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Review Article

An Intelligent Virus Infection Detecting System based on Immunoglobulin's (IgM and IgG): Proposed Model

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Abstract

The potential information remains in the blood test results. Currently the whole world is under the outbreak of Coronavirus diseases 2019 (COVID19), so there is a need of developing an accurate assisting tool that analyzes the immune system of healthy persons and COVID19 infected persons. In this paper an intelligent model is proposed for the same, in the context of mainly comparing immunoglobulin (IgM and IgG) from blood test results. Furthermore, various combinations of IgM, IgG and other immunoglobulin's will be studied for identifying severity of diseases. The aim of the study is to build preventive intelligent model that can predict human body is currently fighting with some unknown infection or not and severity of it.

Keywords: Expert System (ES); Immune System; Immunoglobulin; Machine Learning; Prediction Model; RT-PCR

Abbreviation

RT-PCT: Reverse Transcription Polymerase Chain Reaction

Introduction

In the late 2019, December the first case of novel corona virus was detected in Wuhan city, China. As of 30 April, this pandemic has the status of total 2, 28,239 killed, 32, 20,847 were infected and 10, 01,008 were recovered. The virus is highly analogous to corona virus that caused Severe Acute Respiratory Syndrome (SARS) in 2003, thus it was named by SARS-COV-2 by World Health Organization on February 11, 2020, and associated disease was named CoV Disease-19 (COVID 19). Various other life threatening virus infections are Ebola, Zika, Middle East Respiratory Syndrome (MERS), SARS, H1N1 etc. The best way to survive in all such infected diseases is preventing our body from such infections. The only way out for preventing from such pandemics is to optimize our immune system potential [1]. In this paper a model is proposed based on maintaining healthy immune system in order to prevent such infections.

Conceptual framework

The motivation of this work supposes the availability of a great number of intelligent systems available in the domain of medicine. The conceptual framework is organized into: A: Immune system and artificial intelligence and B: Expert systems for diagnosing diseases as follows.

Immune system and artificial intelligence

The function of immune system has benefited the AI in order to study intrusion detection, self-healing of robots, and area of optimization and abnormality detection. AI can be applied in the molecular level to clinical level to help immune system. Machine Learning (ML) is an emerging branch of AI is having very wide applications in diagnosing, feature extraction etc. Using different algorithms of ML, Naïve Bayes, Support Vector Machine, k-Nearest Neighbor etc., first data are preprocessed and then diagnosing has been done. There were plenty of databases now created to make the concrete study using computational intelligence [2].

The mapping of senescence in immune system with aging was greatly studied by Eduardo and his friends. With age there is decrement in immune responses, leads to severe situations of bacterial and viral infections. The condition with low responses of immune system gets exposure to antigens increases in production of pro-inflammatory cytokines [3]. The immune system responds in two ways, innate and adaptive immunity. Due to aging, alterations like decrement in functioning of T cells and many more increases the rate of infections and a person needs to evaluate for immune senescence treatment [4].

In 2003, laboratory tests were diagnose for severe acute respiratory syndrome (SARS) at Toronto, study interprets reports of RT-PCR for SARS-CoV and proved to be an efficient tool for rapid response to SARS CoV as new emerging infectious diseases [5].

One more intelligent system was designed to diagnose hydrocephalus. The whole system was designed in two phases, in phase-1 web based application NeuroDiary was improved in context of their input and output interfaces and in phase-2, an android based mobile application was proposed and was extension to NeuroDiary [6].

Irun Cohen and Sol Efroni had greatly explained the concept of Supervised Machine Learning and immune wellness as input from the body, whether healthy or ill, is gathered by receptors of immune cells and processed through interactions of layers of innate cells, B cells and T cells. By putting this concept this will open new directions for novel research [7].

A very concrete and important system was built as an application of Machine Learning, to diagnose based on blood reports. Two models with different parameters from blood reports were designed for diseases like Iron deficiency anemia, Lymphoid leukemia, Myeloid leukemia etc. Both models were evaluated with ten-fold cross-validation of 8,233 cases. SVM, Naïve Bayes, k-Nearest Neighbor, Decision tree algorithms were implemented and their results in form of accuracy were compared. The main concept behind designing such system is the very practical truth that is, when our body is infected with any diseases than it must leads to alteration in cellular or molecular level and these changes are always detects from any of blood parameter values. Smart blood analytics algorithms show great promise in medical laboratory diagnoses and creates values for both physicians and patients [8].

