JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

COVID 19 : DIAGNOSIS AND TREATMENT USING ARTIFICIAL INTELLIGENCE AND DEEP LEARNING MODELS

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ABSTRACT

The COVID-19 outbreak has put the whole world in an unprecedented difficult situation bringing life around the world to a frightening halt and claiming thousands of lives. Due to COVID-19's spread in 212 countries and territories and increasing numbers of infected cases and death tolls mounting to 5,212,172 and 334,915 (as of May 22 2020), it remains a real threat to the public health system. This paper renders a response to combat the virus through Artificial Intelligence (AI). Some Deep Learning (DL) methods have been illustrated to reach this goal, including Generative Adversarial Networks (GANs), Extreme Learning Machine (ELM), and Long /Short Term Memory (LSTM). It delineates an integrated bioinformatics approach in which different aspects of information from a continuum of structured and unstructured data sources are put together to form the user-friendly platforms for physicians and researchers. The main advantage of these AI-based platforms is to accelerate the process of diagnosis and treatment of the COVID-19 disease. The most recent related publications and medical reports were investigated with the purpose of choosing inputs and targets of the network that could facilitate reaching a reliable Artificial Neural Network-based tool for challenges associated with COVID-19. Furthermore, there are some specific inputs for each platform, including various forms of the data, such as clinical data and medical imaging which can improve the performance of the introduced approaches toward the best responses in practical applications.

Keywords:

COVID19,Deep Learning, Long Short Term Memory(LSTM),Extreme Learning Machine(ELM),Artificial Neural Network(ANN)

1. INTRODUCTION

In this work, our team relies on the findings of the most recent research focusing on COVID-19 and its various challenges to generalize and suggest a variety of strategies relevant but not limited to high-risk groups, epidemiology, radiology and etc. As the paper unfolds, it explores and discusses the potentials of AI approaches to overcome COVID-19 related challenges.

The novel Coronavirus designated SARS-CoV-2 appeared in December 2019 to initiate a pandemic of respiratory illness known as COVID-19 which proved itself as a tricky illness that can emerge in various forms and levels of severity ranging from mild to severe with the risk of organ failure and death. From mild, self-limiting respiratory tract illness to severe progressive pneumonia, multiorgan failure, and death [1][4]. With the progress of the pandemic and rising number of the confirmed cases and patients who experience severe respiratory failure and cardiovascular complications, there are solid reasons to be tremendously concerned about the consequences of this viral infection [5]. Determining appropriate approaches to reach solutions for the COVID-19 related problems have received a great deal of attention. However, another huge problem that researchers and decision-makers have to deal with is the ever-increasing volume of the date, known as big data, that challenges them in the process of fighting against the virus. This justifies how and to what extent Artificial Intelligence (AI) could be crucial in developing and upgrading health care systems on a global scale [6]. AI has been recently attracted increasing research efforts towards solving the complex issues in a number of fields, including engineering [7][9], medicine [10][13], economy [14], and psychology [15]. Hence, a critical situation like this necessitates mobilization and saving medical, logistic and human resources and AI can not only facilitate that but can save time in a period when even one hour of the time save could end in saving lives in all locations where Coronavirus is claiming lives. With the recent popularity of AI application in clinical contexts, it can play an important role in reducing the number of undesired deletions as well as improving the productivity and efficiency in studies where large samples are involved [16], and higher degrees of accuracy in prediction and diagnosis are intended [17]. Utilizing big data can also facilitate viral activity modeling studies in any country. The analyses of results enable health care policymakers to prepare their country against the outbreak of the disease and make well-informed decisions [11]. Nevertheless, while treatment strategies, crisis management, optimization and improvement diagnosis methods, such as medical imaging and image processing techniques could take benefit from AI which is potentially capable of helping medical methods, it has not been desirably employed and well-appropriated to serve health-care systems in their fights against COVID-19. For instance, one area that can take special advantage of AI's useful input is image-based medical diagnosis through which fast and accurate diagnosis of COVID-19 can take place and save lives [10]. Appropriating AI techniques to deal with COVID-19 related issues can fill the void between AI-based methods and medical approaches and treatments. AI specialists' use of AI platforms can help in making connections between various parameters and speed up the processes to obtain optimum results.

In this proposed work, our team relies on the findings of the most recent research focusing on COVID-19 and its various challenges to generalize and suggest a variety of strategies relevant but not limited to high-risk groups,

epidemiology, radiology and etc. As the paper unfolds, it explores and discusses the potentials of AI approaches to overcome COVID-19 related challenges

The present section focuses on the introduction of some applicable AI-based strategies that can support existing standard methods of dealing with COVID-19 in health care systems around the world. With the aim of foregrounding the enhanced effectiveness of these strategies and techniques, their formation has been informed by and based on the most recent AI-related published medical updates as well as the latest updates on COVID-19. Therefore, this section presents ideas that can enhance and speed up ANN-based methods obtaining process to improve treatment methods and health management as well as recognition and diagnosis

AI could be extensively applied for COVID-19; however, we aim at finding the best possible solutions COVID-19 related issues that have put the biggest challenges ahead of health care systems. Accordingly, these solutions have been categorized into 3 parts, including high-risk groups, outbreak and control, recognizing and diagnosis.

