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LIDAR BASED GUIDING DEVICE FOR VISUALLY IMPAIRED PEOPLE

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Abstract— **The issue of visual impairment or blindness is faced worldwide. According to statistics of the World Health Organization (WHO), globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion are blind. In terms of regional differences, the prevalence of vision impairment in low- and middle-income regions is four times higher than in high-income regions. Blind people generally have to rely on white canes, guide dogs, screen-reading software, magnifiers, and glasses to assist them for mobility, however to help the blind people the visual world has to be transformed into the audio world with the potential to inform them about objects, direction information using lidar as well as their spatial locations with GPS. Therefore, we propose to aid the visually impaired by introducing a system that is most feasible, compact, and cost effective. So, we implied a system that makes use of Raspberry Pi in which you only look once (YOLO v3) machine learning algorithm trained on the coco database is applied.**

***Index Terms*— Guiding device, LIDAR, raspberry pi, GPS module, Pi camera, smart mobile application, push buttons.**

I. INTRODUCTION

"ONLY BECAUSE ONE LACKS THE USE OF THEIR EYES DOES NOT MEAN THAT ONE LACKS VISION." Eyesight is one of the essential human senses, and it plays a significant role in human perception about the surrounding environment. For visually impaired people to be able to provide, experience their vision, imagination mobility is necessary. The International Classification of Diseases 11 (2018) classifies vision impairment into two groups, distance and near presenting vision impairment. Globally, the leading causes of vision impairment are uncorrected refractive errors, cataract, age-related macular degeneration, glaucoma, diabetic retinopathy, corneal opacity, trachoma, and eye injuries. It limits visually impaired ability to navigate, perform everyday tasks, and affect their quality of life and ability to interact with the surrounding world upon unaided. With the advancement in technologies, diverse solutions have been introduced such, as the Eye- ring project, the text recognition system, the hand gesture, and face recognition system, etc. However, these solutions have disadvantages such as heavyweight, expensive, less robustness, low acceptance, etc. Hence, advanced techniques must evolve to help them. So, we propose a system built on the breakthrough of image processing and machine learning.

The proposed system captures real-time images, then images are pre-processed, their background and foreground are separated and then the DNN module with a pre-trained YOLO model is applied resulting in feature extraction. The extracted features are matched with known object features to identify the objects. Once the object is successfully recognized, the object name is stated as voice output with the help of text-to-speech conversion

The key contributions of the paper include:
- Robust and efficient object detection and recognition for visually impaired people to independently access familiar and unfamiliar environments and avoid dangers.
- Offline text-to-speech conversion and speech output.

People who are visually impaired face two major obstacles to leading fully independent lives: the ability to consume mass media and the ability to safely navigate unfamiliar environments. Electronic reading materials and various other text to speech technologies have significantly improved the ability of visually impaired people to consume the majority of mass media. Engineers, however, have largely failed to develop user-friendly and effective technologies for assisting in navigation. The team sought to develop a LIDAR-based navigation system with auditory feedback that would allow the blind to navigate in unfamiliar environments and perform basic obstacle avoidance. The system need be cost-effective compared to that of a guide dog and practically effective compared to that of a cane or previously developed technological solutions.
GPS system provides the information regarding to his current location. The system has one more advanced feature integrated to help the blind find their stick if they forget where they kept it.

