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VI Spectacle – A Visual Aid for the Visually Impaired

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Abstract - *It is arduous for the visually impaired people to identify every object in their immediate surroundings. With recent advancements in technologies, various products are being developed to overcome these constraints. In contrast to these products, this paper delivers a solution which is portable and economically viable for the visually impaired. A device is being developed, equipped with an ESP32 camera and multiple sensors. A real time system is created which performs object detection on the live streamed data, generated by the camera. In accordance with the data from the sensors, the object and its proximity are identified. A graphical user interface acquires this data and cautions the user about the imminent obstacles, thus guiding them through a pertinent path to reach their destination safely.*

Key Words: ESP32 camera, object detection, visually impaired, ultrasonic sensor, obstacles, IoT, real time system.

1. INTRODUCTION

According to a survey conducted by the WHO (World Health Organization) in 2012, over 39 million people in the world suffer from complete vision loss [1]. Vision loss causes considerable repercussions on the lives of those who experience it as well as on their family, friends and society. It directly influences the patient's ability to carry out day to day activities like reading, travelling and fraternizing. It is also burdensome for them to move from one location to another as it requires identifying various objects and their positions.

An instrument or a tool is required in order to assist them in carrying out these activities. The white cane is the most frequently used device among the visually impaired people [2]. This device enables its user to scrutinize the neighbourhood to identify obstacles and travel safely. It also assists the bystanders to identify if the user is visually challenged and hence take appropriate care. Even though the cane helps in alerting the user of the surrounding, it does not necessarily let them recognize the type of object. However, other sensory organs can be utilized to identify and pinpoint these objects. Despite the fact that it helps the user to speculate the object type, the accuracy is substandard.

This paper aims to present a solution to these problems faced by the visually challenged, furthermore, yielding a higher accuracy. The paper proposes an idea, wherein a pair of spectacles are developed, loaded up with state-of-the-art technologies. The initial work comprises of integrating a set of ultrasonic sensors onto the belt of the user. Ultrasonic sensors are placed in three different directions of the user. The data from these sensors are compared and the user is guided through the proper direction.

This initial work is extended by integrating a camera module into the existing set of hardware. Secondly, the image generated is transferred over a network using a Wi-Fi module. Finally, object detection is performed, and the user is informed about the obstacle.

2. RELATED WORKS

2.1 Voice Assistance for Visually Impaired People

A. Karthik et al [3] describes the difficulties faced by the visually challenged in reading messages on posters, billboards, etc in their day to day life. They generally rely on Braille scripts to read these messages. The paper proposes the use of Optical Character Recognition for detecting messages which are not in the Braille format. A Raspberry Pi equipped with a digital camera is used to take input images. The detected messages are then converted from text to audio using a voice synthesizer.

2.2 Lightweight smart glass system with audio aid for visually impaired people

Feng L. et al [4] have created a smart glass prototype system using an Intel development board called the Intel Edison. It is a portable device which assists the user in locating public signs like bus stations, subway stations, public toilets, hotels and so on. This system automatically identifies public signs throughout the path that the user is walking. Open CV is being used for efficient image analysis. A voice assistant helps in hinting the user of these signs using a wireless bone conduction headphone.

2.3 Smart walking cane for the visually challenged

S. Murali et al [5] proposes a device which is mounted with multiple sensors to guide the user safely. This smart walking cane consists of several sensors, including a depth sensor, a step sensor and a water sensor. These sensors help in identifying the type of terrain in which the user is in. The cane also consists of GPS and GSM modules that help in tracking the user and alerting the police in case of emergencies. The user is guided by an audio module which directs the user via a secured direction. This helps the user in having a better understanding of their surroundings.

2.4 Smart device for visually impaired people

R. Kasthuri et al [6] elucidates the use of Android technology to solve the problems faced by the visually challenged. The paper proposes a voice-based application with a user-friendly UI that enables the user to access any application on the phone, play songs or even call any contact with mere voice commands. These voice commands are converted into text by using the Speech Recognition Engine. The development environment being used is the Selendroid which is an instrumentation-based automation framework.

2.5 Smart Assistive Navigation Devices for Visually Impaired People

A. Pardasani et al [7] have designed a set of smart devices that helps the visually impaired people in navigating outdoors. The paper mainly talks about two devices namely, a smart glass and a smart pair of shoes. The smart glass is able to detect objects and convert it into audio messages. Furthermore, it can convert the detected texts into braille scripts, by printing them using the braille printer, to store as permanent records. The second device is a pair of smart shoes equipped with various different sensors and a micro controller. This helps in alerting the user about the object's distance and proximity.