2. LITERATURE SURVEY

Literature survey is the most important step in software development process. Before developing the tool, it is necessary to determine the time factor, economy and company strength. Once these things are satisfied, ten next steps are to determine which operating system and language used for developing the tool. Once the programmers start building the tool, the programmers need lot of external support. This support obtained from senior programmers, from book or from websites. Before building the system the above consideration r taken into for developing the proposed system.

1) Clinical Features Of Patients Infected With 2019 Novel Coronavirus In Wuhan

AUTHORS: C. Huang et al

Coronaviruses are enveloped non-segmented positive-sense RNA viruses belonging to the family Coronaviridae and the order Nidovirales and broadly distributed in humans and other mammals.1 Although most human coronavirus infections are mild, the epidemics of the two betacoronaviruses, severe acute respiratory syndrome coronavirus (SARS-CoV)2, 3, 4 and Middle East respiratory syndrome coronavirus (MERS-CoV),5, 6 have caused more than 10 000 cumulative cases in the past two decades, with mortality rates of 10% for SARS-CoV and 37% for MERS-CoV.7, 8 The coronaviruses already identified might only be the tip of the iceberg, with potentially more novel and severe zoonotic events to be revealed. In December, 2019, a series of pneumonia cases of unknown cause emerged in Wuhan, Hubei, China, with clinical presentations greatly resembling viral pneumonia.9 Deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus, which was named 2019 novel coronavirus (2019-nCoV). Thus far, more than 800 confirmed cases, including in health-care workers, have been identified in Wuhan, and

several exported cases have been confirmed in other provinces in China, and in Thailand, Japan, South Korea, and the USA[9].

2) An Anfis Approach To Modeling A Small Satellite Power Source Of Nasa

AUTHORS: M. B. Jamshidi, N. Alibeigi, A. Lalbakhsh, and S. Roshani.

Before launching satellites into space, a wide variety of practical and comprehensive tests must be done on their different subsystems. Because, the cost spent for designing and manufacturing satellites is much higher than these investigations. One of the prominent sectors of these devices is their power supplies. In this paper, a neuro-fuzzy based black-box technique for modeling a li-ion battery used in a small satellite of the National Aeronautics and Space Administration (NASA) is presented[3]. The dataset was extracted from a range of particular tests on 18650 lithium-ion cells by scientists of NASA. The proposed approach includes an Adaptive Neuro-Fuzzy Inference System (ANFIS) model with a Fuzzy Inference System (FIS) generated by a subtractive clustering algorithm to estimate and predict the capacity of the cell for next cycles. The results indicated the proposed method can be considered an efficient and reliable technique for estimating parameters of batteries[5].

3) A Novel Multiobjective Approach For Detecting Money Laundering With A Neuro-Fuzzy Technique.

AUTHORS : M. B. Jamshidi, M. Gorjiankhanzad, A. Lalbakhsh, and S. Roshani

Using the computational inelegant methods in processing financial data is a practicable action to reduce a wide variety of crime in this domain. In this paper, a new intelligent multiobjective to recognize money laundering in banks and currency exchanges is presented. The introduced approach is based on Adaptive Neuro-Fuzzy Inference System (ANFIS) which is set up by MATLAB software. The proposed method can replace conventional methods to detect the risk of money laundering in suspicious banking transaction. In addition, this approach can be used in banking systems as an online technique to analyze the data of customers' accounts. Also, the probability of money laundering's risk for each exchange is processed and monitored. One of the main advantages of the system is categorizing customers for different customers. The results illustrate the accuracy of this system in filtration of accounts infected by money laundering is acceptable[4].

4) Fault Diagnosis And Remaining Useful Life Estimation Of Aero Engine Using Lstm Neural Network

AUTHORS : **M. Yuan, Y. Wu, and L. Lin**

Aero engine is a kind of sophisticated and expensive industrial product. Accurate fault location and Remaining Useful Life (RUL) estimation for aero engine can lead to appropriate maintenance actions to avoid catastrophic failures and minimize economic losses. The aim of this paper is to propose utilizing Long Short-Term Memory (LSTM) neural network to get good diagnosis and prediction performance in the cases of complicated operations, hybrid faults and strong noises. The whole proposition is demonstrated and discussed by carrying out tests on a health monitoring dataset of aircraft turbofan engines provided by NASA. Performances of LSTM and some of its modifications were tested and contrasted. Experiment results show the standard LSTM outperformed others[2].

