Model For Covid'19 Spread Region Detection Using Deep Learning

Dr. Dinesh Mishra[1], Dr. Sumit Singh Sonkar[2]
[1]Associate Professor, Dept of IT
[2]Asstt. Prof, Dept of IT
[1, 2] Mangalyatan University,Jabalpur, Madhya Pradesh, India.

Abstract- *A hotspot is a geospatial tool that helps in detection of possible centers of emerging cases. Currently, many spatial techniques have been applied for monitoring and tracing the 2019-nCoV virus. Apart from the vaccine, the only cure for this drastic disease is to follow restrictions, rules and regulations that avoid future spread. There are different mechanisms like (Social Distancing, Mask Detection, Human occupancy etc.) through which we can able to stop the spread of the coronavirus. To implement the SOPs in public places like Railway Stations, Airports, Metropolitan Bus Stations, states have issued the instructions to the heads of the concerned authorities. But it has been found that people are not following the SOPs until some penalty has not been imposed in most cases. So the authorities have taken help from law enforcement agencies to implement the SOPs on the general public strictly. This approach is not good for any part of the world. Because we cannot place so many security persons in that public places to avoid the covid19. A new report shows that practicing social distancing and wearing masks is a significant regulation measure to slow down the spread of SARSCoV-2 since individuals with mild or no indications at all may accidentally convey crowd contamination and can spread the virus to others. The artificial intelligence industry can check the public's behavior, whether they follow the SOPs or not. Computer Vision is a major domain in artificial intelligence. Many tasks have been solved using computer vision like image classification, video classification, object detection, and image generation. Hotspot zone detection is also detected using computer vision approaches. This paper presents a review on deep learning approaches for COVID spread detection.*

Keywords- COVID, Deep learning, CNN, ML, Hot spot detection

I. INTRODUCTION

Since the coronavirus disease 2019 (COVID-19) outbreak has been started in Wuhan, China in January 2020, it quickly spread to 216 countries by 16th May 2020 leading to not only health problems but also socioeconomic issues (WHO, 2020) Sohrabi et al (2020). The most important aspect of this pandemic is the speed of transmission through people mobility and interaction. Therefore, people mobility and physical interaction have been restricted to control the pandemic, that in turn, this situation has given great impacts on social and economic activities. However, as policies to reduce mobility and interaction are different between countries, thus, these affect the effectiveness of efforts to slow down the global transmission.

In India, the first COVID-19 case was reported on January 30, 2020, in Kerala (Gupta (2020)). Thenafter, matro cities like Mumbai, Ahmedabad, Pune, Chennai, and Kolkata became the epicentres for spreads of COVID-19 in India (Hindustan Times (2020)). To anticipate the COVID-19, countrywide lockdown was imposed on March 24, 2020 in India. On the basis of risk profile of COVID-19 infection, the states, districts (sub-states) have been categorized into red, orange, and green zone (https://www.mohfw.gov.in).The districts is considered as red zone where a large number of COVID-19 outbreaks and low time interval for doubling of positive cases were identified and the districts with no COVID-19 incidence were demarcated as the green zone.

The districts which have reported at least one COVID-19 case were classified as orange zone if they are not in red zone. The spatial clustering has been performed on the basis of the neighbourhoods (residential colony and mohalla) either in the form of a large outbreak from a single location or multiple locations. Cluster containment strategy has been adopted for breaking the chain of transmission to prevent its spread from one neighbour to other neighbourhoods. In developing countries, the lockdown policy has become problematic as it reduces economic activities as well as the purchasing power of the society, thus, the government should provide social aid amid declining national income due to deceleration of economic growth. Even at the beginning of the pandemic, lockdown policy did not become an option thus many governments were late to respond to this unprecedented challenge.

