Simultaneous Localization and Mapping Portable Assistive Device for Visually Impaired People

Abhinay Saini
Vardhaman College of Engineering, Hyderabad, India.
saiabhi1425@gmail.com
Harshini E
Vardhaman College of Engineering Hyderabad, India.
harshuharshini297@gmail.com
J. Krishna Chaithanya
Vardhaman College of Engineering Hyderabad, India.
j.krishnachaitanya@vardhaman.org
Revanth Kaparthi
Vardhaman College of Engineering Hyderabad, India.
revanth333kaparthi@gmail.com

***Abstract*—**The study of assistive technologies for the blind is an interesting field. Although a number of navigation systems have been presented, they cannot provide exact information about the obstacles or help the vision impaired traverse their environment. Through audio broadcast, this information is accessible to those who are visually impaired in real time. The results will show that the system can function on a wearable navigation device in real-time with sufficient precision. This device can recognise both traffic signs and traffic signals. Navigation and positioning are handled by the GPS module. The blind wear a variety of supplemental devices that send navigational data through earbuds.

Keywords— GPS module, Navigation.

I. INTRODUCTION

A significant portion of the population, believed to number in the tens of millions globally, are those who are visually impaired. An essential and ongoing goal is to integrate them into society. A health care system has been ensured through significant effort. The advancement of various guidance system techniques has helped the vision impaired live more normal lives. These systems frequently only have particular functions in mind.

However, these solutions can significantly improve these individuals' mobility and safety. The development of cutting-edge navigation to aid blind people depends on modern ways to computer vision and image processing and also the speed effectiveness of the devices and microprocessors. Recently, wearable blindness-assistive technology has gained popularity and has even been made available for purchase.

These discreet wearable assistive devices for the blind are highly accurate at recognising faces, text, traffic signs, and currency. For the blind these are a significant subset of wearable blindness-assistive

technology that continue to rely on established technologies like GPS positioning, ultrasonic obstacle avoidance.

The system is designed to help the blind person and impaired persons by combining the camera module for image processing and the microcontroller. The suggested module can also be utilized independently off the system that can be used outside. The proposed portable assistive navigation system is designed and developed for the visually impaired so they are experimentally validated iteratively.

The module corresponds to the concept of developing a highly effective technology that can be made easily and economically. The module can be updated and also enables the addition of features that can be supported through software updates. The entire person's activity in an indoor or outdoor area is covered by a looped process of image acquisition, image analysis, and audio alerting.

Nonetheless, blind people have a lot of trouble navigating, especially when utilizing public transportation to go great distances and when strolling down the street. Reading street signs and traffic lights can be exceedingly difficult, if not impossible, for someone who is visually challenged.

The total time that the image can be acquired for the input image frames is calculated by adjusting the processing times and adding them together, which makes the total processing time for that session. The session must go quickly and it should be enough such that there can be some time to avoid any potential roadblocks.

II. DESIGN

Proposed system consists of Raspberry Pi, Ultrasonic sensors, GPS module, Camera, buzzer. We made sure to develop an image processing module for the raspberry pi platform, which is suitable for quick and accurate processing of the data in required time and which also consumes less energy. The design of the system is required to test with the visually impaired in real-world circumstances and adjust its parameters in order to evaluate performance.

While processing the image, different techniques are used to perform a specific object detection task, specifically the recognition of traffic signs. For the Python version, we used the built-in OpenCV method cv2.matchTemplate that is present in the library. These covert wearing blind assistive devices are very good at reading faces, text, traffic signs, and money.

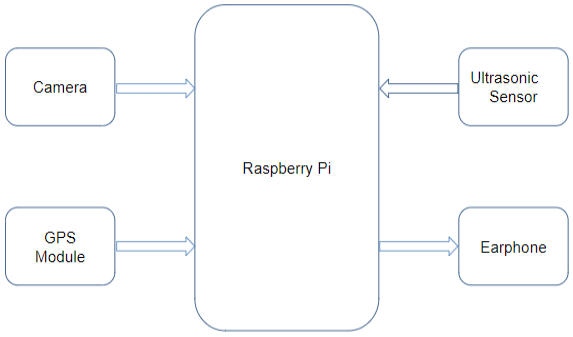

Fig. 1. Block Diagram

The block diagram shows that the data is gathered from 3 sources and they are ultrasonic sensors, camera module, GPS module. This data is processed using the machine learning algorithms and they are

populated with the pre trained data algorithms. This way the system will be able to predict the situation the user is in and also the necessary alerts that need to be given to user to safely navigate the person.

The output to the user is either given through the earphones or using the speakers depending on the choice of the user. This helps as the only way we can give information is with earpiece.

We took care to create an image processing module for the Raspberry Pi platform that is ideal for timely and accurate data processing while using less energy. In order to evaluate performance, the system's design must be tested with visually impaired people under realistic conditions and have its settings adjusted.