BLOCK DIAGRAM

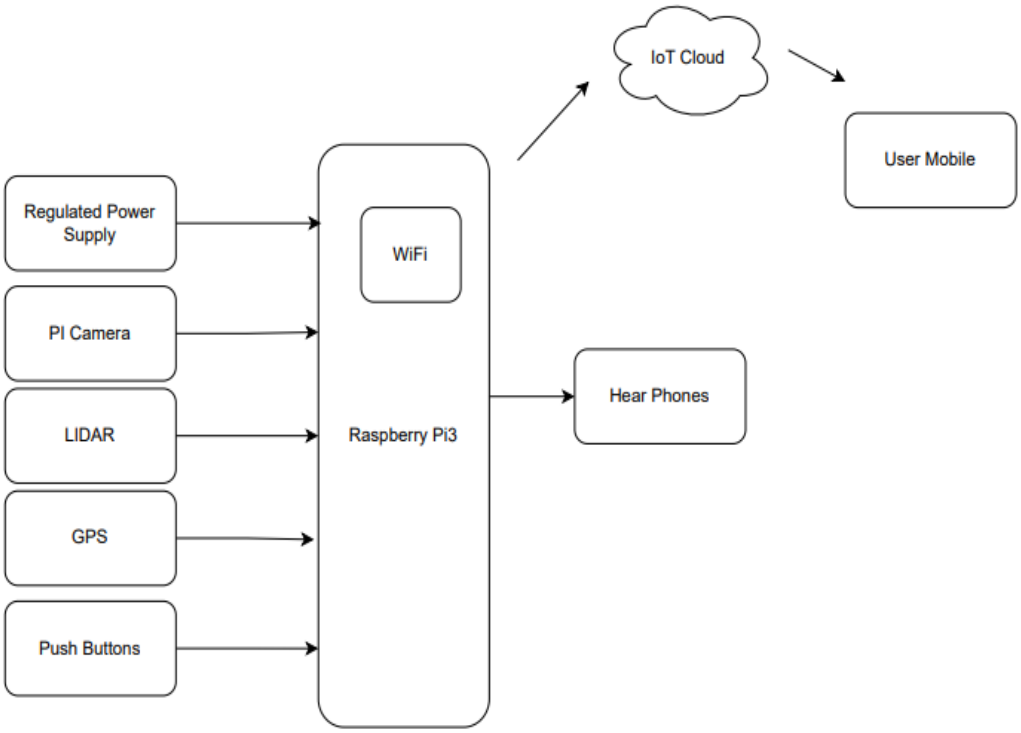

Fig:Block diagram of LIDAR based guiding device using Raspberry pi.

II. MOTIVATION

Many types of research have been done in the past and now about to overcome the problems facing by the visually impaired people through different sensors and software applications. As the LIDAR provides accurate measurements of distances which rotates in all directions, Hence it makes easy for blind people to detect the obstacles presented around him. By using the web application Things view it helps to recognise the user location by his/her parents or caretakers when he is in any problem. This guiding device makes more interesting using for more applications.

III. METHODOLOGY

The project is provided for the safe navigation of the blind people. It consists of three push buttons one is used for the purpose of capturing images , other for sending location through web application and the third one is for user current Location. The camera is to identify the objects, LIDAR uses to detect the distance between the user and obstacles.

Step 1: Pressing of first button the camera captures the image and it tells the object name as audio output through the speakers or headphones.

Step 2: By giving long press to the first button it reads the information which is present on the object throught capturing of images.

Step 3: Pressing of second button GPS gets activate and tells the present location of the user..

Step 4: Pressing of third button using Things view web application the information of the blind person is given to his parents or caretakers.

IV. HARDWARE SETUP

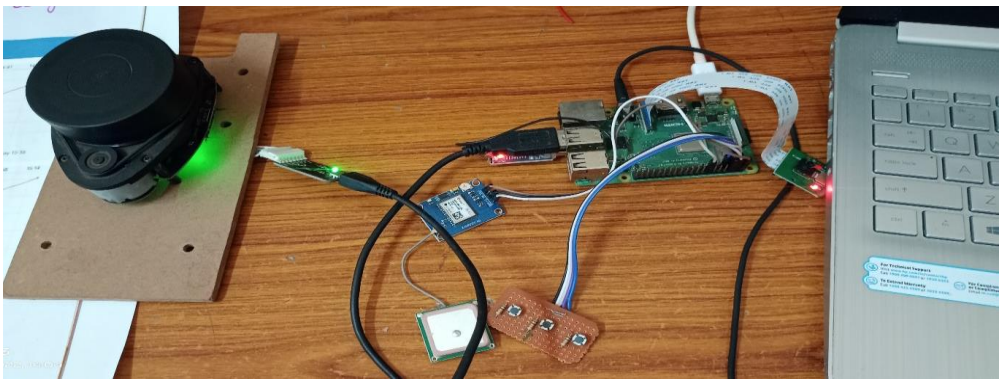

Fig: Hardware Imlpementation of raspberry pi with LIDAR and GPS module

V. SIMULATION

Booting the Raspberry Pi for the first time

- insert SD card in to raspberry pi b+ board
- On first boot you will come to the Raspi-config window
- Change settings such as timezone and locale if you want
- Finally, select the second choice: expand_rootfs and say 'yes' to a reboot
- The Raspberry Pi will reboot and you will see raspberrypi login:
- Type: pi
- You will be asked for your Password
- Type: raspberry
- You will then see the prompt: pi@raspberry ~ $
- Start the desktop by typing: startx
- You will find yourself in a familiar-but-different desktop environment.
- Experiment to start a new python project.

