

Navigating Alert for Visually Impaired Using Computer Vision Aided System

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Abstract—Covid-19 pervaded the entire world very soon after the outbreak, and it is still present and people are still suffering. In a medically advanced world, where technology is futuristic, but the fact that the virus has still caused deaths of over 3 million people all over the world reportedly and over 180 million affected cases. While the governments of all countries have been trying their best to keep the situation in control, and as the virus continues to evolve and keeps evolving, various countries have been engaged in manufacturing vaccines and have even successfully produced them. The only thing left for us to do, is to, at the least, not catch the virus from other people who are already infected. And the way to do that is to practice social distancing. While it is not something normal people can't do, yet in actuality some don't do, for them it becomes more difficult to maintain such social distance when they are outside, on the streets because not everyone is going to practice social distancing, and it is not doable for them to know if someone is standing at a very close distance. The proposed mobile application is going to target this issue and help the visually impaired to maintain social distancing to keep themselves safe in this pandemic. This application will help resolve the issue for visually impaired people by detecting a person on behalf of them, so that they can become alert and do what is required. The main objective of proposed application is to help the visually impaired to maintain social distance without having to rely on other people for help or asking someone to accompany them wherever they go using OpenCV, Yolo v4 for human detection.

Keywords— COVID-19 Pandemic, Visually Impaired, Human Detection, Mobile Application, OpenCV

I. INTRODUCTION

On March 11, 2020, COVID-19 was declared as a pandemic which is the second pandemic of the 21st century after the H1N1 virus which struck the world back in 2009. Covid-19 has become a nightmare for everyone, and we can't seem to recover from it mentally as the entire world is in a state of trance frozen as the cases accrue drastically with every

passing day. One of the biggest norms to follow right now is to practice social distancing. This is a pre-disaster measure by deterring ourselves from catching the virus.

Social distancing has become highly inevitable in a situation like this, because only by abiding by it, can we prevent ourselves from getting affected. Social distancing simply refers to avoiding any contact with other people to fend off the virus and also to ward off people near us like our family members or others. According to WHO, we must maintain a distance of at least 6 feet from anyone coughing or sneezing or even if they don't show any symptoms. This prevents the spread of the virus and helps people to stay safe.

Now that the virus has also become airborne, it has become quite dangerous to even take a stroll outside. But since that is not doable as we need to step out of our houses to buy groceries and other items from time to time, we have to go to marketplaces and such. Essentially, since each one of us has to go out to get our jobs done, the movement of people increases and asymptomatic people might be present in the crowd and likely pass on the virus without them knowing it. This risk of community spread is feared by many people, so social distancing is the only way to reduce that risk.

Having said that, for normal people all they would have to do, is distance themselves if they see someone in proximity. Many elderly people are by themselves and are left behind and are not taken care of. They would have to do their work by themselves and so many people are like that. Imagine having no one by your side and being visually affected. Mobility is one of the basic needs of people, the visually impaired find it very difficult to move out independently in society. Few people also faces many other challenges too as in [1]. The challenges endured by them can be resolved by using technologies and advanced devices in real-time to help them to face their difficulties to some extent as in [2]. The proposed system targets those people as it helps them to maintain social distancing without having to rely on others to accompany them, as to accompany itself denies obeying

the rule of social distancing. So this surges them independent. When they are on their own, out there shopping, the proposed application will detect the presence of any person in the vicinity and alert them in advance and guide them with the direction they have to move so that they can isolate or navigate even if the other person doesn't. This way they can shop without bumping into others and stay away from the virus spreading through the air, which helps them to care less about catching the virus. They can continue to benefit from the proposed application even after the pandemic is over to navigate outdoors.

II. LITERATURE SURVEY

Visual impairment is one of the biggest problems for mankind. For all the day-to-day activities they need some help. With the increase in popularity of mobile technology, users can access location and get information from anywhere virtually. Few apps as in [3] which support visually impaired people to do their work on their own and function independently are shown in Table 1.