The device can classify an object and also the threat it poses. From there, it will provide the user directions based on the risk the object poses and safely guide them to a safe place by scanning the surroundings using a camera module. Depending on the user's preference, the output is either delivered through speakers or earphones.

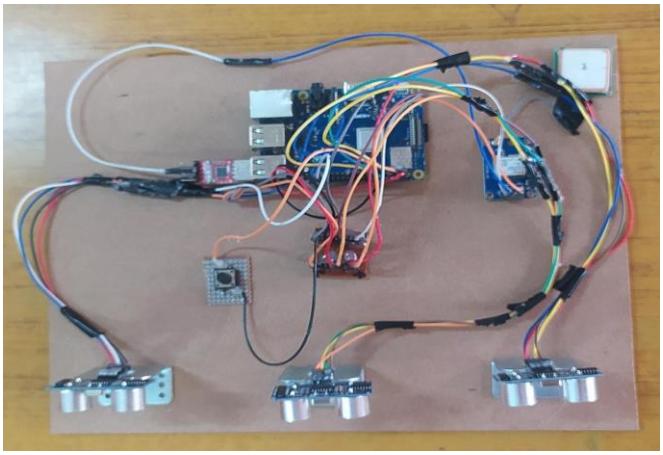

Fig. 2. System Prototype

A. Raspberry Pi

The Raspberry Pi is a small, inexpensive computer. We used raspberry pi in our design as it can be used to process the data the camera module gathered and give the outcome. The raspberry pi can handle these tasks without any difficulty and the response time is too quick where it is handy for these applications.

We are using Raspberry Pi to process the information gathered from the sensors and also to efficiently use the power so the system can utilize less energy.

Fig. 3. Raspberry Pi

B. UltraSonic Sensor

Fig. 4. UltraSonic Sensor

Ultrasonic sensors can identify targets in motion and determine their distance from the sensor. To detect the movement of objects, sensors can produce a digital output that is either on or off. So whenever the object comes in front of the sensors the system using the camera module will detect the object.

To navigate these challenges, a person with vision impairment can use a walking cane, a guiding dog, and a sighted guide. These alternatives, which are often referred to as assistive devices. The system will also be able to categorize the risk level to the user from that object depending upon the object detected. In this way, the system will be able to safely navigate the user.

C. GPS Module

The Global Positioning System (GPS) is a satellite-based system which calculates and estimates its position on Earth using ground stations and satellites. In order to track or determine the location of the user and the navigation .

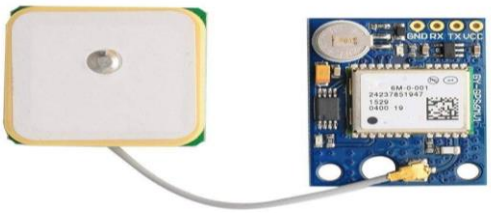

Fig. 5. GPS Module

By using the GPS module in our system we will be able to locate the user's location and also alert the user about the location and also where the user is heading.

III. IMPLEMENTATION

However, blind persons encounter numerous navigational difficulties, particularly when using public transportation to reach distant areas and when walking along the street. For someone who is vision impaired, it can be extremely challenging, if not impossible, to read street signs and traffic lights.

To navigate these challenges, a person with vision impairment can use a walking cane, a guiding dog, and a sighted guide. These alternatives, which are often referred to as assistive devices, can be helpful to the blind even though they are not highly effective. We have also added the system with the GPS

module such that the user will be able to locate himself and also the system to navigate him from one place to another.

Many labeled data points are needed to train an object detection model. Images or videos with annotations identifying the location and class of each object make up this data. Then, after analyzing the data, machine learning algorithms are employed to discover the patterns that correlate to the required objects.

While processing the image, different techniques are used to perform a specific object detection task, specifically the recognition of traffic signs. For the Python version, we used the built-in OpenCV method cv2.matchTemplate that is present in the library. These covert wearing blind assistive devices are very good at reading faces, text, traffic signs, and money.

The Raspberry Pi is being used to process the data obtained from the sensors and to effectively use the electricity so that the system uses less energy. Depending on the object spotted, the system will also be able to classify the risk level to the user from that thing. The technology will be able to safely guide the user in this way. Our system's GPS module will enable us to pinpoint the user's location and notify them of both it and their current location and direction.

The system is trained and tested in order to determine the effectiveness of the proposed module for traffic sign recognition, the processing time to match the template and also distance detection of the object, where the distance range is subjected to a 90% accuracy level. We only took into account the range of distances where the module could recognise the traffic signs and showed an accuracy greater than this matching criterion.