5) Generative Adversarial Networks For Noise Reduction In Low-Dose Ct

AUTHORS: J. M. Wolterink, T. Leiner, M. A. Viergever, and I. Isgum

Noise is inherent to low-dose CT acquisition. We propose to train a convolutional neural network (CNN) jointly with an adversarial CNN to estimate routine-dose CT images from low-dose CT images and hence reduce noise. A generator CNN was trained to transform low-dose CT images into routine-dose CT images using voxelwise loss minimization. An adversarial discriminator CNN was simultaneously trained to distinguish the output of the generator from routine-dose CT images. The performance of this discriminator was used as an adversarial loss for the generator. Experiments were performed using CT images of an anthropomorphic phantom containing calcium inserts, as well as patient non-contrast-enhanced cardiac CT images. The phantom and patients were scanned at 20% and 100% routine clinical dose. Three training strategies were compared: the first used only voxelwise loss, the second combined voxelwise loss and adversarial loss, and the third used only adversarial loss. The results showed that training with only voxelwise loss resulted in the highest peak signal-to-noise ratio with respect to reference routine-dose images. However, CNNs trained with adversarial loss captured image statistics of routine-dose images better. Noise reduction improved quantification of low-density calcified inserts in phantom CT images and allowed coronary calcium scoring in low-dose patient CT images with high noise levels. Testing took less than 10 s per CT volume. CNN-based low-dose CT noise reduction in the image domain is feasible. Training with an adversarial network improves the CNNs ability to generate images with an appearance similar to that of reference routine-dose CT images

3. EXISTING SYSTEM AND ITS LIMITATIONS

In the existing system, there was no concept like identifying covid19 and its symptoms using neural networks or cnn models. All the prediction is done using manual approach or by using primitive Machine Learning models. In the ML we can able to classify whether any abnormality is present or not by physically monitoring the patient with his symptoms. But there is no accuracy in the existing system because manual prediction may sometimes generate wrong results.

DISADVANTAGES OF THE EXISTING SYSTEM

In the existing or current clouds the following are the main limitations that are available

1. All the existing schemes are limited to the few classes classification only.
2. All the existing systems are failed to classify the covid 19 disease accurately based on the user symptoms.
3. All the existing approaches use the manual approach in order to cluster and classify the problem.

4. There is no accurate model to classify the real time patient data based on some automatic approaches.

4. PROPOSED SYSTEM AND ITS ADVANTAGES

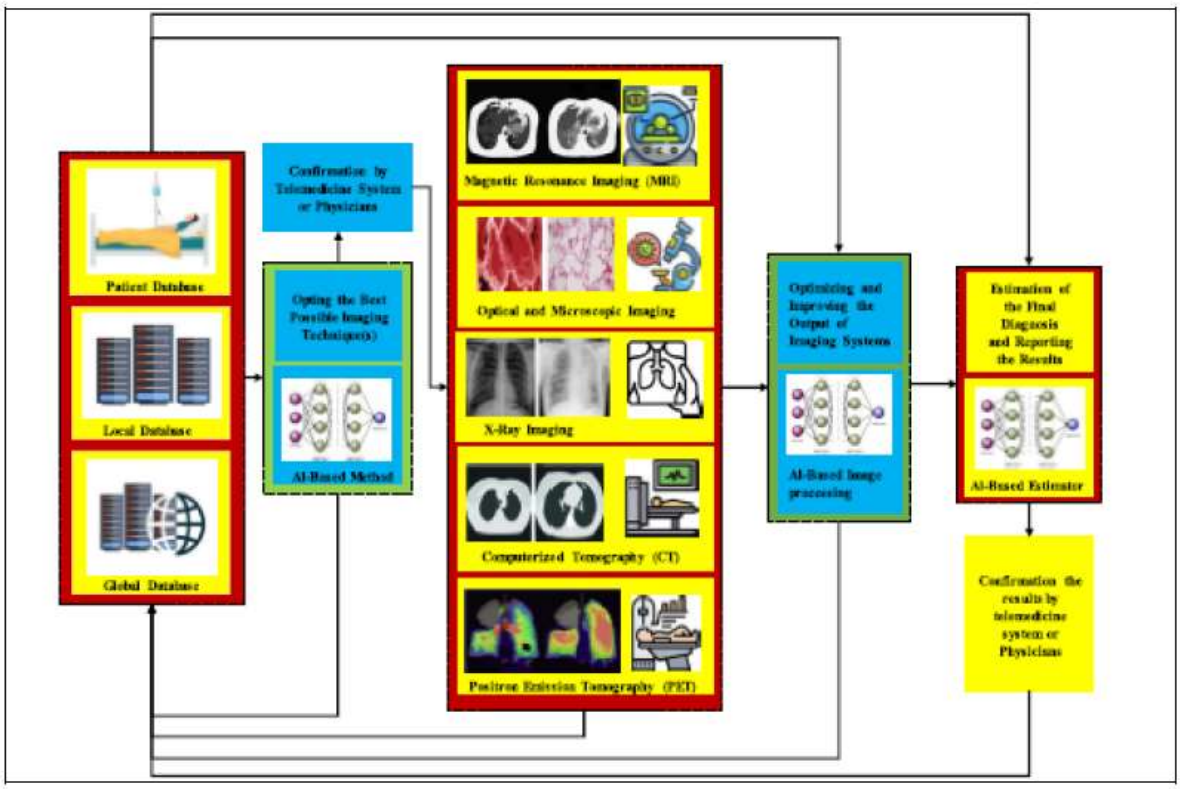
In this proposed work we try to design an application in which automatically we can able to cluster the patient data and identify whether he is suffering with covid or not. Here we use the artificial intelligence and neural networks combine to identify and predict the covid 19 disease present in that patient or not. For this we try to use KAGGLE dataset and check the performance of our application.