Government agencies and the medical field are now looking at the artificial intelligence community to take the

necessary actions. The artificial intelligence industry can check the public's behavior, whether they follow the SOPs or not. Different applications are helpful to control the spread of covid19. These applications include the prediction of statistical analysis of Covid19 patients into some specific region, find out the origin of this disease etc. Moreover, through computer vision using machine learning, we can implement the SOPs related to the prevention of Covid19 patients. These applications are non-interactive like Face Attendance System, Automatic Mask Detection from Face, Footfall Measuring, Maintaining the Social Distance of 6ft among people, hotspot zone detection etc. Hotspot zone spot detection is defined as the particular area where the number of touches exceeds some particular threshold. In covid19, it is considered a dangerous act because there is a possibility that germs may be stayed out there and transmits through hands upon touch.

Computer vision (CV) is an interdisciplinary research field, and it mainly explores the methods to make a machine "see". Instead of using human eyes, CV technology uses cameras and computers to recognize, track and measure. It processes graphics into images that are more suitable for human eyes to observe or transmit to instruments for detection (Fang et al (2020), Huang (1996), Lecun et al (1998), Schmidhuber (2015)). With the advancement of machine learning, computers have been trained to better understand what they "see". Machine learning focuses more on the methodology issues, while CV studies the application of technologies in real-world scenarios. Machine learning methods have been widely used in the CV field, such as the statistical machine learning represented by support vector machine (SVM) and the deep learning represented by artificial neural network (ANN)(Kotsiopoulos et al (2021), LeCun et al (2015)). These two methods have played crucial roles in promoting the continuous development of CV technology in monitoring construction sites.

The original form of natural data processing process is cumbersome, which leads to the difficulties in achieving simplicity and automation. The traditional statistical machine learning method was widely used in the CV field (Fang et al (2020)).

II. RELATED WORK

Figure below represents taxonomy of computer vision:

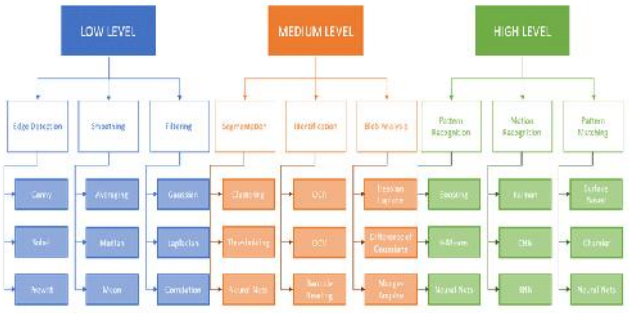

Figure 1: Taxonomy of Computer vision

Medical image segmentation is a popular technique for computer-aided diagnosis (CAD) systems. The approaches include learning-based and nonearning-based methods. Since learning-based methods, especially deep learning-based methods, have achieved state-of-the-art segmentation performance, we focused on deep learning-based methods. Several deep learning-based methods, such as U-Net++ (Zhou et al (2018)), and U-Net3+ (Huang et al (2020)), have been proposed for image segmentation. In U-Net, which is extensively utilized for biomedical image segmentation, the concept of an encoder and a decoder with a skip connection is used. The present methods (i.e., U-Net, U-Net++, and V-Net) were also used for COVID-19 segmentation (Wang et al (2021)). Fan proposed Inf-Net, a COVID-19 lung CT infection segmentation network (Maninis et al (2018)). This network uses implicit reverse attention and explicit edge attention to improve the infected regions. Though these automatic methods are useful, the segmentation accuracy is not high enough (approximately 85%) due to variations of the COVID-19 infected area (such as shape and size variations) and the similarity of COVID-19 and non-COVID-19 areas. Interactive refinements are required to improve the segmentation accuracy.