3. DESIGN OF THE SYSTEM

The design mainly consists of two parts:
1) VI Spectacle
2) Mobile Application

The VI Spectacle consists of multiple hardware modules that are mounted on a pair of glasses. These hardware modules include an ESP32 cam, ultrasonic sensors and jumper cables. The mobile application receives the data sent by the hardware modules through the Wi-Fi network. All the computations are performed by this mobile application as shown in Fig -1. Once the output is obtained, the application transmits the data in the form of an audio message using an earphone.

3.1 VI SPECTACLE

The hardware part of the system comprises of an ESP32 cam as well as ultrasonic sensor modules. The ESP32 cam is a micro controller chip with integrated Wi-Fi and dual mode Bluetooth. It also includes a compact camera module along with GPIO pins and a micro SD card slot to store the captured images. The pin diagram is as shown in Fig -2.

It has cutting edge features that enhances the efficiency and efficacy of the project. The development environment is Arduino IDE and the language used is the C programming language. The ESP32 cam does not come with a USB connector, so the code is uploaded by using a USB to TTL serial converter.

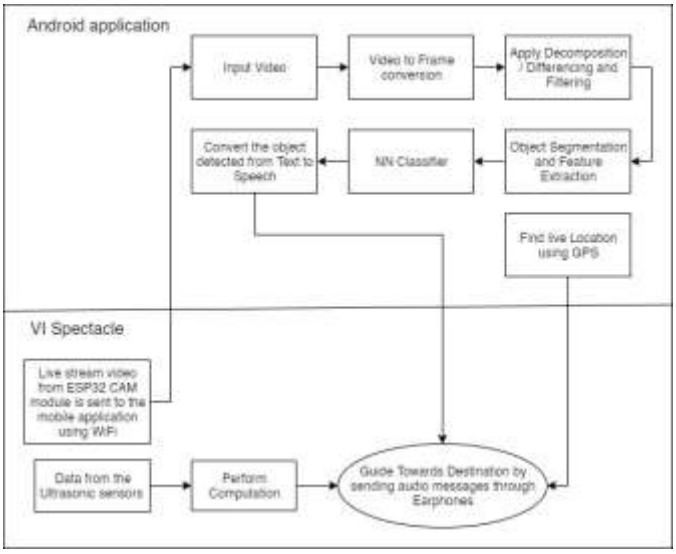

Fig -1: Block Diagram

Fig -2: Pin Diagram for ESP32 Camera Module.

FTDI232RL is the most commonly used USB to TTL converter. It has a mini-B USB port which is connected to a programming device with a USB input. A voltage of 3.3V-5V is provided by its Vcc along with a current supply of 500mA. It contains Rx and Tx pins which helps in transmitting and receiving the data from the ESP32 cam module.

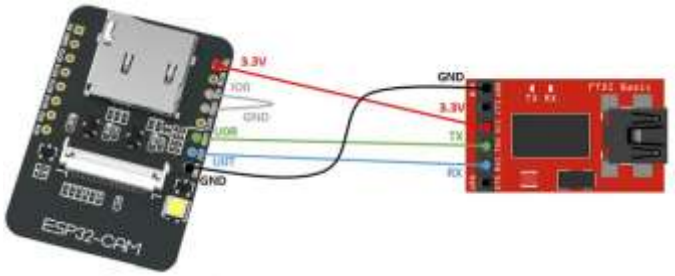

Fig -3: Circuit Diagram. Image taken from [8].

The connections are as shown in Fig -3. In order to upload the code, ESP32 has to be kept in the flashing mode. After the code is uploaded, it is taken out of flashing mode and an IP address is generated. The video can be streamed by using any digital device that is connected to the same network using the generated IP address.

3.2 Mobile Application

The Front End of the system is developed using the integrated development environment called Flutter. The application asks the user to input the destination address, by speaking into the device. The Global Positioning System (GPS) enables application to pinpoint the current location. Depending on the current and destination addresses, the application generates the shortest path by the use of Google APIs. The use case diagram is as shown in the Fig -4.