ADVANTAGES OF THE PROPOSED SYSTEM

1. The proposed scheme is very accurate in classification of COVID 19 patients from the CT or MRI images.
2. The proposed system gives accurate recommendation for the doctors.
3. The proposed system is capable of segmenting the image and predict the anomaly which is present in that patient.
4. The proposed system gives accurate results
5. The proposed model will be helpful for rural areas to predict the person whether they are suffering with covid or not.

5. PROPOSED CNN MODEL FOR COVID 19 DIAGNOSIS

In this section we try to discuss about proposed CNN model which is used to detect COVID 19 Diagnosis.



The Application is mainly divided into 4 modules. They are as follows:

A. Convolution Layer
B. Rectified Linear Unit (RELU) Layer
C. Pooling Layer
D. Fully Connected layer

Implementation is the stage where the theoretical design is converted into programmatically manner. In this stage we will divide the application into a number of modules and then coded for deployment. The application is divided mainly into following 4 modules. They are as follows:

1) USER MODULE:

The User can register the first. While registering he required a valid user email and mobile for further communications. Once the user register then admin can activate the customer. Once admin activated the customer then user can login into our system. First user can get the current covid status in USA.

In the programmatically url "http://covidtracking.com/api/states/daily.csv" will get the current status of covid data from USA. I the daily.csv will get the results of how many patient are infected on the day. How may recovered on the day. After user can get the clinical reports weather what drug they are used. The user will invoke the algorithms by making sub process call. The user will train the model by infected x-ray imagesand normal images. Once the model trained then it is ready for testing.

2) ADMIN MODULE :

Admin can login with his credentials. Once he login he can activate the users. The activated user only login in our applications. The admin can set the training and testing data for the project dynamically to the code. The model covid19_pneumonia_detection_cnn.model is available under the media folder. So that the user can test by browser. We used ANN model to predict the given CT scan images weather covid patient or not.

3) CLINICAL PROCESS MODULE:

This is an effort to compile a repository of the clinical characteristics of patients who have taken a COVID-19 test. By sharing our schema and data, we hope that we can 1) accelerate information sharing among frontline healthcare providers and 2) facilitate studies on COVID-19 signs, symptoms, stages, and care plans. The repository is maintained as CSV file. Further, a patient's reported age differs from their actual age by a reasonable randomized amount to protect their privacy. The data includes clinical characteristics (epidemiologic factors, comorbidities, vitals, clinician-assessed symptoms, patient-reported symptoms), in addition to radiological and laboratory findings. It does not include treatment plans, complications, and clinical outcomes, which is collected at inpatient facilities. Details about each field are available in the data dictionary. The data includes both positive and negative test results for symptomatic and asymptomatic patients. The data does not include results for patients with severe symptoms. It is important to note that our data collection is clinically-driven and therefore not systematic. This means that overall positive rates are descriptive of the Carbon Health patient population and cannot be generalized to the unobserved population. We provide functions to identify symptom severity to aid in accounting for the various admission criteria that affect positive rates.

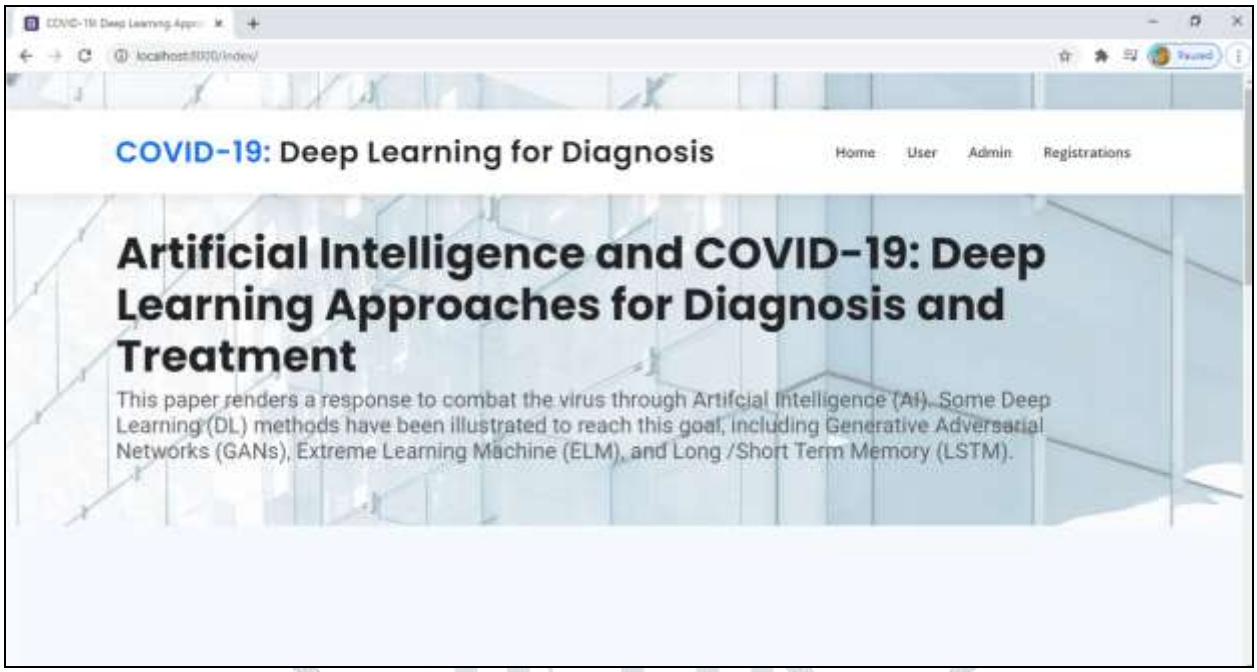
4) CT SCAN TEST MODULE :

