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A Hybrid Model for Selection of Patients for COVID-19 Testing

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Abstract*: Today the whole world is suffering from corona virus or Covid-19. The World Health Organization (WHO) also declared it as "pandemic" which means that it has spread over a large geographical area and affecting an exceptionally high proportion of the population.The world has already seen some others pandemic too, such as H1N1 virus, Ebola, AIDS, etc. but none of them has covered this much of the world's population. Today the total cases of covid-19 are approx. 7.94 million out of which 435 thousand have already died and this graph is increasing day by day. In this paper we have shown a hybrid model comprising of technologies such as thermal detectors, audio-based sensors and deep learning techniques that will help us in selecting the patient for Covid-19 testing.

***Keywords*: Corona virus, Covid-19, Pandemic, Thermal Sensors, Audio-Based Sensors, Artificial Intelligence, Deep Learning**

I. INTRODUCTION

In this evolving world, computer technologies are being used in each and every field. It is also widely used in the field of medical science and has made a lot of changes to it. Every time we come up with some medical problem or disease, medicinal practitioners also tries to seek the solution by using computer technologies. Artificial Intelligence, a major sub-field of computer science is widely used and here we are going to take the help of it.

Today there is an ongoing tension all around the globe because of the spread of corona virus.

If we look at the stats, today there are approx. 7.49 million cases of corona virus with 1435 thousand deaths worldwide. It's affecting 213 countries and territories all over the globe [2].

It is first reported to the WHO Country Office in the city of Wuhan, Hubei province in China on 31st December 2019, basically seen as pneumonia with an unknown cause and from that time the number started to multiply day by day [4, 5, 6]. This epidemic was considered a public health disaster by WHO on 30 January 2020 [1].

Nowadays you must have noticed the we use the term "novel" with corona virus because it is a novel strain in the family of viruses and this term is coded by WHO itself on 11th February 2020 [1]. The deadly virus belongs to the family of virus which can lead to common cold to deadly symptoms such as shortness of breath and sometimes death and it is found in both humans as well as animals [11].

The strain of virus that was seen in Wuhan is similar to two viruses that were also seen earlier, i.e."Severe Acute Respiratory Syndrome" (SARS) and the "Middle East Respiratory Syndrome" (MERS). Once entered into the body this virus can cause a lot of serious damage, starting from respiratory complication like pneumonia, kidney disorder and development of liquid in the lungs and death in some cases [12].

Two pandemics of the virus have observed over the last twenty years, i.e. SARS-CoV and cov-MERS. The first began in China, expanding to 24 countries and documented 8,000 cases & 800 fatalities, the second began in Saudi Arabia, registered 2,500 cases and 800 deaths. [13]. The extent of the dissemination of corona virus is presently shown in the given figure 1 and 2.

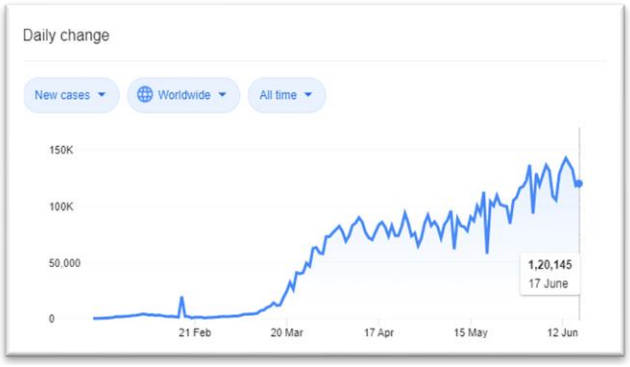

Fig. 1.COVID-19 outbreak inworldwide

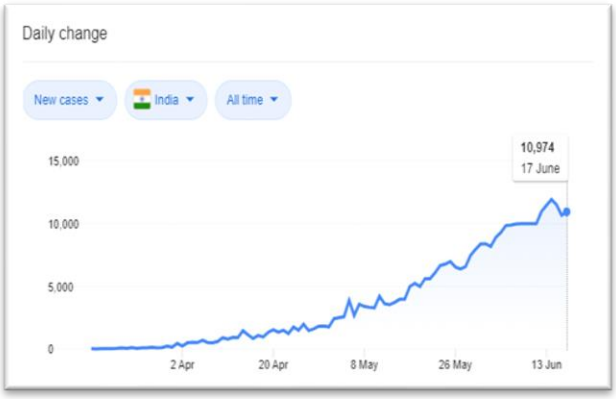

Fig.2. COVID-19 outbreak in India

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Even though it was originally assumed that the virus was transmitted only via human contact with livestock since the origin of the spread was suspected to become a fish and living animal business in Wuhan, the Chinese government have reported that the corona strain could also be transmitted from one person to another , as a result of which cases seem to be increasing [4, 5].

