IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 3, May 2022

COVID-19 Prescreening Tool Using Deep Neural Network

Isha Patel[1], Ruchita Potamsetti[2], Mayuri Ubale[3], Vaishnodevi Ghodake[4], Prof. Archana Dirgule[5]

Students, Department of Computer Engineering[1,2,3,4]

Faculty, Department of Computer Engineering[5]

Sinhgad College of Engineering, Pune, Maharashtra, India

Abstract: *The emergence of COVID-19 has led to unprecedented global disruptions. Over the course of the COVID-19 pandemic, efforts were made to rapidly scale diagnostic tests to increase access and throughput. Strict social measures in combination with existing tests and consequently dramatic economic costs were proven sufficient to significantly reduce pandemic numbers, but not to the extent of extinguishing the virus. It is well recognized that in order to limit outbreaks, testing is needed to identify as many individuals that are infected as quickly as possible so they and their contacts can be isolated. The speed, scarcity, supply chain, and costs of clinical tests such as antigen and polymerase chain reaction (PCR) tests are many of the key factors behind the rapid spread of COVID-19 across countries and continents. Developing countries continued to be impacted by several compounding issues: the spread of COVID-19, the challenges associated with testing, the challenges associated with mass vaccinations, and medical supply scarcity, even though mass vaccinations were being administered at record rates in developed countries. It becomes imperative that issues of testing improve and become more accessible and responsive. The use of acoustic signatures of COVID-19 to accurately discriminate between positive and negative subjects has been proposed in several recent studies. In this work, we propose an AI pre-screening tool that could test the whole world on a daily, or even hourly basis at essentially no cost. The user will record his cough audio on our UI which will be processed and the necessary features will be extracted. The features extracted will work as inputs to the DNN model which will in return give us the prediction within seconds.*

Keywords: DNN (Deep Neural Network), MLP(Multilayer Perceptron), feature extraction, K-fold Cross Validation

I. Introduction

1.1 Detailed Problem Definition

To design and implement an AI audio Processing Framework for COVID-19 diagnosis using cough recordings.

1.2 Justification of Problem

The system can be considered as smart and reliable for COVID-19 diagnosis. It will be able to provide a platform for all stakeholders of the healthcare system. Additionally, the application will memorize its users by keeping user records and also authenticate for enhanced security features. However, it will be not possible for users to analyze symptoms unknown to the system, and detect newly discovered diseases.

1.3 Need for the New System

There is a need for this system because outbreaks such as COVID-19 are very hard to contain with current testing approaches unless regions-wide confinement measures are sustained. This is partly because of the limitations of current viral and serology tests. Also there is a lack of complementary pre-screening methods to efficiently select who should be tested. To solve this problem our AI- Prescreening tool could test the whole world on a daily, or even hourly basis at essentially no cost.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 6.252
Volume 2, Issue 3, May 2022

II. LITERATURE SURVEY

The five research papers referred to, propose different approaches to diagnose Covid-19. Previous literature has shown promising results identifying COVID-19 positive patients via cough sound analysis. Laguarta, Jordi et al. proposed an AI speech processing framework that leverages acoustic biomarker feature extractors to pre-screen for COVID-19 from cough recordings, and provide a personalized patient saliency map to longitudinally monitor patients in real-time, at essentially zero variable cost and non-invasively. The COVID-19 sensitivity achieved by this model is 98.5% with a specificity of 94.2% (AUC: 0.97) when it is validated with 98.5% with a specificity of 94.2% (AUC: 0.97). It achieves sensitivity of 100% with a specificity of 83.2% for asymptomatic subjects . But there is no process to verify if recordings correspond to coughs.

In the paper by Melek Manshouri on Rapid and Scalable COVID-19 Screening using Speech, Breath, and Cough Recordings, we see that power spectral density based on short-time Fourier transform and mel-frequency cepstral coefficients (MFCC) were chosen to be the efficient feature extraction method. The processed signals were then feeded to a support vector machine (SVM) algorithm so as to spot and classify COVID-19 cough. A sensitivity and specificity of 98.6% and 91.7% respectively, were achieved by this model. But the proposed algorithm(SVM) is typically not fitted to large and noisy datasets.

In the paper by D. Grant, I. McLane and J. West, mfccs and relative spectra perceptual linear prediction (RASTA-PLP) features are evaluated independently and conjointly with two different classification techniques, random forests (RF) and deep neural networks (DNN). Though the results are promising, the presence of noise wasn't considered during this analysis and would need to be taken into consideration to translate to audio data collected in the wild.

A paper by M. Jamshidi et al. proposes the implementation of an AI-based platform. This platform uses Deep Learning methods including Generative Adversarial Networks (GANs), Extreme Learning Machine (ELM), and Long /Short Term Memory (LSTM). But the implementation of this model will require direct contact with the patient. Bless Lord Y. Agbley, Jianping Li, Amin Ul Hao, Bernard Cobbinah1, Delanyo Kulevome, Priscilla A. Agbefu and Bright Eleeza in Wavelet-Based Cough Signal Decomposition for Multimodal Classification proposed a multimodal cough data classification approach with scalogram images obtained by decomposing cough signals using continuous wavelet transform and clinical information of subjects. By considering the different approaches proposed in these papers we created a model that extracts 26 features from the recorded cough audio from the user and makes a prediction using a multilayer perceptron model with 6 hidden layers.