Along with conventional methods, deep learning techniques have been used for solving the problem of segmentation with interactive segmentation techniques. Deep Extreme Cut (DEXTR) (Maninis et al (2018)) is a recently developed deep learning technique using the concept of interactive image segmentation. To perform segmentation using DEXTR, the user should provide the four most extreme points of the object. The Gaussian distribution technique is employed to transform the seed points before sending them to the deep learning network. Another deep learning method is DeeplGeoS (Wang et al (2019)), which uses the concept of interactive segmentation. DeeplGeoS generates an initial

segmentation from the backbone segmentation network. Seed points from the user are utilized as refinement criteria in their network. The refinement network has architecture similar to the backbone segmentation network; however, it has three extra input channels, including two geodesic distances of foreground and background seed points and initial segmentation from the first network. The refinement is performed using seed points as the extra channel with the initial segmentation result. Via this refinement technique, low-level information of the input image will be overlooked.

To tackle the spread of disease, governments all over the world had to impose sudden lockdowns with strict restrictions and have resulted in stressing most of the enterprises on the financial fronts. As the governments all over the world are now relaxing the restrictions, businesses are re-opening gradually and employees are returning back to work. There is huge responsibility on the enterprises to stay vigilant when an employee tests positive for COVID-19. To target the issue, authors have come up with a contact tracing solution, P-Tracer application which uses users wifi association data from Arista Networks' Cloud-Vision Wifi. This paper shortly presents the P-Tracer application working principle. We claim that the application will be useful in tracing the user's association journey and detection of new hot zones and possible new cases (L. Thakare 2021) (Wang et al (2019)).

The classification of COVID-19 as global pandemic has led researchers and scientists to design solutions in order to reduce the fast spreading of the virus. This paper presents a novel detection and control system that utilizes Computer Vision based video analytics to help in reducing the speed of the spreading of the virus by recognizing people and detecting masks. The system uses the body temperature and other user biometrics to give access to a particular environment. The proposed system is able to identify a person who wants to access an environment and tracks his movement. The system can also control the door of the main entrance, the elevator, or any access zone, and generate audio notifications to alert user(s) to put their mask(s). The implementation results show that the proposed system has the advantages of a high sensitivity of 98.8% for front faces and 90.3% for turned faces, and ensure a safe environment while preserving the benefits of being modular and low cost (Gemayel et al (2021)).

The main objective of this research work is to solve multiple object tracking problems in a given frame, wherein the proposed model intends to identify and track various objects. The problem has been solved in three stages viz. detecting, identifying, and tracking the object in a particular zone, i.e., but it is observed that something more could be done in this field, mostly the MOT-A score was not up to the mark; hence the proposed research work utilized Kalman filters for obtaining enhanced results and compared the obtained MOT-A metric with previous works, and the results were good. Object detection and recognition occur via the YOLO algorithm, which enables us to classify the objects into 80 classes. Then, Motion Prediction and feature generation occur in which an estimation model is created, and Kalman filters are used to model these states for capturing moving objects in the frame. Finally, tracking takes place with Kalman filters in the previous frame, and newly detected objects are placed in the current frame, after which an association is made for new detection. All this is done via the DeepSORT algorithm, which is essentially a Deep association metric with the SORT algorithm. Here, Kalman filters are used as they improved the accuracy of the proposed model and yielded better results. On the same lines, YOLO is used to perform object detection and recognition at the same time. It is also a detector, which by applying a single neural network; it can predict the bounding boxes and perform multi-class classification. This problem can have various applications, especially in traffic management. It can also prevent people from gathering during COVID times and raising an alert for all the authorities (Kumar et al (2021)).

The extreme pandemic has changed the traveling habit as people are skeptical about traveling through the infection outbreak regions. Therefore, it has become a need to find alternative routes whenever traveling in a city kind of regions. In the current paper, we have proposed a simple yet smart system for predicting the safest route between source and destination amongst other alternative routes. The safest route is with minimum exposure to localities affected by the spread of communicable diseases like COVID-19. It is done by considering different quality measures assuming that there will be available information on the active number of infection cases from the governing authorities. However, the only information taken into account is the location of the confirmed active cases without using any other sensitive information of the patients. The proposed system will help common people while traveling in the pandemic situation. It will also be helpful for the local administration in restricting movement to and from containment zones (Akon et al (2021)).