At the present time there is an emphasis on preventing and managing the propagation of this uncommon virus, because there are no clear therapeutic strategies for this specific strain of the virus existing. The only way to prevent this virus is social distancing due to which the whole world is going to through lockdown [1]. The government of every country is making all the possible efforts to cut down the spread.

Despite the accelerated progression of the virus, the test of corona virus is a very difficult task because of the unavailability of the test kits and diagnosis system everywhere, which is a reason of panic. The numbers of patients to be checked are a lot more in comparison of the test kits available and it is not feasible to check all of them with the limited number of kits so we need to come up with some other approaches to deal with this situation [14].

Here we're going to provide a model of "Selection of Patients for COVID-19 Testing".

II. LITERATURE REVIEW

Many researchers and health scientists are working on the vaccine of the corona virus but as of now we haven't achieved any milestone in that area. Therefore, government of every country is coming up with different strategies to cut the spread of this deadly virus.

Some of the computer researchers are also working on this issue and trying to make techniques to tackle this disease [22-24]. Here we have used three technologies thermal sensors, audio-based sensors and deep learning so we will look at the related work of these three fields.

The thermal sensors are being used from quite a long time for the detection of body temperature and since fever is one of the primary symptoms of Covid-19 therefore thermal sensors in the form of "infrared thermometers" are being used from malls to restaurants and hospitals to hotels, everywhere [8, 10]. First the temperature of the person is checked and if his body temperature is normal then only he's allowed to enter the place. This measure is helpful as of now and being practiced almost everywhere. The infrared thermometers works on the principle called "black body radiation". As this virus can be spread by coming close to the infected person infrared thermometer are of great help in this case because for measuring the temperature, we don't actually have to touch the body, we can actually do that with keeping our safe distance [7].

Taking about audio-based sensors, they are used for the detection of cough. Cough being a very common symptom of Covid-19 can easily be detected by their use [15]. Audio-based sensor not only tells us that the person is suffering from cough it also tells us about its type, i.e. whether it's dry or wet [16]. In Covid-19 patient's dry cough is usually seen and we can use audio-based sensors to detect that. These sensors follow a cough recognizing algorithm and their accuracy is pretty good [9].

We also come across several studies in which X-ray images are being used as instruction set data for SVM. Widely used pre-trained models such as "ResNet50", "InceptionV3" and "Inception ResNetV2" are used in the process [17]. Researchers have found that the X-ray images of Covid-19(+) is different from that of Covid-19(-) and we can use this for differentiating the two categories. For the detection of lungs infection, we'll use deep CNN technology. We'll take two data sets, one will include the X-ray images of Covid-19(+) and the other will have the X-ray images of Covid-19(-) [19]. With the help of Deep Learning the machine will train and learn from the given data and the SVM will classify the deep features from these two datasets. Once this is done the system will be fully trained on the X-ray images and will be able to differentiate whether the given X-ray is of Covid-19(+) or Covid-19(-) [17, 18].

III. PROBLEM STATEMENT

A. Problem

At the moment, the emphasis is on preventing and combating the expansion of this new corona virus, because there are no precise alternative treatments for this unique virus strain [1]. The only way to prevent this virus is social distancing due to which the whole world is going to through lockdown. The government of every country is making all the possible efforts to cut down the spread but still it's increasing day by day.

Given the rapid progression of the disease, the test of corona virus is a very difficult task because of the unavailability of the test kits in comparison of the patients suffering and diagnosis system everywhere, which is a reason of panic.

The numbers of patients to be checked are a lot more in comparison of the test kits and it is not feasible to check all of them with the limited number of kits so we need to come up with some other approaches to deal with this situation.

B. Objective

The key aim of this work is to provide a model for the selection of patients to be tested for corona virus. The reason of this research is the unavailability of the testing kits therefore we can't just test everyone standing in the queue, out of two patients only the one who has more similar symptoms to that of corona virus must be tested first and this model will help us in the selectionof that patient.

C. Methods of solving the problem

As we all know the few first symptoms of corona virus include: fever, cough and lungs infection, therefore we'll work on these three with the help of different technologies available.

1) **For fever:** As per the World Health Organization (WHO), the period between contact to COVID-19 and the duration when symptoms begin is generally between five to six days, and can vary from 1 to 14 days and one of the initial symptoms is fever [10]. If a person is suffering from Covid-19 his body temperature will increase. For the measurement of fever thermal sensors in the form of "infrared thermometers" are used all over the world. People are checked before entering places like airports, offices, restaurants, stores and even in residential areas [8].