TABLE I
LIST OF EXISTING APPS FOR VISUALLY IMPAIRED

S.No.	App Name	domain	Features
1	NavCog[3]	Navigation	NavCog is a app that gives the path in which the user has to turn step by step and help to navigate around the world not unlike GPS. It gives safety guide to the user using Bluetooth signals, both in indoors as well as outdoors.
2	EyeNote[3]	Text Recognition	The application tells the value of the currency or coin using text recognition. The user using the app gets the information about the value of the money through a voice, vibrations or tone.
3	TapTapSee[3]	Object recognition	TapTapSee is application that helps the blind or visually impaired to determine the object them without any real person around them. The picture is first captured and the user gets a voice message followed by that, correctly naming the item.
4	Voice Dream Reader[3]	Text Recognition	Voice Dream Reader is a application that converts the text from websites, local files of disk, pdf, or anything that contains text to voice. The app provides various customizable text and reading options, for various font sizes and colours. The voice message received can also be changed to different frequency and pitches
5	A Blind legend[3]	Gaming	It is the first developed audio only based mobile game, based on the 3D sound the player who is a blind Knight along with her daughter Lousie has to reach the Castle Kingdom to safe his wife Players navigate and interact with the game using the touchscreen.

A piece of good knowledge about the existing tools and software as described in the book, Assistive Technology for Vision-impaired and Blind People as in [4]. The paper as in [5] describes a device to cope up with social life. The wordings from banners, posters, newspapers etc. As in [6] they have described the use of ears as their eyes, by using a new white crane device. Vision for the blind was given through vibrations as in [7] through machine learning algorithms to interpret various objects. An alert message via speech is sent to the user making him/her to know the nature of potential encountered and the presence of obstacles employing a Bluetooth module. As in [8] they have used GPS and predicted the routes and bus/train schedules. They are unable to see the poster or boards in the bus or the live information running in the railway station. In few applications as in [9], they have used object detection and depth mapping along with Tensorflow lite to calculate the distance between the user and objects.

All the existing systems detect the objects that are around them and inform the user that an obstacle is near them. But the proposed application detects the person who is close to the user. The next session describes the methodology and idea of application in detail.

III PROPOSED SYSTEM

As mentioned in the previous sections the detection of objects was done with various technologies, but detection of humans who are closer is not done separately. Thus the proposed application is developed in such a way that it detects the person who is nearby. Initially, the code was developed with python using Yolo v4 as in website [10] and as in paper [11]. It used Yolo v4, hence the objects can be recognized faster with more precision. The object thus detected is more precise. And for developing the app we used TensorFlow lite as in [12] and [13] to deploy the code to develop as an application. Tensorflow lite is a tool that allows developers to enable on-device machine learning by helping them to run their models on mobile. It is used to deploy real-time live video feed which is received as an input via the application and get the required results via the application with the help of tensorflow lite interrupter API. Firstly tensorflow lite Model was created and then using Android studio by importing tensorflow lite model. Tensorflow lite task library and tensorflow support library as in [9] are used together to develop the application.

A. Idea

Visually impaired need someone to guide them to maintain social distancing. But someone accompanying them will also cause some problems as they may not maintain social distancing. This was the birth of the idea to develop an application to help them to move outdoors safely and independently. The main feature of the application is to detect the person near the user. The application guides the user via the voice message saying the directions so that the user can move safely. An alert message is given through a voice message when the camera is not turn on or the camera is turned off by mistake.

B. Methodology

Once the app is opened the camera is automatically turned on, just as the normal camera of the phone. Now the feed that is captured live is taken as the input. This feed is further processed with Yolo v4 along with OpenCV to get the optimum results. Initially, the frame is divided into three sections as mentioned in Fig. 1, to detect the person in the left, right, centre, and who is closer to the user. The optimal size of the rectangular box was determined after series of trials. The main importance of the box is to determine the direction in which the user has to navigate. This is done by detecting the person in the rectangular sections. As mentioned earlier Yolo v4 is used to identify the person. If the person is detected in any one of the rectangular sections the user is given a voice message in the direction he has to navigate. The direction in which the user has to navigate is determined with a simple algorithm as shown in Fig. 5. The situation is analyzed with four scenarios, when the person is in the left section, when the person is in the right section, when the person is in the centre section. The scenarios are discussed in detail in further sub-sections

1) Person identified in the left section of the frame:

As in this case the person is identified in the left section as shown in Fig. 2, the user is given information through voice to move towards the right.

2) Person identified in the right section of the frame:

As in this case the person is identified in the right section as shown in Fig. 3, the user is given information through voice to move towards the left.

3) Person identified in the middle section of the frame:

As in this case the person is identified in the middle/ centre section as shown in Fig. 4, the user is given information through voice to STOP.