As the population ages globally, COVID-19, faced the crisis of collapsing medical practice. It has made the world feel through the prevention of infection for medical and care staff. It is important to recognize the condition of patients and care recipients without contact as much as possible. In this research, they will collect living behavior and vital data without contact by combining sensing technology and multiple Wireless Sensor Network systems. They had proposed a

hybrid wireless sensor network platform for medical & nursing care sites that can collect the conditions related to patients & recipients in each zone (Tsuge et al (2021)).

Prinosil and Maly (2021) deals with the evaluation of several methods for face detection when the face is covered by a mask. The methods evaluated are Haar cascade and Histogram of Oriented Gradients as feature-based approaches, Multitask Cascade Convolutional Neural Network, Max Margin Object Detection and TinyFace as convolutional neural network based approaches.

Srinivasan et al (2021) proposes a comprehensive and effective solution to perform person detection, social distancing violation detection, face detection and face mask classification using object detection, clustering and Convolution Neural Network (CNN) based binary classifier. For this, YOLOv3, Density-based spatial clustering of applications with noise (DBSCAN), Dual Shot Face Detector (DSFD) and MobileNetV2 based binary classifier have been employed on surveillance video datasets. They also provides a comparative study of different face detection and face mask classification models.

Nowadays, the situation of the Covid-19 virus still intensifying throughout the world. The number of populations of each country is severely infected and deaths. One solution to prevent is to wearing a masked face. Many businesses and organization need to adapt and protect an infected person by detecting whoever does not wear masked face; however, the number of users or customers are more than staffs result in difficult checking. Vijitkunsawat et al (2020) studies the performance of the three algorithms: KNN, SVM and MobileNet to find the best algorithm which is suitable for checking who wearing masked face in a real-time situation. The results show that MobileNet is the best accuracy both from input images and input video from a camera (real-time).

III. RESULT

Comparative analysis of work under study is as follows:

Author	Approach Used	Methods/Findings
Khan et al (2021)	YOLO-v3, Faster RCNN, SSD	The proposed algorithm detects the persons and extracts the region of interest points on which the user draws the rectangle.
Hussain et al (2021)	CNN	The project is developed as a prototype to monitor temperature measurement and to detect mask for the people.
Loey et al (2021)	Hybrid of SVM, DT & Ensemble	The study utilized three datasets from the Real-World Masked Face Dataset (RMFD), the Simulated Masked Face Dataset (SMFD), and the Labeled Faces in the Wild.
Singh et al (2021)	RCNN, YOLO	They implemented popular models, namely, Faster RCNN and YOLO v3. F-RCNN has better precision.
Meivel et al. (2020)	Faster R-CNN	Detecting Mask detection and Social distance, Multiple picture detection
Srithar et al. (2020)	RCNN	Social distance using ultrasonic sensor and mask detection using face features
Chen et al (2020)	PCA	This transfer learning approach combines the skip-connected structure for better accuracy of the masked face that shows classification in the absence of masked face in the given dataset.
Jagadeeswari et al (2020)	MobileNet V2, ResNet 50, VGG 16, ADAM, SGD	MobileNet V2 classifier has the best result with high accuracy.
Jiang et al. (2020)	ResNet and mobile Net	Here introduces a Retinal Face Mask Detector. It is a One-stage object detector. The dataset contained 7959 images.
Sabbir Ejaz et al. (2019)	PCA & Eigen Vector Calculation	Analyzed a person with masked and without masked face with accuracy.

IV. CONCLUSION

After carefully reading the past several papers, found the following research gaps :

- The main challenges are illumination & background changes that occurs with Template Matching algorithms.
- Occlusion & scale changes are other limitations found.
- Objectiveness loss occurs with yolo due to logistic regression.
- Requirement for more efficient and accurate method.

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