The infrared thermometer can measure the temperature without even touching people's skin and also gives a faster result that's why it's used over mercury thermometer [7].This thermometer comes with an infrared sensor and works on the phenomenon called "black body radiation". The infrared thermometer depicts a visible infrared light. concentrate infrared radiation on a sensor called a thermopile through one body to another as in figure 3.The infrared radiation is then suck by thermopile, after absorbing the thermopile convert it into heat, as infrared energy increases thermopile gets hotter, then heat changes into energy and sent towards the detector, finally detector apply it to measure the temperature of anything [7].

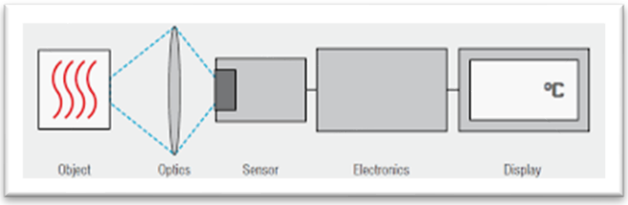

Fig.3.Working of infrared thermometer.

2) **For cough:** Cough is the other most common and initial symptom in corona virus patients [10]. We'll use audio-based sensors for the testing of cough. Audio based sensors can detect whether the person is suffering from cough or not. They work on the algorithm that examines the cough features such as frequency, type and intensity [9]. This algorithm consists of three parts:

After processing the raw audio data in the first layer, audio events will be detected. A random forest algorithm will differentiate whether it's cough or speech.

In the second layer of the process a majority voting scheme will be applied on the output to gives the final result for that time window(which consists of multiple time frames) [9]. Basically, in Covid-19, the patient usually suffers with the problem of dry cough. The voice recognition technology will first tell us whether the person has cough or not, in the addition of this it will also let us know whether the cough is dry or not, usually patients suffers from problem of dry cough in Covid-19 as shown in figure 4.

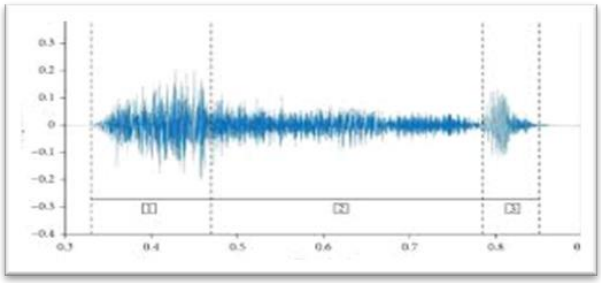

Fig. 4.Audio-based assessment of cough.

3) **For lungs infection:** Fever and cough can happen due to various other reasons too but for a surety check we can use the X-rays images of the patients. When the virus finally reaches the lungs, it starts to attack them and we feel symptoms like shortness of breath [8]. The X-ray images of Covid-19 patient is different from the X-ray images of patient not suffering from Covid-19. So, for tor the detection of lungs infection we'll use deep CNN technology. We'll take two data sets; one will include the X-ray images of Covid-19(+) and the other will have the X-ray images ofCovid-19(-) [17]. With the help of Deep Learning the machine will train and learn from the given data and the SVM will classify the deep features from these two datasets. Once this is done the system will be fully trained on the X-ray images and will be able to differentiate whether the given X-ray is of Covid-19(+) or Covid-19(-).

According to medical research COVID-19 target the epithelial cells that line our respiratory tract therefore the health of the patient's lungs can be analyzed by doing X-rays [19]. Almost every hospital has X-ray imaging machines and it is used by medical practitioner to diagnose pneumonia, lung inflammation, abscesses, and/or enlarged lymph nodes therefore it could be possibly used for the detection of covid-19 patients [18].

The most deadly and severe symptom arises when the virus of Covid-19 reaches your lungs and attacks it and this results in the respiratory problems such as shortness of breath, etc. Researchers have found that the X-ray images of Covid-19(+) is different from that of Covid-19(-) and we can use this for differentiating the two categories. For the detection of lungs infection we'll use deep CNN technology [17, 19]. In the given study, two data sets is used, one will include the X-ray images of Covid-19(+) and the other will have the X-ray images ofCovid-19(-). With the help of Deep Learning the machine will train and learn from the given data and the SVM will classify the deep features from these two datasets. Once this is done the system will be fully trained on the X-ray images and will be able to differentiate whether the given X-ray is of Covid-19(+) or Covid-19(-) in given below in figure 5 and 6 [20].