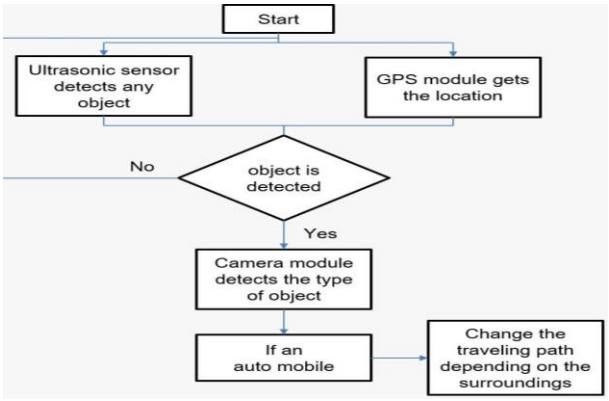

Fig. 6. Flow Chart

Depending on the object type they are categorized into different risk levels and that the user can be able to understand the risk the object possesses. The main reason to categorize the object is to ensure if the user is able to walk freely and also he can be able to understand the environment easily.

The results will show that the system can function on a wearable navigation device in real-time with sufficient precision. This device can recognise both traffic signs and traffic signals. Navigation and positioning are handled by the GPS module. The blind wear a variety of supplemental devices that send navigational data through earbuds.

The system can categorize the object and the risk that it possesses, now the system will give instructions to the user depending on the risk that object possess and safely navigate the user to a safe location or an area by scanning the location using a camera module.The output to the user is either given through the earphones or using the speakers depending on the choice of the user.

This helps as the only way we can give information is with an earpiece. This advancement of various guidance techniques will help the vision impaired live more normal lives. These systems frequently only have particular functions in mind.

Using the GPS module to quickly go to the location he is in and the raspberry will give the location details through the output to the user. This will help the user to be aware of the location he is in and the location needs to be navigated.

CONCLUSION

A portable assistive device with navigation module has been proposed to assist individuals with visual impairments. The vision module has a respectable detection range and is highly accurate at detecting and identifying traffic signs. The Raspberry PI is used to develop the application.

The trials established the OpenCV library's template matching capabilities. The improved system and the algorithm has been set to the best values for the parameters. This can be used by the person with physical disabilities as they also need some support.

An object detection model must be trained on a large number of labeled data points. This data consists of pictures or videos that have annotations indicating the place and kind of each object. Machine learning techniques are then used to identify the patterns that correspond to the necessary objects after the data has been analyzed.

Where they can be scaled and have been identified. And also the results that are given to the user through earphones. We are also looking into the ways he can interact with the environment. Depending on the parameters which are adapted for a real-world setting, the vision module's accuracy might be increased.

RESULTS

The objects are detected and the system will categorize the objects using the YOLO algorithms and the data is fed to the system and using that information the raspberry pi will send the output signal to the user depending upon the data that has to be given to the user so he can navigate safely.

Fig. 7. Detecting Objects

The readings from the ultrasonic sensor and teh Gps module location details are being fed to the raspberry pi such that using this information the system will be able to safely navigate the person.

The Raspberry Pi is used to process the data collected from the sensors and to utilize the electricity more efficiently, resulting in a system that consumes less energy. The system will also be able to categorize the risk level posed to the user by the object spotted based on that object. The user will be led in this manner safely by the technology. The GPS module in our system will allow us to determine the user's location and inform them of it as well as their present location and heading.

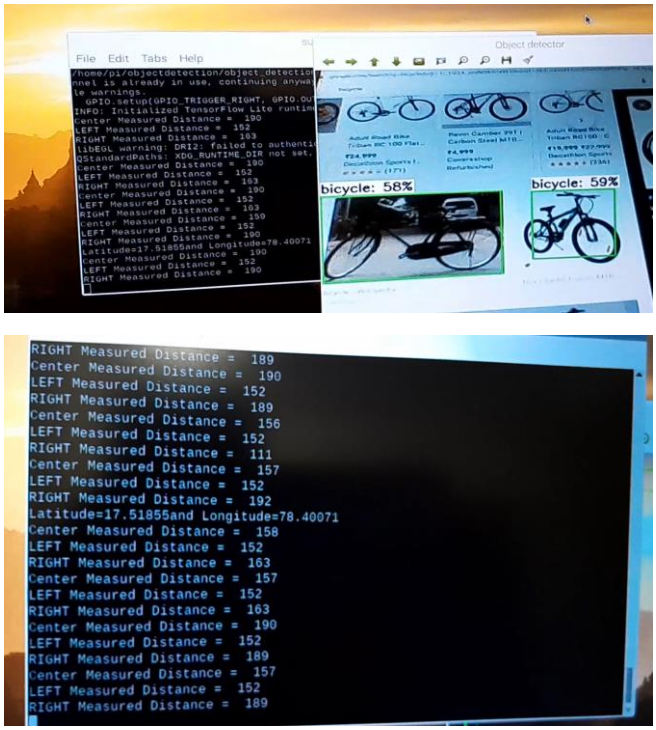

Fig. 8. Reading from ultrasonic sensors

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