4) Person identified in more than one section of the frame:

If the person is identified in two sections of the frame either in left and middle or right and middle, the user is given information through voice to move straight. If people is identified in all the three sections of the frame then the user is given information through voice to STOP



Fig. 1. Three sections of the frame

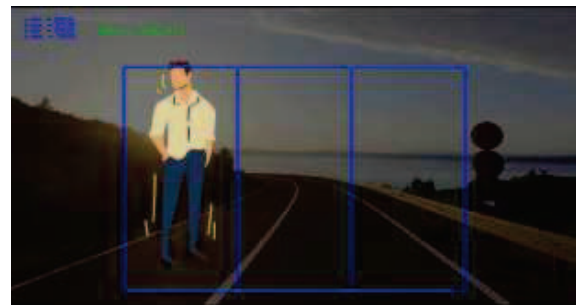


Fig. 2. Person identified in the left section of the frame

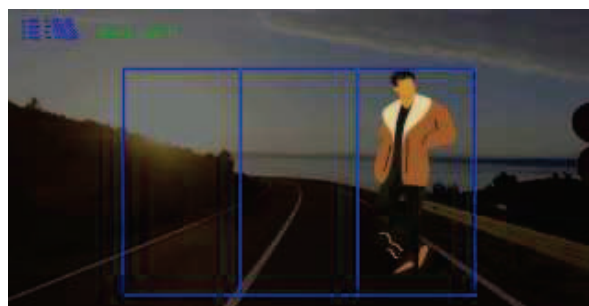


Fig. 3. Person identified in the right section of the frame



Fig. 4. Person identified in the middle section of the frame

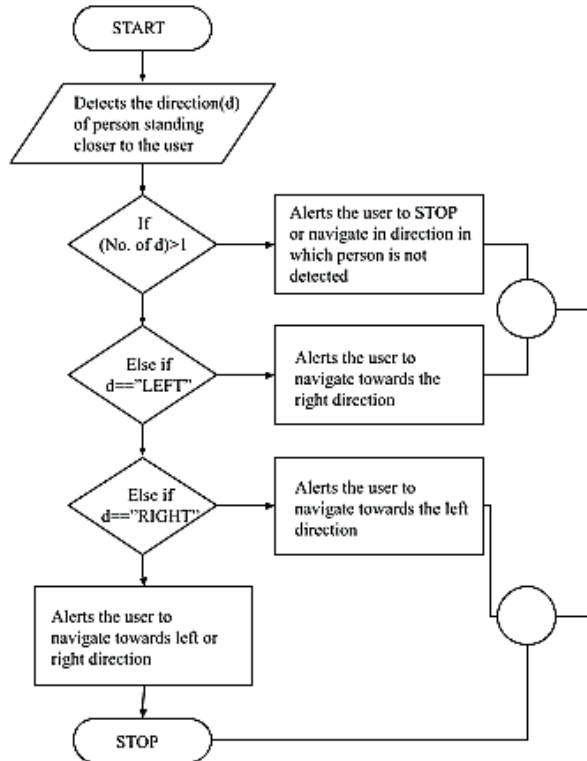


Fig 5. Flowchart of proposed system

IV IMPLEMENTATION

The implementation of the application was done with Jupyter Notebook as shown in Fig. 6. Firstly the modules like cv2, NumPy, time, and TensorFlow. As mentioned in previous sections Yolo v4 was used for human detection. Out of all the available classes in Yolo V4 data set as shown in Fig. 7, the person class is separated to identify the person. A person who is standing closer to the user is found using the bounding box. The dimensions (20 x 75) of the bounding box were fixed after several trials. This detects the person who is at a distance of fewer than 6 feet to the user, and alerts the user with a voice command, and guides the correct direction.

```

ret, frame = video.read()
stime = time.time()
objects = []
class_str = ""
frame_width = frame.shape[0]
frame_height = frame.shape[1]
rows, cols = frame.shape[:2]
left_boundary = [int(cols * 0.40), int(rows * 0.95)]
left_boundary_top = [int(cols * 0.40), int(rows * 0.20)]
right_boundary = [int(cols * 0.60), int(rows * 0.95)]
right_boundary_top = [int(cols * 0.60), int(rows * 0.20)]
bottom_left = [int(cols * 0.20), int(rows * 0.95)]
top_left = [int(cols * 0.20), int(rows * 0.20)]
bottom_right = [int(cols * 0.80), int(rows * 0.95)]
top_right = [int(cols * 0.80), int(rows * 0.20)]
vertices = np.array([(bottom_left, top_left, top_right, bottom_right)], dtype=np.int32)
cv2.line(frame, tuple(bottom_left), tuple(bottom_right), (255, 0, 0), 5)
cv2.line(frame, tuple(bottom_right), tuple(top_right), (255, 0, 0), 5)
cv2.line(frame, tuple(top_left), tuple(bottom_left), (255, 0, 0), 5)
cv2.line(frame, tuple(top_left), tuple(top_right), (255, 0, 0), 5)
copied = np.copy(frame)
interested = region_of_interest(copied, vertices)
frame_expanded = np.expand_dims(interested, axis=0)

(boxes, scores, classes, num) = sess.run(
    [detection_boxes, detection_scores, detection_classes, num_detections],
    feed_dict={image_tensor: frame_expanded})