Fig. 5.X-ray images of healthy person.

Fig. 6.X-ray images of Covid-19(+) patient.

IV. PROPOSED HYBRID SOLUTION

Covid-19 cases are increasing with a greater rate every day and due to the availability of limited number of test kits in many countries like India we can't test all the patients with symptoms similar to that of Covid-19.

The symptoms of Covid-19 include "fever", "cough", "headache", "loss of taste and smell", etc. and these are the symptoms that can be seen in many humans due to various other reasons other than Covid-19 virus. Due to the worldwide spread, people get panic easily if they see any of the symptoms without knowing whether it is Covid-19 or not and run for testing.

In India there are504 laboratories doing Covid-19 testing. Till now they have conducted around 0 lakhs tests out of which around 4 lakhs tests are confirmed as Covid-19 (+) [14].

In this proposed work, we havemerge all the three technologies, thermal detectors, audio-based sensors and deep learning techniques in figure 7.

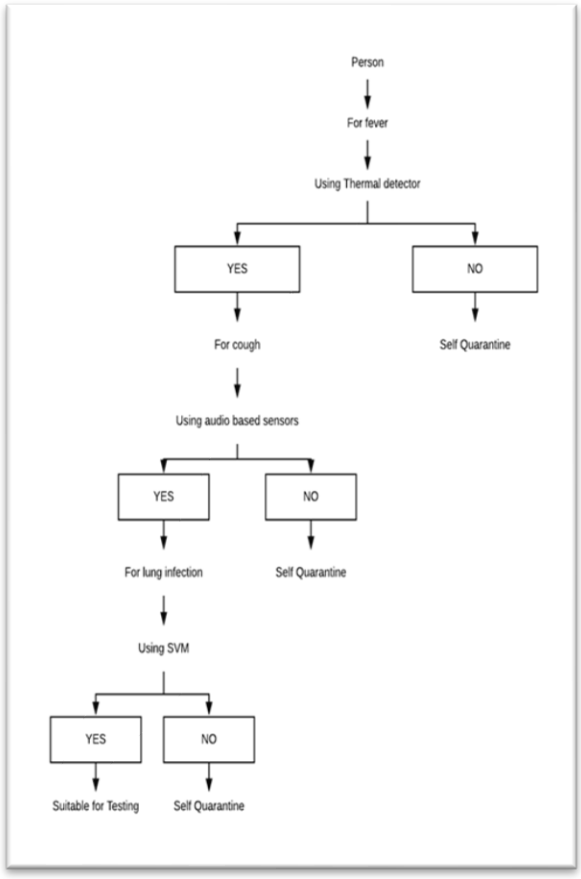

Fig. 7. HybridSolution

By using hybrid model, we can get the idea who is more likely to be suffered from Covid-19 virus. We may not be sure whether it's Covid-19 or not without the actual test that's we are not giving a model for checking if it's Covid-19 virus or not but rather we are giving a model for selection of patient which will be put first for Covid-19 testing. This is more feasible and it will save a lot of time and the person who's more likely to have the virus will be checked first and undergo the proper treatment.

After applying this proposed model we will be able to increases the number of positive results per number of Covid-19 testing. By doing this we'll be able to save time, kits and resources. The person who's more likely to be suffering from corona virus will get the chance to be tested first.

V. CONCLUSION

We have suggested a framework in this document, utilizing three current technologies. The model looks one the three main symptoms of Covid-19 and for each symptom we've used different technology, thermal sensors for fever, and audio-based sensors for cough and deep learning for shortness of breath. The main objective of this model is to find whether the given person is suitable for Covid-19 testing or not, this is measured on how close his symptoms are to those of Covid-19(+). The need of this arises because as this disease is spreading rapidly the number of test kits are less than the number of patients waiting to be tested and out of these patients some of them may not have Covid-19 but similar symptoms so this will give a more strong answer whether you're close to Covid-19 or not and that will help the patient with Covid-19 to get the chance of testing first. By doing this we'll save time, kits and moreover lives.