Here we will be using Tensor flow 0.14.0 with Python3 for detecting Covid-19 Pneumonia signs from CT Scan Images by a CNN (Convolutional Neural Network) Model. The model has a uniform dataset of 764 Images of CT Scan which consist 349 Images of Covid-19 Pneumonia affected patients and remaining shows normal patient scans. The dataset was taken from the following (https://github.com/UCSD-AI4H/COVID-CT/tree/master/Images-processed). You can go through our [dataset](Classes/ct_scans_png_dataset.rar) where we have indexed all the images and converted them into same format(PNG). We have used tensor flow library for training a binary classification model of CT Scans using Convolutional Neural Network. The graph of model is as follows

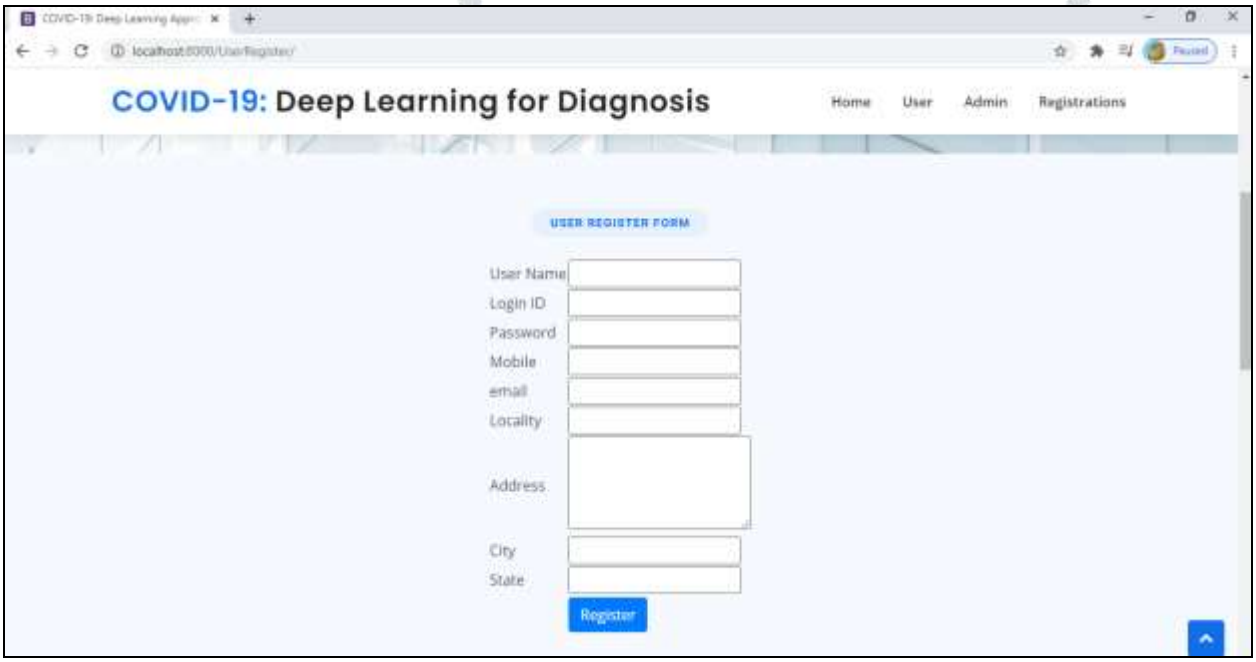
6. EXPERIMENTAL RESULTS

Implementation is a stage where the theoretical design is converted into a programmatic manner. In this proposed application we try to use PYTHON as a programming language in which Jupiter Notebook as a working platform to process the current application.

