm consistently beats the others; it all depends on the population of interest, the factors measured, and the outcome being examined. Some models, however, have advantages over others in specific areas. [5]The mortality prediction model must be specific to a disease or condition. The performance of disease-specific models is better than models designed to predict mortality for various conditions. The future has great potential to apply artificial intelligence to improve many aspects of the patient care process. [9]

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