REFERENCES

1. World Health Organization. "Coronavirus disease 2019 (COVID-19): situation report, 72." (2020).
2. Dong, Ensheng, Hongru Du, and Lauren Gardner. "An interactive web-based dashboard to track COVID-19 in real time." The Lancet infectious diseases 20, no. 5 (2020): 533-534. [CrossRef]
3. Sethy, Prabira Kumar, and Santi Kumari Behera. "Detection of coronavirus disease (covid-19) based on deep features." Preprints 2020030300 (2020): 2020. [CrossRef]
4. Wu, Fan, Su Zhao, Bin Yu, Yan-Mei Chen, Wen Wang, Zhi-Gang Song, Yi Hu et al. "A new coronavirus associated with human respiratory disease in China." Nature 579, no. 7798 (2020): 265-269. [CrossRef]
5. Huang, Chaolin, Yeming Wang, Xingwang Li, Lili Ren, Jianping Zhao, Yi Hu, Li Zhang et al. "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China." The lancet 395, no. 10223 (2020): 497-506. [CrossRef]
6. World Health Organization. World Health Organization (WHO); 2020. Pneumonia of Unknown Cause–China. Emergencies Preparedness, Response, Disease Outbreak News.
7. Fuchs, M., and C. B. Tanner. "Infrared thermometry of vegetation 1." Agronomy Journal 58, no. 6 (1966): 597-601. [CrossRef]
8. Barkur, Gopalkrishna, and Giridhar B. Kamath Vibha. "Sentiment analysis of nationwide lockdown due to COVID 19 outbreak: Evidence from India." Asian journal of psychiatry (2020). [CrossRef]
9. Sugimoto, Chika, Hamed Farhadi, and Matti Hämäläinen, eds. 13th EAI International Conference on Body Area Networks. Springer Nature, 2020. [CrossRef]
10. World Health Organization. "Coronavirus disease (COVID-19) advice for the public: myth busters." (2020).
11. Holshue, Michelle L., Chas DeBolt, Scott Lindquist, Kathy H. Lofy, John Wiesman, Hollianne Bruce, Christopher Spitters et al. "First case of 2019 novel coronavirus in the United States." New England Journal of Medicine (2020). [CrossRef]
12. Wu, Zunyou, and Jennifer M. McGoogan. "Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention." Jama 323, no. 13 (2020). [CrossRef]
13. Kong, Weifang, and Prachi P. Agarwal. "Chest imaging appearance of COVID-19 infection." Radiology: Cardiothoracic Imaging 2, no. 1 (2020): e200028. [CrossRef]
14. Singhal, Tanu. "A review of coronavirus disease-2019 (COVID-19)." The Indian Journal of Pediatrics (2020): 1-6. [CrossRef]
15. Abu-Faraj, Ziad O. "Understanding COVID-19 and some Effective Means for Combating it!." LinkedIn Pulse 15.
16. Shi, Yan, He Liu, Yixuan Wang, Maolin Cai, and Weiqing Xu. "Theory and application of audio-based assessment of cough." Journal of Sensors 2018 (2018). [CrossRef]
17. Carithers, Latarsha J., Kristin Ardlie, Mary Barcus, Philip A. Branton, Angela Britton, Stephen A. Buia, Carolyn C. Compton et al. "A novel approach to high-quality postmortem tissue procurement: the GTEx project." Biopreservation and biobanking 13, no. 5 (2015): 311-319. [CrossRef]
18. Rosebrock, Adrian. "Detecting COVID-19 in X-ray images with Keras, TensorFlow, and Deep Learning." URL: https://www. pyimagesearch. com/2020/03/16/detecting-covid-19-in-x-rayimages-with-keras-tensorflow-and-deep-learning (2020).
19. Santarpia, Joshua L., Danielle N. Rivera, Vicki Herrera, M. Jane Morwitzer, Hannah Creager, George W. Santarpia, Kevin K. Crown et al. "Aerosol and Surface Transmission Potential of SARS-CoV-2." medRxiv (2020).

20. Hall, Lawrence O., Rahul Paul, Dmitry B. Goldgof, and Gregory M. Goldgof. "Finding covid-19 from chest x-rays using deep learning on a small dataset." arXiv preprint arXiv:2004.02060 (2020). [CrossRef]
21. VanBerlo, Blake, and Matt Ross. "Investigation of Explainable Predictions of COVID-19 Infection from Chest X-rays with Machine Learning." Artificial Intelligence Lab (2020).
22. Birjais, R., Mourya, A. K., Chauhan, R., & Kaur, H. (2019). Prediction and diagnosis of future diabetes risk: a machine learning approach. SN Applied Sciences, 1(9), 1112. [CrossRef]
23. Kaur, H., Alam, M. A., Jameel, R., Mourya, A. K., & Chang, V. (2018). A proposed solution and future direction for blockchain-based heterogeneous medicare data in cloud environment. Journal of medical systems, 42(8), 156. [CrossRef]
24. S. Kalsi, H. Kaur, V. Chang, DNA Cryptography and Deep Learning using Genetic Algorithm with NW Algorithm for Key Generation. J. Med. Syst. 42(1): 17, 2018. [CrossRef]