Expert system for diagnosing diseases

Sr. No	Title	Description of Study
1	An Expert System for the interpretation of full blood counts and blood smears in a hematology laboratory.	Hematex is a rule-based Expert System. Interpretation has been done from red blood cell, white blood cell, blood platelets, which leads to quick and accurate interpretations will be more detailed and standardize [9].
2	An Expert System of diagnosis of Blood Disorder.	The system was designed with user interfaces, from which patient can enter symptoms and based on it system will diagnose about the disorders [10].
3	Expert System for Medical Diagnosis of Hypertension and Anemia.	Hypertension and Anemia were diagnosed on the basis of Bayesian network, which is efficient enough to work with uncertainty. The system will take input inform of various parameters with Boolean as well as multiple values. The output was shown in term as probability index [11].
4	Role of an Expert System in Identification and Overcoming of Dengue Fever.	Rule based reasoning was used to propose this system and was predicting Dengue in early stages [12].

Table 1: ES in medical field survey.

Proposing new preventive model based on immunoglobulin

From the blood test data anemia was classified, Iron deficiency was identified; liver diseases were classified, chronic hepatitis c was diagnosed using different Machine Learning techniques where well defined rules were faded into the system as per the expert guidance. The speed is one of the strength of such systems in the designing of pathways of diagnosis based on laboratory tests data. The only weakness can be the reasonability of systems, so such system cannot replace experts but definitely results help medical practitioners [13].

In the field of computational pathology one more system was designed to predict ferritin test result using the results from other tests. By achieving 97% of accuracy, findings claims that consider-

able duplication present on patient test results and propose novel type of decision support system integrate, interpret and enhance diagnostic value of multiple analysis sets of clinical laboratory test data [14].

Above 90% of accuracy achieved for predicting vaccine's ability to immunize a patient in case of yellow fever. The project guide fast development of better vaccines to fight with emerging infections, even they expects that project should assist universal flu vaccine [15].

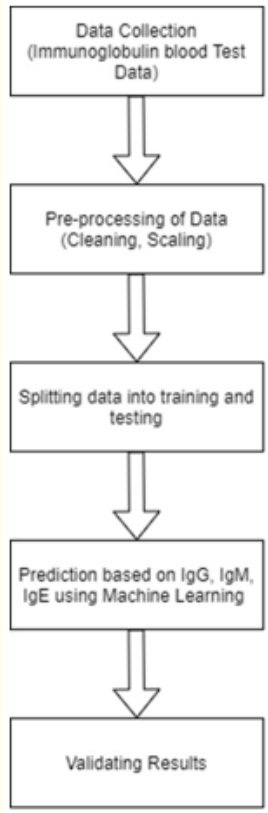

Figure 1: Proposed preventive model.

Looking towards current situation, where whole world is facing the pandemics of COVID19, if a system can build that can first study the immunoglobulin levels of healthy humans and COVID19 infected humans. Further trying to find out the intensity of immunoglobulin present in COVID19 infected people analysis indicates the severity of infection. The proposed model is shown in figure 1.

To execute proposed model step by step actions will be explained in the below mentioned algorithm:

- Step-1: Collection of Immunoglobulin values from blood test.
- Step-2: Pre-processing of collected data. After pre-processing scaling is implemented.
- Step-3: Splitting the data in to training and testing.
- Step-4: Various supervised machine learning techniques will be used for study for analysis of Immunoglobulin (IgM, IgG and IgE).
- Step-5: Prediction based on various combinations of different types of immunoglobulin.
- Step-6: Validating the results with statistical tools (F-test, T- test, Regression Analysis) and with the real world expert.

Discussion and Conclusion

The system is proposed based on the fact that any disease reflects some changes in blood test results. The proposed model gives a pathway to build a concrete system that assist medical professionals. It will be useful tool in case of any infection detection as well as its severity detection. By validating results with various statistical models and with real world expert it becomes a robust system that will be very effective in this kind of pandemic situation of COVID 19 and for future also.

Succeeding plan

The success of execution of any such model is depending on the data. So first important task must be collection of data from hospitals. The data of blood test specially based on immunoglobulin of healthy individuals and COVID19 infected persons. Then under the guidance of medical professional, dataset is build will be built with different features like age groups, gender, various immunoglobulins and even it is good if we can find blood test reports indicates level of vitamin D. As we all know that vitamin D is affected by the immunity of human body, so it is helps to improve our results in terms to prediction based on immunity. After building the dataset proposed model steps should be implemented to achieve results.

Acknowledgments

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