Fig: Interfacing of raspberry pi and LIDAR codes in VNC viewer

VI. RESULTS

Proposed guiding device is designed using Python software tool, LIDAR sensor, GPS module, raspberry Pi3b+ and many results has been extracted for the safe and independent navigation of an impaired person . The below shown figures are the results that has been extracted for the implemented design.

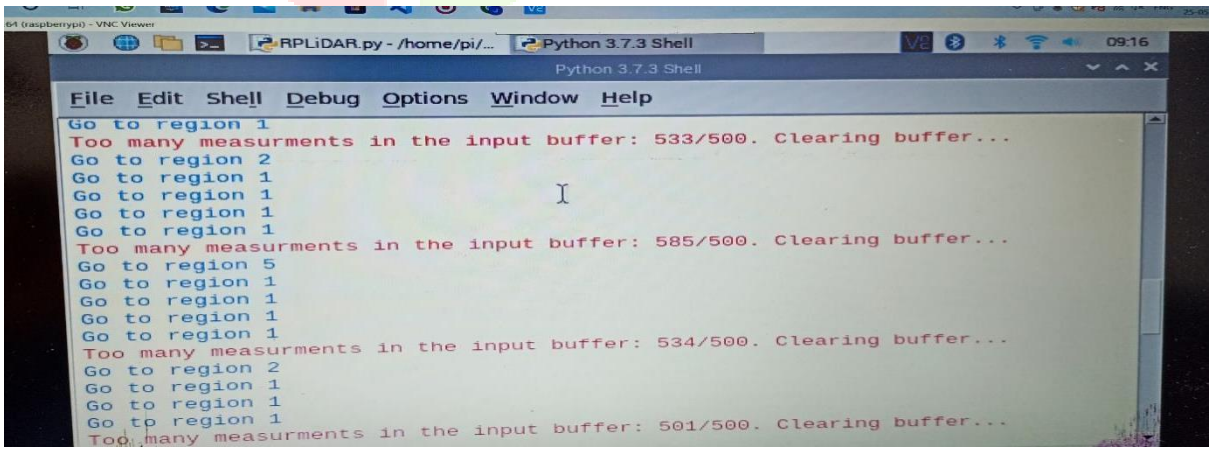