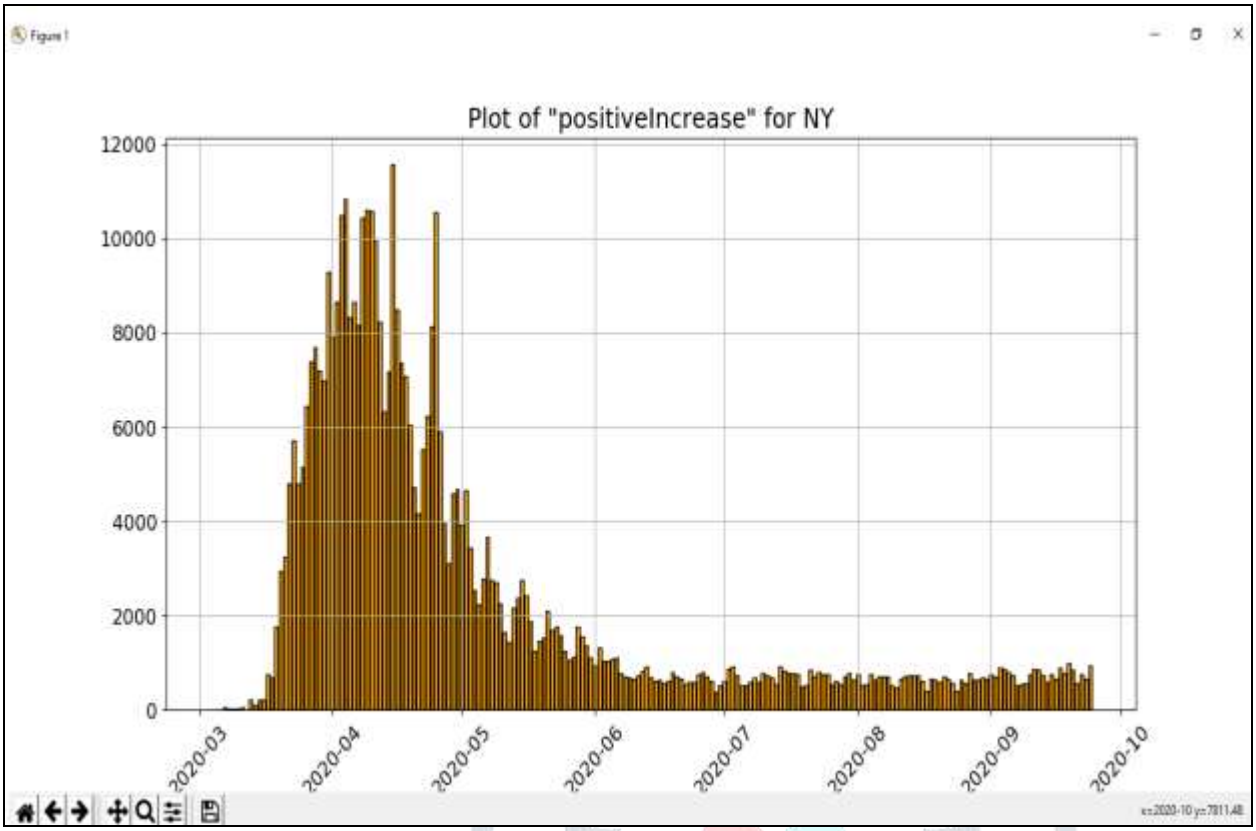
STEP 1: HOME PAGE



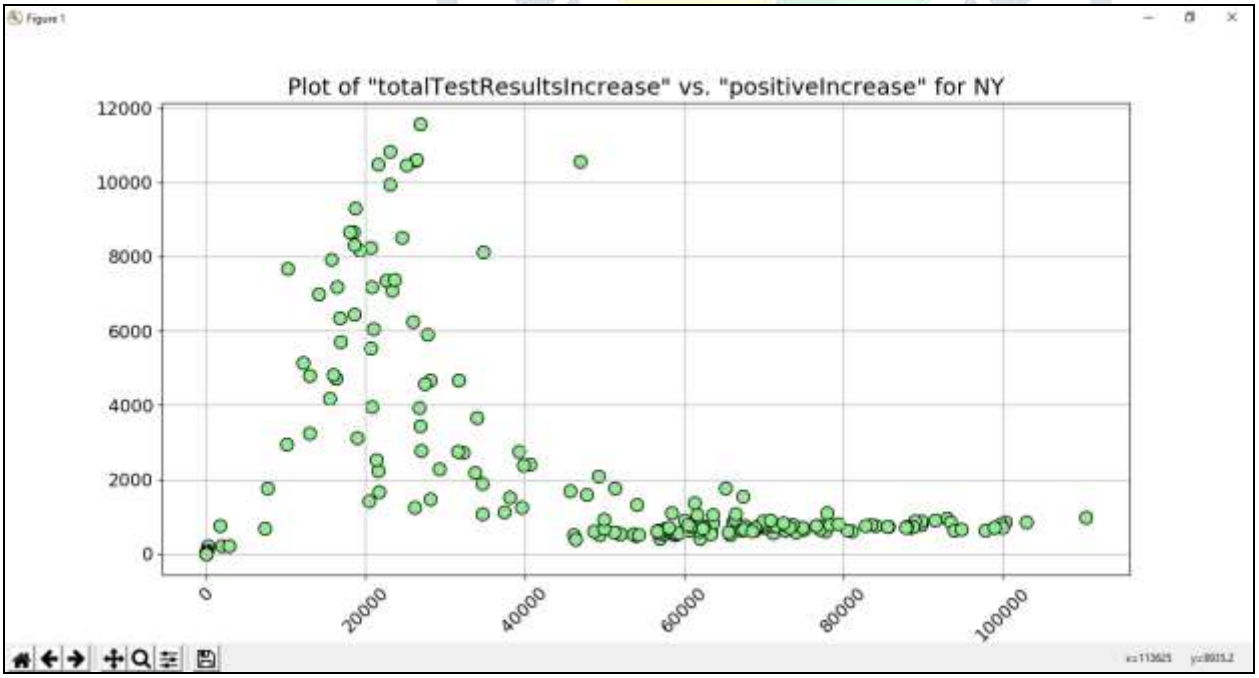
STEP 2: USER REGISTRATION PAGE



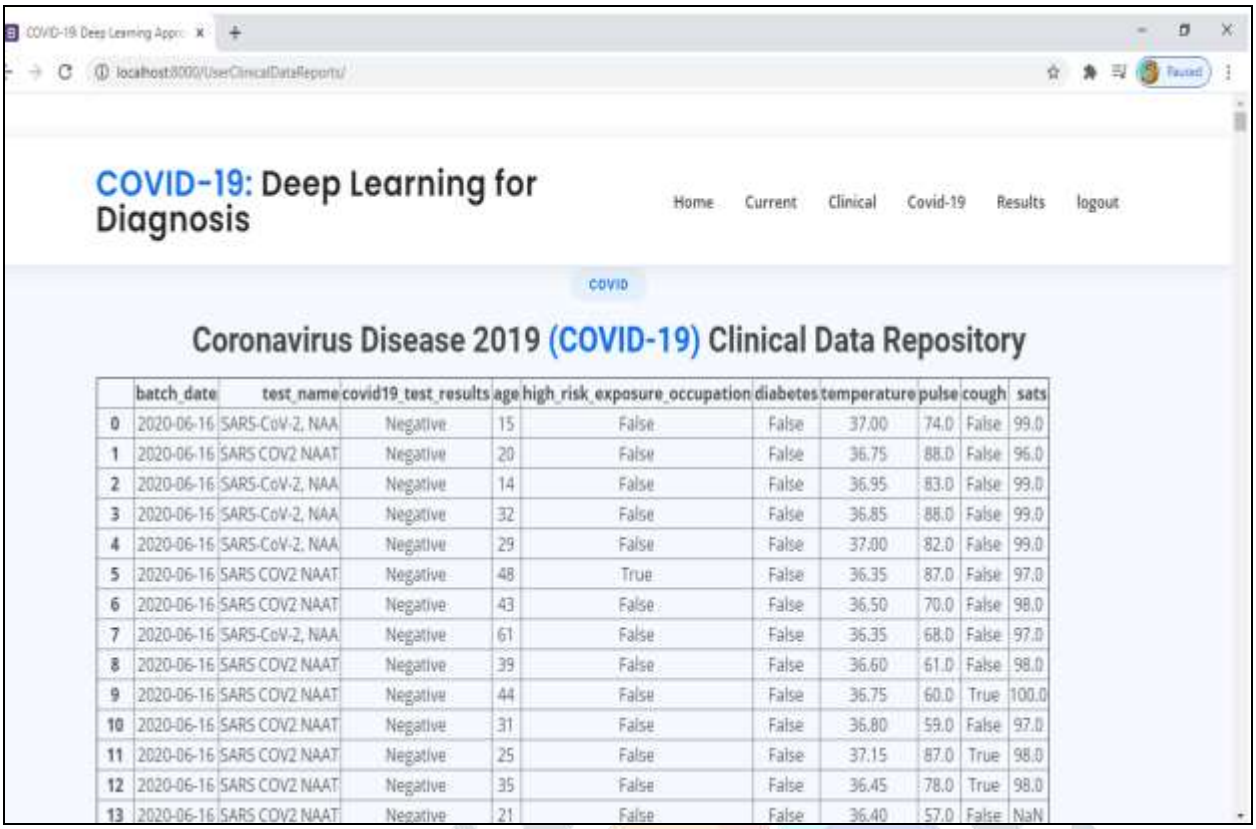
STEP 3: CURRENT STATUS



STEP 4: TEST RESULT



STEP 5: CLINICAL DATA



COVID-19: Deep Learning for Diagnosis

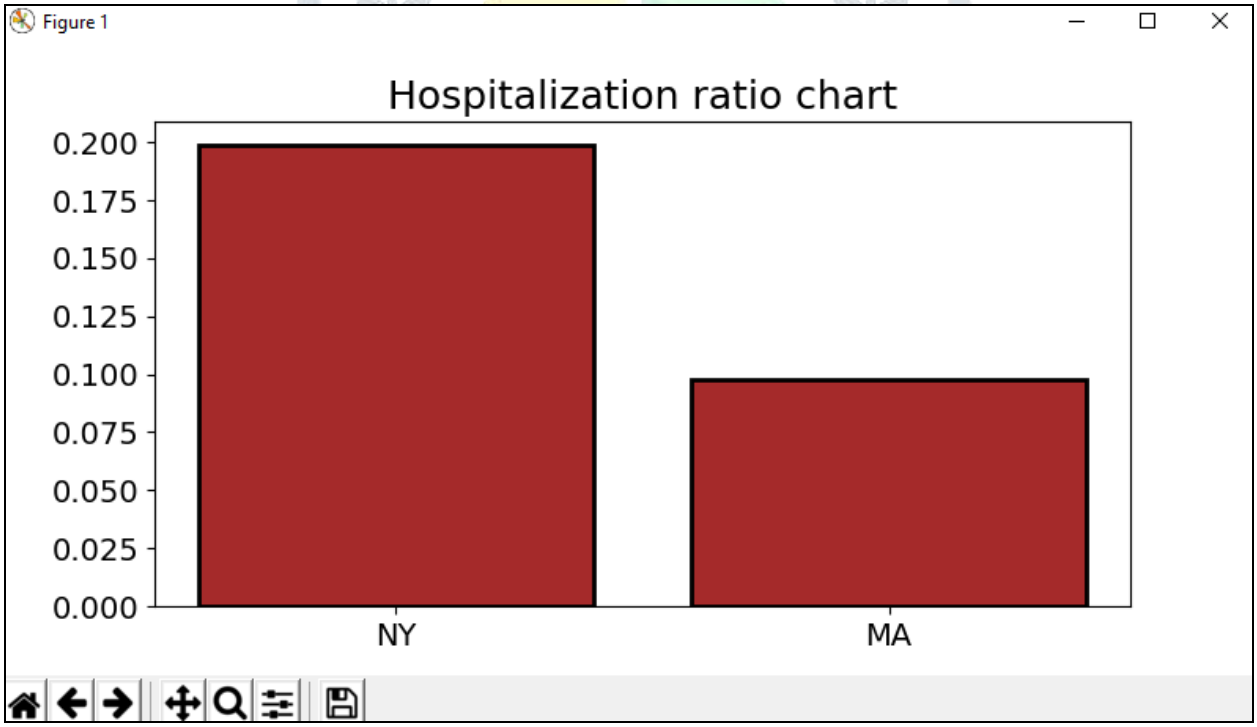
Home Current Clinical Covid-19 Results logout

COVID

Coronavirus Disease 2019 (COVID-19) Clinical Data Repository

	batch_date	test_name	covid19_test_results	age	high_risk_exposure_occupation	diabetes	temperature	pulse	cough	sats
0	2020-06-16	SARS-CoV-2, NAA	Negative	15	False	False	37.00	74.0	False	99.0
1	2020-06-16	SARS COV2 NAAT	Negative	20	False	False	36.75	88.0	False	96.0
2	2020-06-16	SARS-CoV-2, NAA	Negative	14	False	False	36.95	83.0	False	99.0
3	2020-06-16	SARS-CoV-2, NAA	Negative	32	False	False	36.85	88.0	False	99.0
4	2020-06-16	SARS-CoV-2, NAA	Negative	29	False	False	37.00	82.0	False	99.0
5	2020-06-16	SARS COV2 NAAT	Negative	48	True	False	36.35	87.0	False	97.0
6	2020-06-16	SARS COV2 NAAT	Negative	43	False	False	36.50	70.0	False	98.0
7	2020-06-16	SARS-CoV-2, NAA	Negative	61	False	False	36.35	68.0	False	97.0