```

Fig. 6. Program in Jupyter Notebook

```

# YOLOv5 by Ultralytics, GPL-3.0 license
# coco 2017 dataset http://cocodataset.org by Microsoft
# Example usage: python train.py --data coco.yaml
# parent
# |
# |__ yolo
# |   |__ datasets
# |   |   |__ coco = downloads here
# |   |
# |   |__ train/val/test sets as 1) dir: path/to/imgs, 2) file: path/to/imgs.txt, or 3) list: [path/to/imgs1, path/to/imgs2, ...]
# |   |__ path: ../datasets/coco # dataset root dir
# |   |__ train: train.txt # train images (relative to 'path') 12847 images
# |   |__ val: val.txt # val images (relative to 'path') 5000 images
# |   |__ test: test-dev2017.txt # 20208 of 20288 of source images, submit to https://competitions.codalab.org/competitions/20704
# |   |
# |   |__ classes
# |   |__ nc: 80 # number of classes
# |   |__ names: ['person', 'bicycle', 'car', 'motorcycle', 'airplane', 'bus', 'train', 'truck', 'boat', 'traffic light',
# |   |         'fire hydrant', 'stop sign', 'parking meter', 'bench', 'bird', 'cat', 'dog', 'horse', 'sheep', 'cow',
# |   |         'elephant', 'bear', 'zebra', 'giraffe', 'backpack', 'umbrella', 'handbag', 'tie', 'suitcase', 'frisbee',
# |   |         'skis', 'snowboard', 'sports ball', 'kite', 'baseball bat', 'baseball glove', 'skateboard', 'surfboard',
# |   |         'tennis racket', 'bottle', 'wine glass', 'cup', 'fork', 'knife', 'spoon', 'bowl', 'banana', 'apple',
# |   |         'candy', 'orange', 'broccoli', 'carrot', 'hot dog', 'pizza', 'donut', 'cake', 'chair', 'couch',
# |   |         'potted plant', 'bed', 'dining table', 'toilet', 'tv', 'laptop', 'mouse', 'remote', 'keyboard', 'cell phone',
# |   |         'microwave', 'oven', 'toaster', 'sink', 'refrigerator', 'book', 'clock', 'vase', 'scissors', 'teddy bear',
# |   |         'hair drier', 'toothbrush'] # class names
# |   |
# |   |__ Download script/URL (optional)

```

Fig. 7. Dataset of YOLO V4 showing various classes.

V CONCLUSION

Proposed application for the visually impaired focuses on the vulnerable section of the population thus helping them curtail bumping into others and become the carrier for the infectious virus, also as many people won't even show the symptoms. Being rapidly spreading it has to be prevented as soon as possible. As it is well-known that "Prevention is better than cure", Social distancing is the only key to prevent the massive spread of the virus, and it is only fair if all people can do it and safeguard themselves.

Since the visually impaired can't do social distancing on their own it puts them in a disadvantageous situation. It's not only them, the people around them may also become the carrier of the virus. Unknowingly it may also lead to the vigorous spread of the virus and harm many. The visually impaired already have their fair share of problems and we as engineers should only work to put them at ease and help the vulnerable, giving them a sense of security to be treated fairly and equally just as the others. Let's fight so that their weakness does not consume them. So this solution will help them overcome their struggles of maintaining social distancing and help them feel secure and less paranoid in this society when they move out more peacefully and independently.

As mentioned the application works only when the camera is kept on. The camera has to be kept on always when the user is going outdoors. This may lead to a faster battery drain. Hence the user is always requested to keep a power backup so that the user can charge the phone whenever required. Also as future work, it can be extended to hardware-related solutions with solar power systems and raspberry pi. Thus a mobile application for helping the visually impaired to move out safely during this pandemic was made with openCV and tensorflow lite along with Yolo v4.

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