Fig: Indicating directions of free path using LIDAR

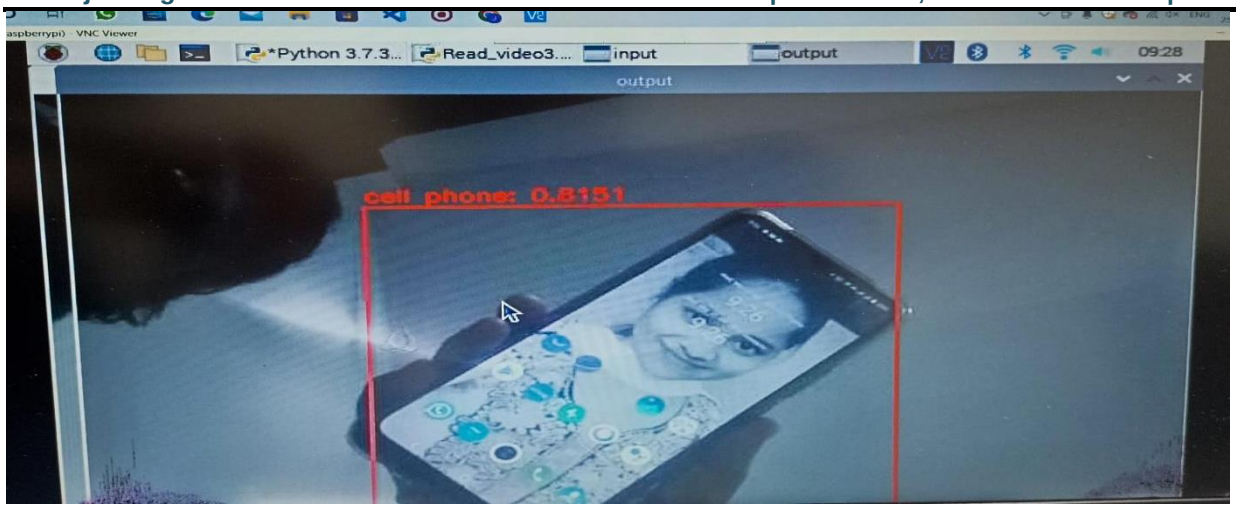

Fig: Image captured and identified as a cell phone and its accuracy

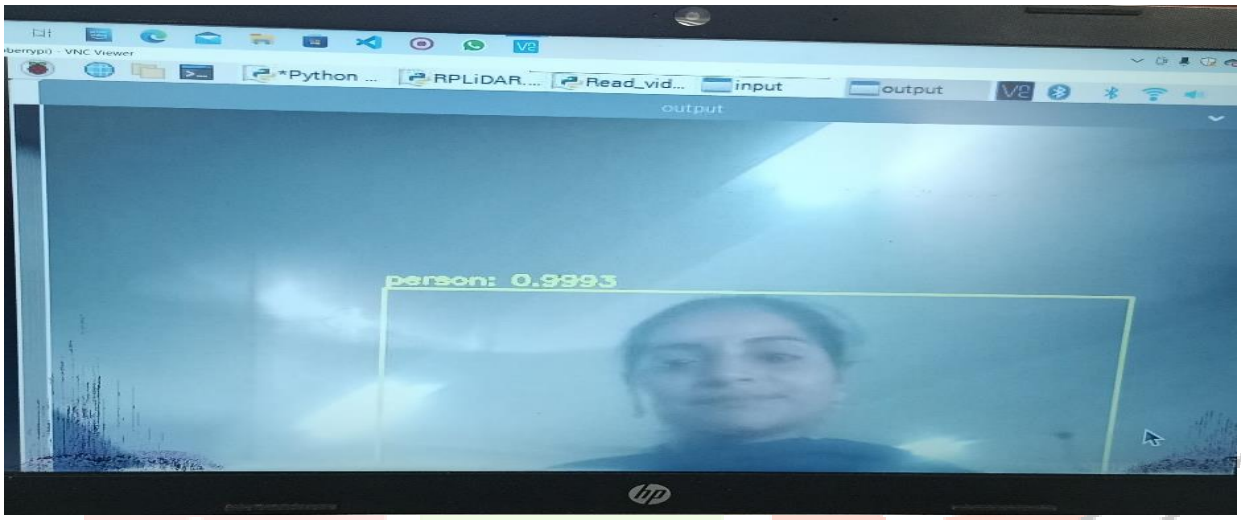

Fig: Image captured and identified as a person and its accuracy

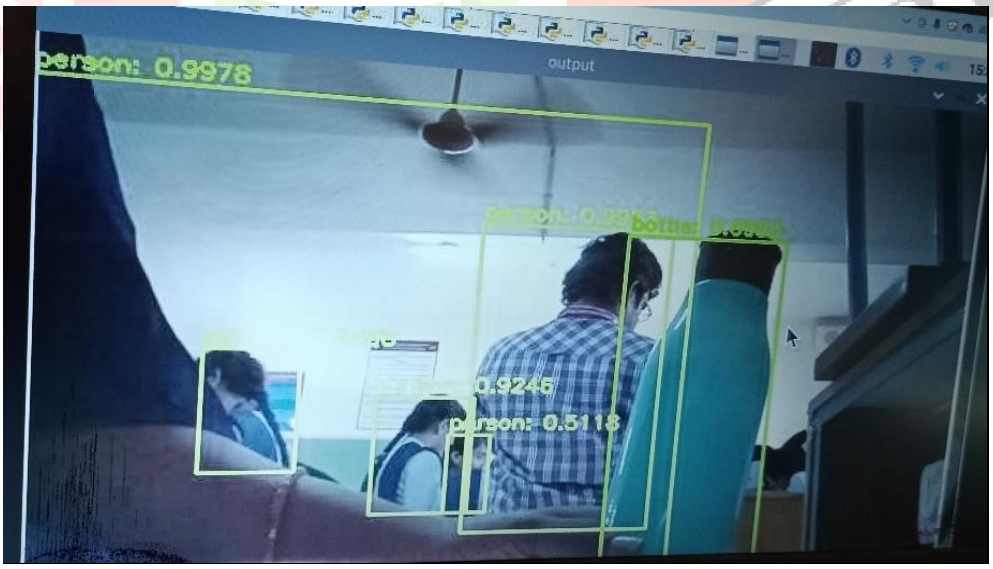

Fig: The image captured and identified the each object in the image and their accuracy