III. DESIGN ANALYSIS

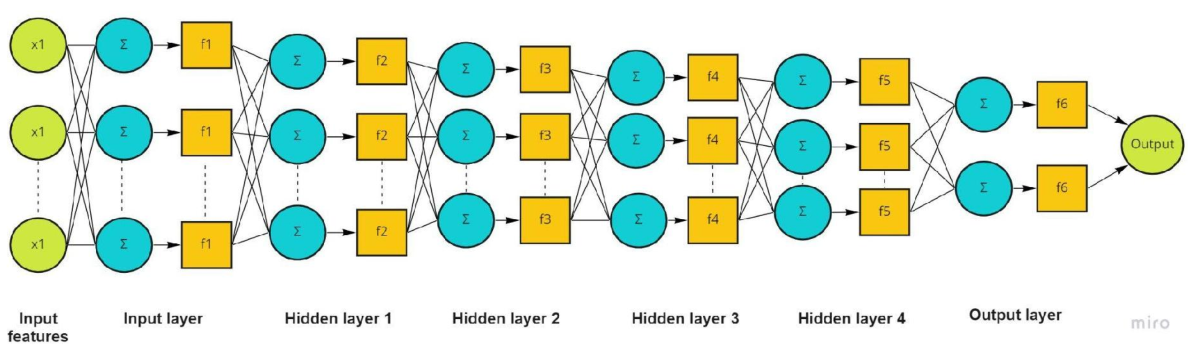

Figure 1: Mathematical model

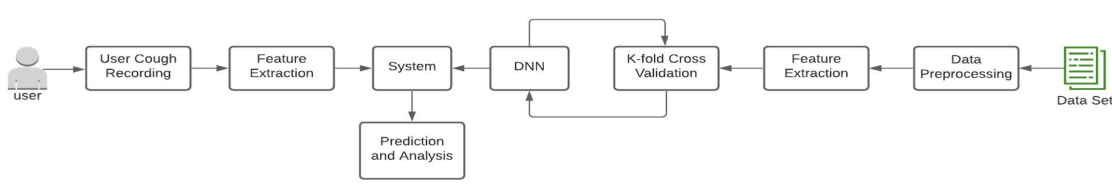

Figure 2: System Flow Diagram

IV. Output

- After the user provides the cough audio relevant audio features are extracted from this audio.
- Then a prediction is made using the pretrained MLP model which gives the output of whether or not the
- The Live tracker module generates and displays live covid cases using corona.lmao.ninja API.
- The live tracker displays Active Cases, Critical cases, Recovered cases, Total cases, Total deaths and Test Done in India.

V. Conclusion

We propose the use of sound in a rapid and scalable COVID 19 screening tool. Using a publicly available dataset, we classify recordings as COVID positive or negative, which results in performance of 0.9035. The use of cough sounds to identify COVID-19 cases shows the possibility of comparable performance to antigen tests at a fraction of the cost and deployable to the nearly 3.8 billion people digitally. The deployment of this system would be highly beneficial to rapidly and repetitively screen a large number of patients at once. The use of acoustic testing may be most useful to identify outbreaks, or to select people with symptoms for further testing with PCR, allowing self-isolation or contact tracing and reducing the burden on laboratory services.

VI. Future Scope

Deep Neural Networks have fueled recent data driven technologies in diverse sectors including medicine and clinical practices because of their ability to internally identify features and maximize patterns and traits from such large datasets. The invention of such a DLL model over data collected on sound of patients was because of the urgency of finding a solution to the COVID-19 pandemic. So in future more complex models can be built supported by the metadata of those patients and including other varying factors like age, gender, etc. Extracting features from the recorded audio has been shown to be effective at revealing characteristics from the different modalities that could help in prediction of diseases.

As we know there are cultural and age differences in coughs, future work could focus on tailoring the model to different age groups and regions of the world using the metadata captured. Also we could include a module to distinguish between cough sounds and other noise. In the coming future we can make this application available to various health organizations, hospitals, schools and companies. Further, we can implement this in the form of mobile applications so that the use can be much easier.

VII. Acknowledgements

First and foremost, the authors would like to express our deepest condolences for the lives lost due to COVID-19 and express our gratitude and respect for the clinicians and scientists on the front lines. We would also like to thank Prof. J. B. Kulkarni and Prof. Archana Dirgule for their insights during development. Finally, the authors would like to acknowledge and thank the team behind the Kaggle dataset and the Virufy dataset for making their data available to the public to accelerate development for the good of humanity.

References

[1]. Bless Lord Y. Agbley, Jianping Li, Amin Ul Hao, Bernard Cobbinah1, Delanyo Kulevome, Priscilla A. Agbefu and Bright Eleeza, 2020. Wavelet-Based Cough Signal Decomposition for Multimodal Classification. In 17th International Computer Conference on Wavelet Active Media Technology and Information Processing (ICCWAMTIP). IEEE

[2]. Melek Manshouri, N. Identifying COVID-19 by using spectral analysis of cough recordings: a distinctive classification study. In Cogn Neurodyn (2021). Springer

[3]. Laguarta, Jordi et al. COVID-19 Artificial Intelligence Diagnosis Using Only Cough Recordings. In IEEE Open Journal of Engineering in Medicine and Biology 1 (September 2020): 275 - 281. IEEE

[4]. D. Grant, I. McLane and J. West, "Rapid and Scalable COVID-19 Screening using Speech, Breath, and Cough Recordings," 2021 IEEE EMBS International Conference on Biomedical and Health Informatics (BHI), 2021, pp. 1-6, doi: 10.1109/BHI50953.2021.9508482.

[5]. M. Jamshidi et al.. Artificial Intelligence and COVID-19: Deep Learning Approaches for Diagnosis and Treatment. In IEEE Access, vol. 8, pp. 109581-109595, 2020. IEEE