8	2020-06-16	SARS COV2 NAAT	Negative	39	False	False	36.60	61.0	False	98.0
9	2020-06-16	SARS COV2 NAAT	Negative	44	False	False	36.75	60.0	True	100.0
10	2020-06-16	SARS COV2 NAAT	Negative	31	False	False	36.80	59.0	False	97.0
11	2020-06-16	SARS COV2 NAAT	Negative	25	False	False	37.15	87.0	True	98.0
12	2020-06-16	SARS COV2 NAAT	Negative	35	False	False	36.45	78.0	True	98.0
13	2020-06-16	SARS COV2 NAAT	Negative	21	False	False	36.40	57.0	False	NaN

STEP 6: HOSPITALIZATION RATIO CHART



7. CONCLUSION

The proposed conceptual structures and platforms in the research field of AI-based techniques, which are suitable for dealing with COVID-19 issues, have been studied in this paper. Different techniques have been developed, incorporating COVID-19's diagnostic systems, such as RNN, LSTM, GAN, and ELM. The geographical issues, high-risk people, and recognizing and radiology were the main problems with COVID-19 and have been studied and discussed in this work. Also, we showed a mechanism for selecting the appropriate models of estimation and prediction of desired parameters using a number of clinical and non-clinical datasets. Considering these platforms assists AI experts to analyze huge datasets and help physicians train machines, set algorithms or optimize the analyzed data for dealing with the virus with more speed and accuracy.We discussed that they are desirable because of their potential for creating a workspace while AI experts and physicians could work side by side. However, it should be noted while AI speeds up the methods to conquer COVID-19, real experiments should happen because a full understanding of advantages and limitations of AI-based methods for COVID-19 is yet to be achieved, and novel approaches have to be in place for problems of this level of complexity. Succeeding in the combat against COVID-19 toward its eventual demise is highly dependent on building an arsenal of platforms, methods, approaches, and tools that converge to achieve the sought goals and realize saving more lives.

FUTURE WORK

In this study we concentrated only on one deep learning model for COVID Disease detection and in future we want to test the same mechanism on multiple deep learning models which can increase the performance of our models.

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