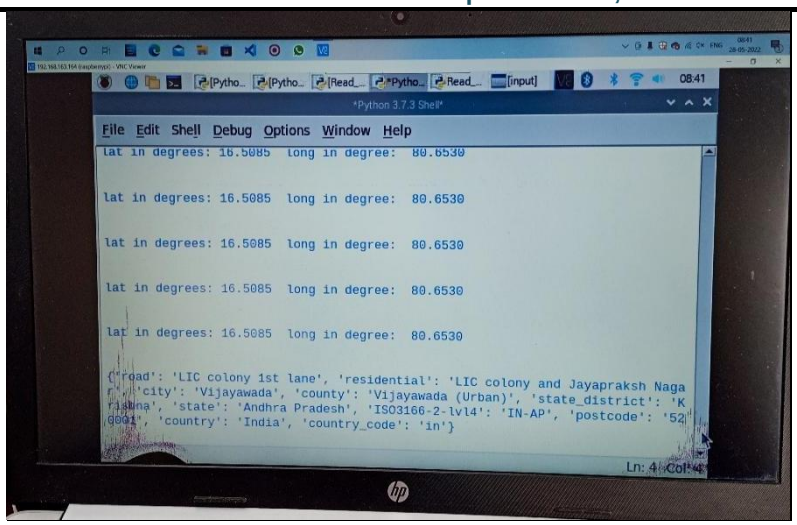

Fig: User Location given as voice output through headphones

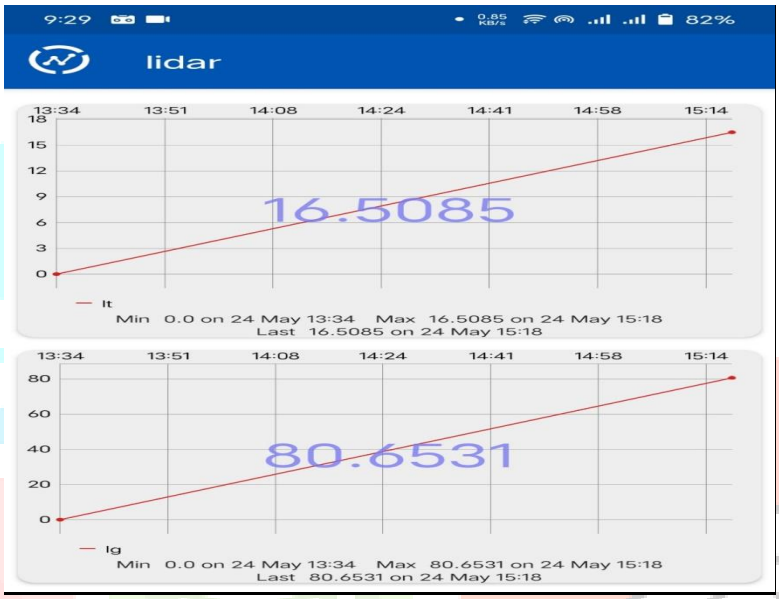

Fig: Latitude and Longitude values of user location sent to his guardian's mobile through web application

VII. CONCLUSION AND FUTURESCOPE

This work represents an implementation of guiding device which helps the blind or visually impaired in recognizing the objects in their environment, many devices have been developed in the recent years for the safe navigation of the visually impaired people, but they are not much sufficient. This guiding device helps to move independently from one place to another place by giving voice input to the impaired person. And also provides the object identification to know the name of the object. Our proposed project uses 2D LIDAR sensor to detect the obstacles in the path by emitting eye safe laser pulses. Our advanced system uses Pi camera to capture the images in front of the user. The YOLOv3 machine learning algorithm is used here for the feature extraction of the objects. The YOLO framework trades with object identification by choosing the entire image in a single instance, and divides the image into grids, and predicts the bounding box coordinates and class probabilities for those boxes and provides audio output. This work also provides the current location using GPS module, directions without obstacles and also reading of text in the form of voice.

This work can be extended in future with minimum delay to recognize the objects by using Raspberry Pi 4 model and can be designed to detect the wet floors using sensors.

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