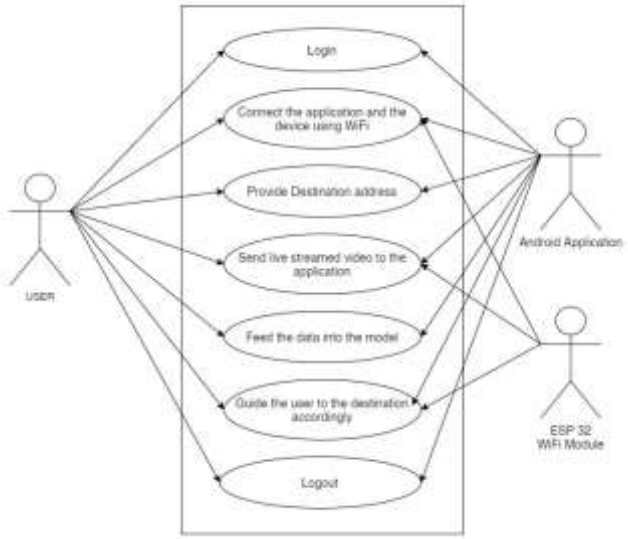

Fig -3: Circuit Diagram. Image taken from [8].

In the meantime, the application receives the image sent by the ESP32 cam module. The image received is stored in a fixed memory location and is then processed through the YOLOv3 object detection model. This model uses the COCO dataset which contains over 90 labels including people, bicycles, cars, trucks, etc. The model performs a series of steps which includes decomposition, filtering, object segmentation and feature extraction to identify the type of object. Once the image is completely processed through the neural network, the object is identified.

The object name is notified to the user by converting the identified text into speech using the Google APIs developed by Google. The user is guided through the path which was initially generated, along with assisting the user in identifying imminent obstacles which comes in the way.

4. CONCLUSION

This paper introduces a prototype design of the VI Spectacle for the visually challenged. The paper describes the methodologies to be used in order to design this product. The proposed system involves two major parts which includes the VI Spectacle and the mobile application. VI Spectacle mainly consists of a ESP32 cam that sends the captured images to the application using WiFi. All the computations take place inside the mobile application. The mobile application performs a variety of tasks like object detection, route planning and guiding the user. The system is able to detect and recognize objects in real time. This device helps the visually challenged to walk around cities without any difficulties.

5. FUTURE SCOPE

The device can further be upgraded to differentiate between moving and stationary objects. As well as incorporating the device into a single unit, thus eliminating the use of the mobile application entirely.

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REFERENCES

[1] The World Health Organization, Global Data on Visual Impairments 2010., Published 2012.

[2] Izaz Khan, Shah Khusro, and Irfan Ullah, "Technology-assisted white cane: evaluation and future directions," PeerJ vol. 6 e6058. 10 Dec. 2018, doi: 10.7717/peerj.6058

[3] A. KARTHIK, V. K. RAJA and S. PRABAKARAN, "Voice Assistance for Visually Impaired People," 2018 International Conference on Communication, Computing and Internet of Things (IC3IoT), Chennai, India, 2018, pp. 465-468. doi: 10.1109/IC3IoT.2018.8668188

[4] Feng Lan, Guangtao Zhai and Wei Lin, "Lightweight smart glass system with audio aid for visually impaired people," TENCON 2015 - 2015 IEEE Region 10 Conference, Macao, 2015, pp. 1-4. doi: 10.1109/TENCON.2015.7372720

[5] S. Murali, R. Shrivatsan, V. Sreenivas, S. Vijjappu, S. J. Gladwin and R. Rajavel, "Smart walking cane for the visually challenged," 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), Agra, 2016, pp. 1-4. doi: 10.1109/R10-HTC.2016.7906791

[6] R. Kasthuri, B. Nivetha, S. Shabana, M. Veluchamy and S. Sivakumar, "Smart device for visually impaired people," 2017 Third International Conference on Science Technology Engineering \& Management (ICONSTEM), Chennai, 2017, pp. 54-59. doi: 10.1109/ICONSTEM.2017.8261257

[7] A. Pardasani, P. N. Indi, S. Banerjee, A. Kamal and V. Garg, "Smart Assistive Navigation Devices for Visually Impaired People," 2019 IEEE 4th International Conference on Computer and Communication Systems (ICCCS), Singapore, 2019, pp. 725-729. doi: 10.1109/CCOMS.2019.8821654

[8] Santos, S. (2020). ESP32-CAM Video Streaming and Face Recognition with Arduino IDE | Random Nerd Tutorials.